



Abstract Book

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Applying a Three-Part Approach to Cognitive Retraining in Concussion Management: Symptom Management, Patient/Caregiver Education, Cognitive Endurance Building

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To provide effective cognitive retraining, the distinction needs to be made between traumatic brain injury with concussion versus other acquired brain injuries. A better understanding of the neurometabolic cascade of concussion and its related symptoms has been emerging in recent years. Practice is moving towards active rehabilitation during the recovery period rather than prescribed rest. As a result, cognitive retraining can play a vital role in assisting the concussed person back to the academic setting. This requires a shift in practice patterns to optimize improved function and avoid a protracted period of recovery. The therapeutic approach to concussion should be systematic with gradual stimulation provided on a hierarchy that includes three key elements: symptom management, patient/caregiver education, and cognitive endurance building.

Concussion symptoms can vary from person to person but typically fall into four categories: somatic, cognitive, affective, sleep. Teaching the concussed person how to manage these symptoms at a sub-threshold level while navigating through their recovery is critical to the success of the therapeutic program. This approach allows for symptom management and patient education while simultaneously building cognitive endurance through systematic and gradual stimulation. Auditory and visual stimuli are introduced on a hierarchy so as not to exceed the symptom threshold. If symptom management is not part of the therapeutic program, then the symptoms themselves have the potential to act as a distracter, thereby interfering with the forward progression of recovery.

CDC estimates between 1.6 and 3.8 million sport-related concussions occur every year in the United States. Although not all concussions are sport-related, this number highlights the frequency that concussions are occurring and the value in providing patient/caregiver education as part of the management tool. Concussion is frequently described as a silent injury, without overt indications that the concussed person is experiencing difficulty. As a result, those in their environment (family, teachers, coaches, peers) may have the erroneous expectation that accommodations are not needed during this critical recovery period. Patient education plays an important role in teaching self-advocacy as well as how to manipulate the environment to their advantage to facilitate success and prevent symptom provocation. Equally as important is providing family/caregiver education so they can become active participants in the recovery process, validate symptoms, and learn how to reinforce accommodations within the home, academic, and community settings.

During this presentation, case study review of concussed pediatric/adolescent patients treated at the Dr. Robert Cantu Concussion Clinic at Emerson Hospital will provide exemplars of the three-part approach to cognitive retraining. The case studies will demonstrate how the speech/language pathologist can simultaneously address symptom management, patient education, and cognitive endurance building through systematic and gradual stimulation on a hierarchy. A 'return to learn' plan will also be included.

Recognising My Progress

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Recognising My Progress was developed in a collaboration with students with acquired brain injury. To make actual progress visible it is important in order for the students to become aware of their difficulties and needs. The rating scale and the assessment bank along with suggested questions make it easier for both students and teachers to express thoughts and work out measures together to help the student. The purpose of the material is to make actual progress, made by the person with acquired brain injury, visible to him/her and others. If no progress has been made within the specified areas, the material can provoke discussion around the possible causes of the lack of progress and the pupils needs.

Rehabilitation without Walls – Reconfiguration of a National Paediatric Service

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Objectives: The project was initiated in response to key challenges to the NRH Paediatric Service including new developments within Paediatric and rehabilitation services, lengthy waiting lists over extended staff and unnecessary hospitalisation of children. The aim was to align the NRH Paediatric service with the models of care developed HSE National Paediatric Clinical Programme and the Rehabilitation Medicine Programme.

Method: The NRH Paediatric Programme was reviewed within the context of the decision to maintain complex paediatric neurological rehabilitation at the NRH, and the Paediatric Clinical Programme Model of Care. This framework formed the basis for a change management project within the current service to reconfigure resources and provide new ways of service delivery. The objectives of quality, access and value were key. The programme has moved to a “children served” approach and broadened the range of service options.

Benefits: The project is on-going but has already shown a reduction in waiting lists, more efficiency in terms of service delivery and greater predictability in terms of service planning. A further outcome is a reduction in unnecessary hospitalisation for children which is key aim of the Paediatric Clinical Programme. Increased resources are being directed at integrated care via outreach and education to community services and schools.

Conclusion: A “rehabilitation without walls” approach has led to a more child and family centred and integrated approach. It has facilitated the team in its objective to provide the service in line with international clinical guidelines. On-going data analysis and stakeholder reviews will be a key priority for the future.

Everyday Communication in Adolescents After Acquired Brain Injuries – A Comparative Study of Self-Ratings and Parent Evaluations Using the CETI

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Communicative participation in adolescents with acquired brain injuries (ABI) has received limited attention. The aim of the present study was to investigate the views of the adolescents themselves (N = 8), in comparison to parent evaluations (N = 11) of daily communication, using the Communicative Effectiveness Index in combination with individual interviews. Two frameworks for analyses.

Activity based Communication Analyses and the distributed cognition approach, identified three main areas of interest: Situations where communication difficulties occur, Coping behaviours used by participants to manage communication difficulties, and, Causes of the communication difficulties. An overall high agreement between the adolescent and parent assessments was shown. However, complex communicative situations more frequently received lower scores in the parent ratings. The results of the study point to the usability of a systematic comparison of the shared points of views on communication after ABI in adolescence, to increase knowledge about the participation perspective in real life communication.

Pediatric TBI Recovery and School Re-Entry: Utilizing Psychologists at All Stages to Maximize Outcomes

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Brain injury is a leading cause of death and disability (Centers for Disease Control [CDC], 2000), affecting approximately 2.5 million people in America in 2010 (CDC, 2016). In 2009, it is estimated that 248,418 children (ages 0-19) were medically treated for TBIs related to sports and recreational activities alone (CDC 2016). However, these statistics likely underestimate the true number of injured individuals; many injured people do not receive medical care (CDC, 2009; Chesire, Canto & Buckley, 2011).

Identification of children who have sustained a brain injury, especially a mild brain injury, within American school systems is particularly problematic. For example, case study data from 2007-2009 reported over 1300 admissions to one hospital's pediatric emergency department and trauma center; yet only 129 cases were reported to schools (Chesire, Canto & Buckley, 2011). Similar findings have been reported nationwide.

In addition to difficulties with the identification of children who suffer brain injuries, many school personnel may not feel prepared to serve this population. Primary barriers to service delivery reported by school psychologists include lack of information about what impairments are associated with brain injuries and what strategies might be employed to facilitate learning (Canto, Chesire, Buckley, Andrews, & Roehrig, 2014).

Given the complexity of issues inherent to the identification of children with brain injuries, education of school-based professionals to deliver services to injured students, and the utilization of empirically-supported individualized remediation and rehabilitation programs, it is imperative that professionals with specific training and expertise be available to assist children and families through the process. In this presentation, the authors will advocate for the inclusion of psychologists at every stage of a child's progress, from within the healthcare system through to the child's re-entry into the school system. The psychologist's particular service to the child and family are focused upon the unique needs at the moment, including but not limited to: 1) providing information and mental health support when a child first arrives to the hospital; 2) serving as a patient/ family advocate for navigating the healthcare process; 3) providing information to the family on what to expect during recovery; 4) providing psycho-education to allied professionals both within the hospital system and later within the school system; 5) communicating to other systems to foster a hospital-school collaboration network; 6) evaluating a child's skills and educational needs through formal psycho-educational evaluations; 7) assisting the child/ family while navigating appropriate educational learning environments and programs; 8) monitoring educational progress; and 9) providing consultative services to teachers and other related educational services. Each service will be discussed, and the means of service delivery and ethical considerations will also be addressed.

Quantitative EEG Assessment of Emerging Cognitive Function in Children After Acquired Brain Injury

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Research Objectives: To create and test the feasibility of a system that can quickly, reproducibly and efficiently measure EEG correlates of cognitive function in children who have survived a moderate/severe acquired brain injury (ABI). The long-term goal is to use sensitive measures of emerging brain function to accurately track functional recovery, understand the brain processes that support recovery, and evaluate response to treatments.

Design: A novel portable EEG system (headset and computer) employing wireless technologies to measure brain response while paying attention to novel stimuli, comprehending language, and generating mental imagery. Tasks have been validated in adults with disordered consciousness.

Setting: Pediatric inpatients and outpatients at a rehabilitation hospital.

Participants: Controls (non-brain-injury) and children recovering from ABI.

Interventions: Not applicable

Main Outcome Measure(s): Feasibility of collecting EEG with good signal-to-noise ratio(SNR) at the bedside with minimal discomfort to subject and in a time-sensitive manner

Results: In 8 ABI (mean 11 years [6 to 15], 14 sessions) and 6 controls (mean 13 years [10 to 16], 8 sessions), we have collected and analysed EEG measures of command following, language comprehension and attention. EEG with acceptable SNR (visual inspection of power spectra error bars) was measured in 78% of ABI and 100% of control sessions. Response to command following was measured in 42% of ABI and 75% control sessions. Average time to collect data for each session was ~1 hour for ABI and ~45 mins for control.

Conclusions: Results demonstrate feasibility of collecting functional EEG from children recovering from ABI, including sensitive quantitative correlates of cognitive function. More subjects, studied longitudinally are needed for studies of validation against standard clinical measures and development of prognosis models.

The Outcome of Cognitive Rehabilitation Therapy Program for Children with TBI (Model to Promote Best Practice)

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Introduction: Traumatic brain Injury consider one of the leading factor to disability in children with different impairment level: sever, moderate and mild, TBI is often accompanied by cognitive impairment affecting attention, working memory, visuoperception and executive functions which is subsequently has a significant impact on patients' functional status and quality of life. More recently, therapy for children with TBI has focused on rehabilitation of cognitive perceptual impairment by using Cognitive Rehabilitation Therapy (CRT) which focuses on: cognitive perceptual stimulation activities (remediation of particular impairment) and real life functional activities (compensatory and adaptive strategies).

Aim: Exploring the effectiveness of structural CRT on the cognitive capabilities in children with TBI.

Method: Uncontrolled experimental design of 50 children (31 male and 19 female) subjects diagnosed with TBI with an age range 6y-12y, mean age 8y 1mo, SD 2y 5mo, who referred to CRT program within 5 month (Oct-Dec 2016-Jan-Feb 2017) in Pediatric Inpatient unit, all children undergone with an average CRT (60 min/day, 5 days/week for 6 weeks) Outcomes were obtained at baseline at time of admission, and post-intervention at time of discharge, the primary outcome measure was: Dynamic Occupational Therapy, Cognitive Assessment for Children (D LOTCA), Wide Range of assessment for memory and learning second edition (WRAML2), Pediatric functional independence measure (WeeFIM).

Results: Our findings shed the light on the fact that children have been improved after CRT program based on standardized outcome-measure as follow: 1. (D LOTCA): nearly 78% of children got better after CRT program services with an average score (53 out of 100) score at ADM and (69 out of 100 score) at D/C. 2. (WRAML2): nearly 71% of children got better after CRT program services, 3. WeeFIM: nearly 85% of children got better after CRT program services with an average WeeFIM score (44 out of 128) score at ADM and (58 out of 128 score) at D/C. (complete data analysis will be presented when required)

Conclusions: The findings demonstrate that the application of structural CRT program is linked to positive functional outcomes. The results suggest that children with TBI may benefit from comprehensive CRT training program. Further studies with a larger randomized sample and longer post-intervention follow-up are necessary to document the long-term effects of rehabilitation programs in the children with TBI.

Keywords: Traumatic brain injury TBI, CRT: cognitive rehabilitation therapy, DOTCA-CH): The Dynamic Occupational Therapy Cognitive Assessment for Children, (WRAML2): Wide Range Assessment of memory and learning.

Pediatric Concussion Evaluation in Europe: Military Medical Providers Leading the Way

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Background: This presentation outlines a performance improvement project highlighting the results of a pediatric working group to educate medical providers, coaches, parents and teachers regarding sports concussion and return to school/return to play activities for children who sustain a concussion. Mild traumatic brain injury (mTBI) or concussion remains significantly underreported and underdiagnosed. This is of particular concern in the pediatric population as evidence is beginning to highlight how children playing impact sports may not only be at increased risk of concussion but how cumulative concussive events may degrade executive function and prolong recovery in this population. The military treatment facilities and Department of Defense Education Agency schools have collaborated in training education efforts to target pediatric concussion evaluation management using established Return to School/Return to Play guidelines.

Methods: A retrospective case analysis of emergency room and primary care encounters on 40 pediatric patients demonstrated how pediatric concussion evaluation and screening was impacted by a substantive training effort to educate medical staff on return to play and return to school graded concussion evaluation recommendations for pediatric patients. Preliminary process results indicate that the training can be effective in engendering a cultural change towards accurate identification of concussion and identifying potential barriers that impact compliance. The retrospective case analysis consisted of (n= 38) pediatric patients diagnosed with concussion over a twelve month timeframe. Case records were paired with provider training records to correlate pediatric outcomes to provider training. Questions asked were: a) whether the providers received training and how many exposures to education and training they had in the past year, b) whether they found it beneficial to their identification and assessment of pediatric concussion and, c) whether the pediatric concussion training was beneficial to them in helping to manage return to school and return to play.

Results: Record reviews indicate a slightly higher than national average incidence of concussion and a mean age of 15.3 years. Males were twice as likely as females to experience concussion. Mechanisms of injury were varied. Results were matched in a Chi-square analysis to correlate training effectiveness to pediatric patient outcome. The statistical significance level was set at $P < 0.05$. The record review revealed that most children (and their parents) seen in the ED had been exposed to pediatric concussion education at least twice over the past 12 months.

Conclusion: Pediatric concussion is a significant health concern that is often underreported and underdiagnosed. Pediatric concussion-specific training can help not only to improve standardized medical management, but also to increase awareness and early care-seeking behaviors among school staff, sports personnel, families and student athletes. Through early recognition, prompt identification, and standardized medical evaluation, children who are concussed will likely have a faster course of recovery.

Preliminary Evidence of Dorsal Stream Vulnerability; Difficulties with Attention and Visuo-Spatial Function in Children Aged 6-8 Years Without Cerebral Palsy, Who Were Given Therapeutic Cooling/ Hypothermia After Neonatal Hypoxic Ischaemic Encephalopathy

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Background: Previous research attests to the vulnerability of the dorsal cortical stream of the visual system in perinatal brain injury. Measures of visuo-spatial ability, and control of attention are reportedly indicators of the integrity of the dorsal cortical stream. Children aged 6-7 years who underwent therapeutic hypothermia (TH) for hypoxic Ischaemic encephalopathy (HIE) are reported to have cognitive impairments even in the absence of cerebral palsy (CP) (Pappas et al, 2015). It is unknown whether visuospatial and attention abilities are affected in early school age children cooled for HIE that do not have CP.

Objective: In children without CP aged 6-8 years who were cooled for HIE we (i) compared visuospatial and attention abilities with a contemporary control group, and (ii) investigated the relation between attention abilities and cognitive function.

Design/Methods: Twenty-seven children aged 6-8 years cooled for HIE, and 18 controls matched for age, sex and socio-economic status were administered an attention test (the Connor's Performance Test) utilizing measures of average speed of correct responses, response speed consistency, and change in reaction time across test-duration. The block construction test from the NEPSY-II was used as a measure of visuo-spatial processing. The WISC-IV-UK was used to generate Full-scale IQ data. We assessed the relation between response times <50th percentile on Full scale IQ (FSIQ<85).

Results: In considering attention, children with HIE were found to have significantly reduced abilities in sustaining attention over time, their reaction-times were slower and there was greater inconsistency in response speed compared to controls. They were also found to have significantly reduced visuo-spatial processing performance. Response times <50th percentile were found to have 100% specificity and positive predictive value in predicting FSIQ<85.

Conclusion(s): Our results provide preliminary evidence to support dorsal stream vulnerability in children with HIE after cooling, and further indicate that difficulties with attention and visuo-spatial processing may contribute to cognitive impairments in cooled children without CP.

Improving Motor Function in Participants with Cerebral Palsy, Duchenne Muscular Dystrophy and Down's Syndrome: Clinical Utility of the Virtual-Reality, Mobile-Phone Game Scenario

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Background: Various motor difficulties are associated with Cerebral Palsy (CP), Duchene Muscular Dystrophy (DMD) and Down Syndrome (DS). Research has indicated that Virtual Reality (VR) as an assistive technology can be useful in rehabilitation of such conditions.

Aim: We explored differences in improvement of performance in individuals with CP, DMD and DS after practice, based upon smartphone virtual-game-use. Materials and

Methods: 25 individuals with CP, 50 with DMD and 50 with DS completed a VR maze task as quickly as possible on a mobile phone. Participants performed 20 repetitions divided in four blocks of five attempts.

Results: repeated measures ANOVA showed that all individuals improved performance from first (M= 9.8ms) to last block (M=7.7ms, $p<0.001$) with statistically significant differences between groups ($p<0.001$). Post-hoc testing identified that the DMD group achieved better performance (M= 7.29ms) than the CP group (M= 9.26 ms, $p=0.018$) and the DS group (M= 9.83ms, $p<0.001$), but no difference was evident between the CP and DS groups ($p=0.495$).

Conclusions: Individuals with CP, DMD and DS all improved in performance, thus there was improvement in motor performance, particularly in relation to participants with DMD. We conclude there is preliminary evidence of clinical utility in such approaches.

Mutations in the KCNJ11 Gene Cause a Range of Neurodevelopmental Phenotypes as Well as Neonatal Diabetes

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Background/Aims: KCNJ11 encodes the Kir6.2 subunit of the ATP-dependent potassium (KATP) channel present in the pancreas and brain. Activating KCNJ11 mutations cause permanent neonatal diabetes; neurological features are also seen in 20% patients. While sulphonyurea treatment greatly improves glycaemic control, children have ongoing neurodevelopmental sequelae that are poorly understood. We aimed to explore the neurodevelopmental impact of KCNJ11 mutations.

Methods: Ten children with KCNJ11 mutations (4xV59M,2xR201C,1xR201H,1xK170N,1xK170R,1xI182V) completed a battery of neuropsychological tests. Psychopathology was assessed via parent and teacher-report Developmental and Wellbeing Assessment (DAWBA). Results were compared with normative data.

Results: Four children with the V59M mutation were untestable or obtained Z-scores ≥ -3 on neuropsychological assessment; all had ≥ 1 neurodevelopmental disorder (autism/ADHD) diagnosed using the DAWBA. In the remaining 6 children, only 1 met diagnostic criteria for neurodevelopmental disorder. However, median Z-scores in all neuropsychological tests were below school-age population average, with lowest scores (median Z-score ≤ -1) in the domains of executive function, verbal comprehension, and visuomotor performance.

Conclusions: KCNJ11 mutations cause a range of neurodevelopmental problems. This is mutation-specific; V59M patients show the most severe phenotype but even those without severe functional impairment have neuropsychological deficits. Early clinical assessment is important for affected patients to facilitate individualised education/treatment plans.

Bridging the Gap - Facilitating Transition of Adolescents with Acquired Brain Injury to Adult Services

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Introduction: The transition between paediatric and adult care for adolescents with disability is challenging, and often poorly managed. People who have sustained an acquired brain injury in childhood have similar aspirations as those without disabilities, but they have more difficulty accessing services that “limits opportunities for full participation in adult life”. In 2014, only three clients transitioned to the adult team from the paediatric service. Poor success with transition of clients discharged from the paediatric service was evident. Transition clinics had been developed, but no formal process was in place. Consultations with carers and clinicians found that clients who did not engage in a transition process succumbed to poorer outcomes such as unemployment or limited employment choices and access to vocational training, poor self-esteem and self-confidence, lacking in self-care abilities, financial issues, drug, alcohol and gambling addictions, crime involvement, and mental health issues. Anecdotal experience was supported by general transition literature, but very little was found specific to brain injury. Attempts to obtain local data was difficult with no significant findings revealed.

Objective: For all paediatric clients with moderate-to-severe brain injury requiring transition to adult services to have a transition plan in place within 9 months.

Method: To achieve this aim previous transition clinics were evaluated using telephone surveys with clients and carers. Consultations were undertaken with past families. A project team was established to examine this data and current practice to identify the barriers to achieving successful transition for the young person. From the information gathered, the project team developed strategies to overcome these barriers and the transition process was amended to better facilitate this transition. The meeting format was more flexible to accommodate individual needs, a resource pack was developed, and the HEEADSSS assessment tool was used to assist with identifying rehabilitation goals and implement strategies. These changes were incorporated into formalised guidelines. Staff were provided with training to work effectively with adolescents.

Results: Following the development of the formalised guidelines in the form of a flow chart, all eligible clients commenced the transition process. Clients attended at least one meeting which included receiving explanation of the transition process and an information pack, and HEEADSSS assessment was undertaken. Goals were identified and an Individual Transition Plan was developed. Clients were observed to exhibit greater confidence and develop increased responsibility for their rehabilitation. Adult team members developed more awareness of issues associated with adolescence that differ from working with adults and increased collaboration between paediatric and adult teams has occurred.

Conclusion: The development of a formalised transition process that incorporates the unique needs of adolescents with brain injury has increased retention of paediatric clients as they transition to adult services, and successful transitions have occurred.

Long Term Outcome Following Mild Traumatic Brain Injury in Children

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Background: Whether mild traumatic brain injury (mTBI) sustained during childhood results in persistent post-concussive symptoms (PCS), over and above those experienced by children who sustain mild trauma to the body, remains highly debated. The current study adopted a prospective longitudinal design to examine the relative influence of injury and non-injury factors in longer term outcomes (>6 months) following mTBI in childhood.

Method: Participants were 64 parents of children (31 mTBI, 33 trauma controls) who sustained injuries between the ages of 2 and 12. The main outcome variable, PCS, was assessed at time of injury, 1 week, and 1, 2, 3, and 6 or more (M=24.3, SD=8.4). Information on a range of non-injury factors such as demographic, premorbid child and family factors were also collected, and examined as predictors of outcome. Predictive analysis was undertaken using a random effects ordinal regression model.

Results: By six months or more post-injury, rates of PCS were comparable between mTBI and trauma control children. Having sustained a mTBI was predictive of poorer outcomes up to 3 months post-injury but not at 6 months or more post-injury. Rather, pre-injury child and family factors, such as pre-existing learning difficulties and increased levels of parental stress, were stronger predictors of persistent PCS.

Conclusions: Whilst injury factors were associated with PCS in first three months post-injury, their association weakened over time. Non-injury factors were stronger predictors of more persistent PCS, and therefore provide an important target for early intervention in 'at risk' children.

Language Outcomes in Serbian Speaking Children with Traumatic Brain Injury

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Traumatic brain injury (TBI) in children may result in persistent, diverse and complex language impairments. In this paper we investigated outcomes of language functions in 15 children who had sustained a TBI in childhood (8 – 10 years). There were nine boys and six girls. A typically developing group of 15 children ('Control' group) was also included. Each control participant was individually age- and sex-matched to TBI participants. All participants were monolingual speakers of Serbian and right-handed. The evaluation of language functions was done three to five years after brain injury. The following tests were used: Boston Naming Test, Token Test, "Cookie Theft Picture" from the Boston Diagnostic Aphasia Examination, Serbian test for lexical-semantics and Serbian reading test.

The results showed that the group of children with TBI had significantly more difficulties on the language assessments compared to the control group. It was concluded that pediatric traumatic brain injury causes long-term sequelae in the area of basic language abilities, as well as in discourse.

Keywords: Children, Linguistic long-term deficits, Serbian language, Traumatic brain injury

Cognitive Recovery in Children with Traumatic Brain Injury: Longitudinal Study

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Aims: The aim of this study was to follow up some patterns of cognitive recovery in children between 4 and 17 for the first 6 months after the trauma and then again after 2 years.

Method: 82 children with sTBI (GCS ≤ 8) were evaluated with the Luria Neuropsychological Battery test within the first six months after sTBI. 28 of them were reevaluated 48 months after their trauma. Also 17 children (7-17 years) were evaluated with Coma Recovery Scale-R at the early stage of consciousness recovery (Giacino JT et al., 2004)

Results: 1) Cortical contusions of the frontal lobes and diffuse axonal injuries were the most frequent lesions. Children with the frontal (fronto-temporal areas) cortex damage had slow dynamics of consciousness comparing to children with posterior (parietal-occipital areas) cortex damages. 2) During the period of consciousness recovery in children after the injury the key role played follow parameters: the time when behavioral changes appeared, character of the dynamics in consciousness recovery and velocity of changes in behavior. 3) The most destroying functions at the early recovery period were the processing speed (neurodynamics of mental activity), executive functions and memory functions (modal-nonspecific memory). 4) The features of cognitive recovery also depends on the age of trauma. The preschool children group was characterized by a high percentage of occurrence of symptoms as "field behavior", not inhibition of the direct reaction to the situation. Compare to the elder group, this group of children did not have disorders of motivation and needs.

Conclusion: The report contains the clinical analysis of various cases and rehabilitation service provided.

Intellectual Outcome Following Childhood Severe Traumatic Brain Injury: Results of A Prospective Longitudinal Study: The Seven-Year Follow-Up of the TGE Cohort

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Background and aims: Childhood traumatic brain injury (TBI) is a leading cause of death and lifelong acquired disability. The aim of this study was to prospectively study intellectual ability following childhood severe TBI over 7-8 years post-injury, and factors influencing outcome and change over time.

Methods: Children (aged 0 – 15 years) consecutively admitted in a single trauma center for severe non-inflicted TBI over a 3-year period were included in a prospective longitudinal study. Assessment was conducted at 3, 12 and 24 months, and at 7-8 years using age appropriate Wechsler Intelligence Scales. For the 7-8 year follow up, a group of matched controls was included. Socio-economic status (SES) was assessed by parental education level.

Results: Sixty-five of the 81 included children survived (66% boys) and were assessed at 3, 12 and 24 months. After a mean delay post-injury of 7.6 years (SD=1.5), one third of the group had reached adult age (≥ 18 years). Thirty-nine patients (60%) participated in the study. The remaining either were lost to follow-up, or did not wish to participate.

Mean age at injury was 7.6 years (SD=4.72; <6 years, n=15; ≥ 6 years, n=23); mean age at assessment was 15.3 years (SD=4.46, 7.2-22.2), median initial Glasgow Coma Scale (GCS) score was 6 and mean length of coma was 6 days (SD=4.8).

At the 7-year follow-up, participants and non-participants did not differ in terms of demographic and severity factors, or mean initial full scale intellectual quotient (IQ). For 36% of the group, at least one parent had graduated from high school.

Mean FSIQ was significantly lower in the TBI than in the control group (86.4; SD=18 versus 97.2; SD=11.2; $p=0.016$), with no significant change over time (FSIQ at 3 months 85.2; SD=18). In multivariate analysis, FSIQ was predicted mainly by parental education ($p=0.031$), with a marginal effect of length of coma ($p=0.079$) and no effect of age at injury, initial GCS score or occurrence of episodes of intracranial hypertension during the acute phase.

Discussion and Conclusion: Severe childhood TBI leads to severe and long-standing cognitive impairments, without significant improvement over time. Parental education, used as a proxy for SES, appeared to be the main predictor of long term cognitive outcome. Long-term specific care and follow-up should be organized

and provided for those patients, until they reach adult age, when their independence, social and vocational outcomes can be assessed and a realistic project can be established.

Educational Outcome, Participation, Health-Related Quality of Life, and Multidimensional Fatigue Following Childhood Severe Traumatic Brain Injury: Results of A Prospective Longitudinal Study: The Seven-Year Follow-Up of the TGE Cohort

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Background and aims: The aims of this study were to prospectively assess educational outcome, health-related quality of life (HRQoL), multi-dimensional fatigue, and participation, 7-8 years after childhood severe traumatic brain injury (TBI), in comparison with a matched uninjured control group.

Methods: Children aged 0 – 15 years (n=65) consecutively admitted in a single trauma center for severe non-inflicted TBI over a 3-year period were included in a prospective longitudinal study.

At 7 years post-TBI, one third of the patients had reached adult age (≥ 18 years). They were offered to participate in the study. Patients were compared to a group of control participants, matched for gender, age and parental education level (used as a proxy for socio-economic status – SES).

Outcome measures comprised qualitative information such as type of ongoing education, care and rehabilitation, as well as standardized questionnaires assessing HRQoL (PedsQL core scale), fatigue (PedsQL multidimensional fatigue scale), and participation (Child and Adolescent Scale of Participation – CASP).

Results: At a mean delay of 7.7 years post-injury, 39 patients (60% of the original sample; 66% boys) participated in the study. Mean age at injury was 7.6 years (SD=4.72; <6 years, n=15; ≥ 6 years, n=23), mean age at assessment was 15.3 years (SD=4.46, 7.2-22.2), median initial Glasgow Coma Scale (GCS) score was 6 and mean length of coma was 6 days (SD=4.8).

Participants and non-participants did not differ in terms of demographic and severity factors, or mean initial intellectual ability. For 36% of the group, at least one parent had graduated from high school.

Only 62% of the TBI group was attending mainstream education (100% of controls). The amount of ongoing rehabilitation was high (35.3% speech-language therapy, 26.4% occupational therapy; 17.6% physiotherapy).

Self-reported HRQoL was significantly lower in the TBI than in the control group [PedsQL scores 71.1; 95%IC 64.8-77.5 versus 83.9; 95%IC 79.3-88.4; $p=0.0026$].

Multidimensional fatigue total scores were significantly worse in the TBI group than in the control group: [parent-report 67.8; 95%IC 59.4-76.2; versus 87.6 (95%IC 82.3 : 92.9); $p=0.0036$; and self-report: 61.1

(95%IC 54.6 : 67.5), versus 77.4 (95%IC 71.9 : 82.8); $p=0.0005$]. The worst scores were found for cognitive fatigue levels: [parent-report 64.4 (95%IC 53.6 : 75.1), versus 87.5 (95%IC 78 : 97); $p=0.0005$; self-report: 53.7 (95%IC 45.7 : 61.7), versus 78.5 (95%IC 71.7 : 85.4); $p=0.0003$]. Parent ratings of participation were relatively good but significantly lower than controls [86.4; 95%IC 81.4-91.3 versus 96.3; 95%IC 94.6-98.1; $p=0.0002$].

Discussion and Conclusion: Severe childhood TBI leads to severe and long-standing impairments, with consequences on school integration, participation and HRQOL. Overall fatigue and especially cognitive fatigue remain at high levels, even several years post-injury, with consequences in everyday life.

Painting A Picture of Possible Clinical Pathways to Address the Diversity of Needs Following Acquired Brain Injury in Children

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Introduction: Children with Acquired Brain Injury (cABI) have poorer long term outcomes than their peers, in terms of emotions, behaviour, quality of life, education, cognition and social interactions. Multiple variables can impact engagement with rehabilitation and outcomes, creating challenges for service delivery, treatment planning and commissioning.

Objective: Identify and characterise different subgroups of service user based on a range of clinical and demographic factors collected prior to and during rehabilitation. Identify predictors of service use.

Method: Participants were 72 consecutive referrals to a child ABI community neuropsychological rehabilitation service (mean age 12; 44 % Female; 57 %TBI). Data was analysed with Hierarchical Cluster Analysis to group participants using 6 clinically meaningful initial assessment variables. Clusters were subject to post hoc analysis comparing 4 demographic and diagnostic variables. Regression analysis planned to explore predictors of intervention received by each cluster.

Results: Three clusters of service user were identified which differed significantly in terms of psychiatric difficulties; executive dysfunction; age at injury; age at referral; number of current family life stressors and school attendance.

Conclusion: Data collected at referral can be used to cluster service users into 3 statistically significant and clinically meaningful groups, characterised by pre and post injury mental health issues, executive functioning and poorer educational and social outcomes. Commissioning guidelines and service delivery models need to recognise the potential implications of family and pre-injury factors, developmental processes and education provision much earlier in the rehabilitation pathway. Targeted community provision following cABI could prevent or limit development of costly and socially significant difficulties requiring multi-agency input, Safeguarding, Youth Offending and in-patient cABI units.

Predictors of Sleep Outcomes After Early Mild TBI

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Objectives: The consequences of pediatric TBI on daily behavioral and cognitive functioning have been extensively documented (e.g., Catroppa et al., 2015; Garcia et al., 2015). In addition, pediatric TBI can be associated with sleep disturbances, such as fragmented sleep and longer sleep latency. An increasing number of studies have investigated the nocturnal effects of childhood TBI, but very few have specifically targeted preschoolers (0-5 years), despite the relative over- representation of children under the age of 5 in epidemiological studies of pediatric TBI (McKinlay et al., 2008). Therefore, the current study aimed to investigate sleep and its predictors in preschoolers with mild TBI (mTBI).

Methods: The sample included 225 children aged 18 to 60 months, divided into three groups: children with accidental mTBI (n = 85), children with orthopedic injury (n = 58), and typically developing children (n = 82). Retrospective reports of pre-injury sleep (Child Behavior Checklist) and family functioning (Parenting Stress Index, Family Assessment Device, Dyadic Adjustment Scale) were obtained as part of a baseline assessment at the time of recruitment. Parental ratings of sleep problems (Child Behavior Checklist) were collected six months post-injury on the full sample, and actigraphy data were collected on a subset of children (n = 85). Demographic, pre-injury and peri-injury factors were examined as potential predictors of sleep outcomes.

Results: No group differences were found in ratings of sleep problems or for nighttime sleep duration and sleep efficiency, as measured by actigraphy at six months post-injury. However, pre-existing sleep disturbances and brain injury resulting in alteration of consciousness were identified as significant predictors of poorer sleep in the mTBI group.

Conclusion: Although mTBI did not result in group-level sleep disturbances six months post-injury, the findings suggest that pre-morbid and injury-related factors place some children at-risk for poorer sleep after mTBI. These factors should be documented so clinicians can intervene early if necessary, especially given that individuals with sleep problems are more prone to future TBI, which could lead to cumulative injuries (Owens et al., 2005).

Physical Activity, Fatigue and Sleep Disorders After Mild Brain Injury and Orthopedic Injury in Adolescents and Young Adults

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Introduction: Physical inactivity, fatigue and sleep disorders are common among adults after traumatic brain injury (TBI) but insight into their occurrence among youth with TBI is limited.

Objective: To compare physical activity, fatigue and sleep disorders in youth after (m;mild) TBI with similar patients after orthopaedic injury (OI).

Patients: Youth aged 12-25 years with mTBI or OI 6-18 months post-injury from two hospitals.

Methods: Cross-sectional study, using an electronic survey including the Activity Questionnaire for Adults and Adolescents (AQuAA; minutes/week moderate-vigorous activity), Checklist Individual Strength (CIS, 4 fatigue subscales), and Pittsburgh Sleep Quality Index (PSQI, total score). Associations between type of trauma (TBI or OI) (dependent) and meeting health enhancing physical activity recommendations (D-HEPA; yes/no), fatigue (CIS), sleep (PSQI) (independent) were examined by multivariable logistic regression analyses, adjusting for potential confounders.

Results: Forty-nine patients with mTBI (mean 16.2 years (SD3.6), 45% male) and 54 with OI (mean 13.8 years (SD3.1), 54% male) were included. The mTBI patients were significantly less active and less frequently met D-HEPA recommendations than OI patients (OR 4.67 (95%CI 1.53-14.22), $p=0.01$). The CIS subscale Concentration was significantly higher in the mTBI-group, whereas other subscales and PSQI were not different from the OI-group.

Discussion & Conclusion: Youth with mTBI were less physically active and more fatigued (concentration) than their peers with OI, with no differences regarding sleep quality.

Clinical Message: Physical inactivity and fatigue were more common after mTBI than OI in youth. Whether physical activity or fatigue is the best target for treatment remains to be established.

Peer Event Initiative Developed to Address Social Interaction and Integration during Acute Neurorehabilitation following Acquired Brain Injury

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It is well documented that the peer relationships of children and adolescents are important for the development of social competence and confidence, and for mental health and wellbeing. Following Acquired Brain Injury (ABI), problems with disinhibition, impulsiveness, poor social judgement, lack of emotional response and slowed processing can all contribute to difficulties maintaining relationships with peers as well as difficulties in acquiring new ones. Evidence shows that when children and young people attempt to reconnect with their pre-injury peers the result is often a gradual loss of friendships and increasing isolation. Loneliness has been reported as one of the dominant concerns for individuals living with a brain injury.

In keeping with this, our routine patient/family follow-up interviews at 6 and 12 months after patients leave our neurorehabilitation program, demonstrate an overwhelming theme of friendship difficulties and isolation. At this conference in 2015 we presented social function being the greatest ongoing burden of disability on objective measures of outcome for children and young people after neurorehabilitation in our service.

To address this concern, we developed a peer event initiative within our acute neurorehabilitation service, based in a busy teaching hospital and major trauma centre in London, to seek to improve the social interaction and integration of children and adolescents following ABI. Our aim was to promote better social competence and confidence, to reduce the likelihood of peer rejection for our patients, and to enhance understanding and involvement of their close friends in their peer's brain injury and recovery from it.

The program has to date run for a year, involving 6 patients. For the event, a group of friends chosen by the patient are invited to an all afternoon session at a nearby non-hospital facility. On each occasion the therapy team has offered brain injury education appropriate to the age group, information about how they could help their friend, a forum for questions, sharing thoughts and feelings and a supported social activity. Feedback questionnaires are distributed after each session.

The feedback has shown that the majority of the peers reported that the amount of information provided in each section identified above was 'just right' (63-100%; mean: 82%). Following the session 78% of the peers reported that they had a better understanding of their friend's injury, and 63% reported feeling better about the situation. These had been identified by them as previous barriers to support for their friends. Finally, they were able to identify practical and realistic support that they could provide. Patients and their families also reported positive outcomes from these sessions.

Although still in development, we regard this peer event initiative important in addressing the ongoing burden of social integration difficulties in children and young people following neurorehabilitation for ABI.

Applying Emerging Evidence to the Assessment and Management of Cognitive Deficit following Acquired Brain Injury as Illustrated by a Child's Journey through Rehabilitation

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Clinical experience and research demonstrate the inextricable and intertwined relationship that exists between cognition and motor function, emotion, behaviour, and social engagement. Overarching these relationships is the child's experience of the before-mentioned within their real life context. It is clear that successful outcomes following neuro-rehabilitation for ABI in children and young people are best achieved when a dynamic approach to intervention is adopted. Traditional impairment-focussed intervention must be coupled with a functional approach, and the complexity of the acquired cognitive deficit should be assessed and managed both within a clinical and community setting.

This paper describes the approach to cognitive rehabilitation developed by the paediatric multidisciplinary team at Kings College Hospital, a teaching hospital and major trauma centre in London. This approach has been continuously adapted and shaped over the last five years, in an intentional effort to translate clinical experience and research findings into practice, and to better rehabilitate patients for re-integration into the 'real world' from a hospital setting. Through describing a patient journey, this paper seeks to illustrate how the acute team assess, understand and manage the complexities of cognitive deficit within the early stages of rehabilitation following ABI. The limitations of standardised psychometric assessments in this context mean that clinical observation within functional activity and formulation of thereof is vital. The paper also demonstrates how using remedial/impairment-based intervention alongside patient and family specific functional intervention, conducted within a context relevant to the patient, bridges the gap between hospital and home.

Consistent with emerging research findings, the benefits of a flexible, trans-disciplinary, personal and integrative approach, where the acute team step into the community domain, are being documented within our service. This approach is demonstrated by the case presented, along with suggestions for building a qualitative and quantitative data set that can further demonstrate the efficacy of this approach in the future.

Moral Reasoning and Empathy After Focal Paediatric Brain Lesions

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Human social functioning is supported by a distributed network of frontal and temporal brain regions that undergoes significant development during childhood and adolescence. Clinical studies of individuals with early brain insults (EBI) to frontotemporal regions suggest that such lesions may interfere with the maturation of sociocognitive skills and lead to increased behavioral problems. However, little attention has focused on the direct assessment of sociocognitive skills, such as moral reasoning, following focal EBI. In the present study, the performance of 15 patients with focal EBI (8–16 years) was compared to that of 15 demographically matched controls on basic neuropsychological measures (IQ and executive functions), sociocognitive tasks (moral reasoning, empathy) and parent reports of behavioral problems and social adaptive skills. Patients with focal EBI had significantly lower levels of moral reasoning maturity, moral decision-making, and empathy than their matched controls, but did not differ on more general measures of cognition. Their parents also reported increased internalizing and externalizing behavioral problems compared to controls. These findings suggest that focal EBI to frontotemporal regions can result in reduced sociocognitive capacities such as poor moral reasoning and reduced empathy, and increased vulnerability to behavioural problems. Challenges for practitioners working with children who sustain focal EBI will be to identify those who are in need of intervention to improve social functioning.

A Model of Integrated Support - A Multi Disciplinary support pathway for Child/Young People and Family Support

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It is estimated that at least 40,000 children and young people are affected by acquired brain injury in the UK. Acute care is rated as good to excellent, but once discharged many children fall through the gaps and fail to achieve their potential. Many studies have identified that early intervention and family support can help the process of rehabilitation when a child acquires a brain injury. This presentation will demonstrate how a 'key worker' approach can have a significant positive impact on the progress of the child and the family, and improve relationships across sectors to 'complement not complicate' existing services. Working across the sectors and building relationships with a variety of agencies, professionals and organisations, the Model of Integrated Support ensures that a full care pathway is in place for every child/young person from the acute stage. Key success factors include consistent support at each transitional stage for the entire family from 'non-injured to injured child, from hospital to home and community, from home back into education and from education to whatever comes next. Families describe how they feel isolated, overwhelmed, stranded and ill-informed about brain injury and the future. The Model places the family's needs at the centre of the pathway, and addresses each need through practical, emotional and social support. Based in Major Trauma Centres across the UK, the 'key workers' are embedded within the multi disciplinary team, working in partnership with clinicians and therapists to provide an approach that 'complements not complicates' the clinical effort. This support continues throughout the growth and development of the child/young person, and as and when their needs change through to transition into adult services.

Outcomes:

- Reduced isolation
- Improved self esteem
- More informed about the future
- Increased confidence to make decisions
- Ability to participate in more activities
- Confidence to plan for the future
- Access to different and more holistic support strategies
- Forum to 'voice' concerns and be heard
- Exposure to wider support network
- Ability to self manage condition

Key Strategies:

- Needs assessment
- Education
- Welfare
- Housing
- Access to finance
- Access to social opportunities
- Transitions
- Support network

Success Factors:

- Early intervention
- Information resources
- Fully integrated service
- Case study analysis
- Statistical analysis
- Testimonial
- Honorary NHS contracts
- Long term input

Child Brain Injury Legal Support Service - A Partnership with Law Firms Across the UK

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This presentation will illustrate a unique partnership with leading law firms across the country who specialise in child brain injury litigation. The partnership is unique in that it provides a 'whole service' approach covering personal injury, clinical negligence, education, housing, court of protection, family law support for families affected by childhood acquired brain injury.

The concept was to ensure that families have access to rehabilitation services to enable them to reach their potential.

Partners were chosen who had the ability to build strong relationships with families, had significant expertise, were 'value' driven, had access to highly skilled litigators and could ensure continuity of support.

A 3 year pilot programme was launched in 2014 to address the significant gap in services and take up of litigation through the Child Brain Injury Trusts model of integrated support across the UK.

The presentation will describe effective partnership working and the 'customer journey'.

Rearrange Your Brain - A Cognitive Behavioural Strategy for Siblings and Friends

Lisa Turan¹

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Rearrange your Brain is a concept and strategy for younger children aged 5 - 10 years old who are siblings or friends of a child or young person who has an acquired brain injury.

The presentation will present the book commissioned by the Child Brain Injury Trust which has been written by children's author Sarah Mackie and works alongside a workshop for schools.

The main concept for 'Rearrange' is that when something negative happens our brains are capable to rearrange our thoughts to find a positive solution.

The mantra "I feel confused, cos things are strange, I need my brain to rearrange" is used as a foundation of 'cognitive behavioural therapy that encourages participants to take a moment to consider a situation from a more positive viewpoint to help to impact negative thoughts, feelings and behaviours.

Recognition that siblings and friends are often faced with difficult or overwhelming situations. Learning a strategy that focuses on thinking differently and behaving differently will, with practice equip them with a robust strategy that promotes emotional wellbeing throughout life.

Tested in a number of schools across Wales in early 2017, the initial findings are positive and feedback has indicated that the concept can be further developed and rolled out across other areas.

Paediatric Clinical Neuropsychologists have endorsed the materials and parents have stated that it has the potential to help siblings to sort out their feelings.

Family Forward: A Social Work Clinical Trial Promoting Family Adaptation Following Paediatric Acquired Brain Injury

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Objectives: To measure and compare the effectiveness of an innovative social work intervention 'Family Forward' with 'Usual Care' social work practice in promoting family adaptation outcomes following a child's acquired brain injury during the inpatient rehabilitation phase of recovery.

Research Design: Prospective, sequential comparison group design.

Methods and Procedures: Participants were parents, carers and siblings of 47 children diagnosed with acquired brain injuries and admitted to an inpatient rehabilitation service. Families were allocated to two groups: 'Usual Care' (n= 22) or 'Family Forward' (n= 25). The participants provided demographics and psychosocial information about their families. They also completed measures assessing family adaptation: family functioning (Family Assessment Device - General Functioning); and family management of the injured child's care (Family Management Measure) at the time of their child's inpatient rehabilitation admission (T1), inpatient rehabilitation discharge (T2) and 6 weeks post discharge (T3). Rehabilitation Social Workers provided information about the social work services delivered to the families in the two groups during their child's inpatient rehabilitation phase of care.

Main Outcomes and Results: Family adaptation outcomes measuring family functioning and family management of the child's care at six weeks post rehabilitation discharge were similar for both groups. The Family Forward group had poorer family functioning pre-intervention and endured longer acute hospital and inpatient rehabilitation admissions than the Usual Care group. The Family Forward group received a higher level of social work activity and intensity than the usual care group. There was a relationship between aspects of the Family Forward intervention and family perceptions of their ability to manage the injured child's daily life at home. As the Family Forward supportive counselling activity and intensity increased, parents in this group perceived their ability to manage the child's daily life as being more family focused. Family Forward's supportive counselling was also associated with family perceptions of their child's condition management, with an increase in the social work activity and intensity relating to a decrease in family members' negative perceptions of the child's condition. The Family Forward group also reported significantly greater condition management ability of their child's care at six weeks post-discharge. In summary, Family Forward delivered social work activity and intensity in accordance with family functioning and point of need.

Conclusions: The findings from this pilot study provide preliminary evidence that Family Forward can assist social workers to understand the role of family functioning in the early adaptation process post injury and deliver interventions accordingly.

A Paediatric Rehabilitation Ingredients Measure (PRISM) For Use in Studies of Severity-Adjusted Outcome and Rehabilitation Treatment Received

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Purpose: To develop an instrument (Paediatric Rehabilitation Ingredients Measure, PRISM) for quantitative estimation of neuro-rehabilitation content for use in studies of relationships between rehabilitation treatment delivered and severity-adjusted outcomes after acquired brain injury.

Materials and Methods: The measure was developed using an ingredients-mediators-outcomes model consistent with the International Classification of Functioning, a literature review, and other current initiatives in the development of rehabilitation treatment taxonomies, with item co-development in workshops with rehabilitation professionals. Inter-rater reliability was assessed in inpatient and residential paediatric rehabilitation settings. The rating method uses the Analytic Hierarchical Process (AHP) to aid raters' subjective assessments of the composition of the rehabilitation team's combined efforts in terms of proportions of standard ingredient-mediator combination "menu items".

Results: professional feedback confirmed the acceptability and face validity of the PRISM approach. Inter-rater reliability (assessed by Kendall W) was excellent. PRISM has the potential to be used by a single rater or by consensus of the rehabilitation team. The challenge for the single rater is their participation in a sufficient range of MDT exchanges to obtain a complete overview of the rehabilitation input. As a collaborative team tool it has value in facilitating inter-disciplinary discussion.

Family Forward: Promoting Family Adaptation Following Pediatric Acquired Brain Injury

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This presentation will describe a new and innovative Social Work intervention Family Forward, designed to promote early adaptation of the family system after the onset of a child's acquired brain injury. Family Forward is integrated into the rehabilitation services provided to the child during the inpatient phase of care and is described in this paper. It recognises the important role of the family in child rehabilitation outcomes and the parallel process of recovery for the child and family following an injury.

Family Forward arose from Social Work clinical practice with families in a paediatric rehabilitation service. The intervention aims to assist Social Workers to conceptualise the family experience post injury and employ interventions that promote early family adaptation.

This paper outlines important contributions to the development of Family Forward including research knowledge on family adaptation for paediatric ABI, a definition of family adaptation that reflects the family experience post ABI, and Family Therapy as a conceptual framework and practice approach.

Clinical Features of Young Children with Disorders of Consciousness

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Objective: Disorders of Consciousness (DOC), including vegetative (VS) and minimally conscious states (MCS), can occur following severe brain injury. Assessment of DOC is challenging in all patients due to questionable and inconsistent responses; however, evaluation is particularly challenging in young children because of their limited repertoire of developmentally-expected behaviors. The purpose of this study was to describe clinical features in a convenience sample of young children with DOC, including exam findings of those in MCS and those who emerged into a conscious state (CS).

Participants and Methods: Chart review was conducted for 25 children admitted to a pediatric inpatient rehabilitation facility directly from an acute care hospital following a new neurologic injury or illness (TBI = 5, Acquired = 20). Age ranged from 6 months through 5 years (M = 2.61). All children were identified to have DOC upon admission (VS = 14, MCS = 11).

Results: Five children (ages 1-5 years) emerged into CS by discharge. All 5 of these children demonstrated features consistent with MCS at admission. The 11 children in MCS at admission displayed visual fixation and/or contingent affective responding; none showed clear command following. Of those in VS at admission, 36% progressed to MCS. At discharge, only 3 children clearly followed commands (ages 2, 4, and 5), each of whom were in CS.

Conclusions: These results contribute to the small literature on DOC in children. Consistent with previous studies of older children, higher level of consciousness at admission appears associated with better outcomes at discharge. The vast majority of the sample was not observed to follow simple motor commands. Overall, future research is needed to establish more distinctive and developmentally relevant behaviors suggestive of MCS in young children, as well as identify factors associated with emergence into CS in this population.

Recovery of Functional Capacity and Performance Following Pediatric Brain Injury During Sub-Acute Rehabilitation: Growth Curve Analysis

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Background: Predicting functional outcomes following pediatric brain injury is important for families and clinicians, as well as for hospitals and medical insurance providers. Several factors may be associated with change over time in functional outcomes during rehabilitation, including age and type of brain insult (traumatic/non-traumatic). The current study evaluated functional capacity and need of assistance in children during sub-acute rehabilitation following brain injury.

Methods: A retrospective cohort design was used. Data were collected from medical files on N=139 children, consecutively hospitalized at the Department of Pediatric Rehabilitation with a diagnosis of brain injury in the years 2010-2015. Measures of functioning in the two domains of Daily Activities - Mobility (M) and Self-Care (SC), were collected using the Functional Skills (FS) and Caregiver Assistance (CGA) scales of the Pediatric Evaluation of Disability Index (PEDI). Growth curve analysis was used to evaluate the relationship between age, gender, etiology and length of stay with values (intercept) and change (slope) of the different PEDI subdomains over time.

Results: 421 observations were analyzed from 66 children with traumatic brain injury (TBI) (10.5±5y old, 80.3% male) and 73 children with non-TBI, e.g. brain damage due to hemorrhagic or ischemic stroke, tumor removals, seizures or infections (9.5±5y old, 56.2% male). The median length of hospitalization was 74 days, and similar between groups. Growth curve analysis provided estimates for global rates of change in PEDI throughout hospitalization. Thus, a child aged 10.5 years with non-TBI was expected to improve an average of 2.8 points in FS-M, 1.82 points in FS-SC, 1.4 points in CGA-M and 1.82 points in CGA-SC score per hospitalization week. Age at injury was associated with PEDI scores: with each year of age, children had additional 1.58 points in FS-M, 1.97 points in FS-SC, 1.13 points in CGA-M and 1.64 points in CGA-SC. In addition, age was associated with degree of change, such that older children improved faster than young children. Gender was not associated with PEDI score or change. Etiology (TBI/non-TBI) was generally not associated with PEDI scores, but children with TBI had lower initial CGA-M scores. Children with TBI recovered faster (steeper slope) in all PEDI domains, compared to those with non-TBI insult. Children who were hospitalized for longer times had lower initial PEDI scores and slower recovery of capabilities (FS) but not of performance (CGA).

Discussion: This study showed that TBI etiology was predictive of faster recovery, and older age was associated with higher initial scores as well as faster recovery. Following brain injury, PEDI scores and changes during hospitalization may allow for basing discharge decisions and fine tuning of rehabilitation programs.

How Do Cognitive Profiles and Academic Performance Correlate in Children Treated for Brain Tumors?

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Objectives: Children treated for brain tumors risk having cognitive difficulties that affect their academic performance later on as well. However, little is still known how certain neuropsychological test results relate to results in academic tests. The aim of this study is to analyze the correlation and potential predictive ability between cognitive profiles and academic performance in children treated for a brain tumor.

Methods: All children between 7-18 years of age in the area of Stockholm that had been treated for a brain tumor between the years 1995-2013 were offered a neuropsychological and academic assessment at the Astrid Lindgren Children's Hospital. Forty children (50% females) between the ages of 7 and 18 years (M=13.28, SD=3.16) were included in this retrospective study. The relationship between their cognitive functions (general verbal abilities, perceptual abilities, working memory and processing speed) and academic skills (reading speed, contextual reading, reading comprehension, spelling, and basic arithmetic skills) was analyzed using multiple regression.

Results: Our preliminary results showed that our sample had cognitive and academic deficits compared to norms. The sample had cognitive deficits in full-scale IQ and a more uneven cognitive profile than norms with large deficits in working memory and processing speed, a medium deficit in shifting, a small deficit in verbal comprehension but no significant deficit in perceptual reasoning. In academic tests, the sample had large deficits in reading speed, medium deficits in contextual reading, spelling and basic arithmetic, but no deficits in reading comprehension. The strongest predictor of reading speed and spelling was working memory, while the strongest predictor of arithmetic ability was perceptual reasoning.

Conclusion: Knowledge of the correlation between neuropsychological and academic tests can provide important information for future interventions for children treated for a brain tumor. For instance, reading difficulties in our sample may not be caused by a difficulty in understanding the material, but rather difficulties with working memory and a slow processing speed.

Using Therapy Dogs as a Rehabilitation Intervention Following Childhood Brain Injury - A Pilot Project

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Working in partnership with Dogs for Good a UK registered charity. The Child Brain Injury Trust and Dogs for Good piloted a programme of intervention working with 4 families. Each family required a different intervention and outcomes were plotted according to the needs of the family it related to.

1. Physical rehabilitation
2. Social integration
3. Puppy training
4. Road safety

The pilot explored how dogs could help children with acquired brain injury overcome their difficulties. A staff member from Dogs for Good has been working with a representative from CBIT and the family to set up a plan of sessions working towards specified goals or objectives for the child with acquired brain injury.

Examples of goals include:

- Learning to cope in busy environments and decreased anxiety in busy environments
- Getting more confident in social interactions with strangers
- Increasing motivation to exercise more
- Improved self-control, emotion regulation, focus and concentration
- Improved confidence and self-esteem

The short pilots that have taken place so far have provided opportunities to develop case studies and gather evidence of the benefits of the service in action.

Success is the Sum of Repeated Efforts: An Evaluation of Repeated Trials in a Modified Constraint Therapy Group for Children with Acquired Brain Injuries

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Background/Rationale: Constraint-Induced Movement Therapy (CIMT) has shown to be an effective approach in improving upper extremity function in children with hemiplegia following an acquired brain injury in both one to one and group programming (Komar et. al., 2016). There is however, no evidence supporting the effectiveness of repeated trials in group based interventions for this population. This study examines the effectiveness of repeat participation in the Helping Hand program, a group-based modified CIMT (mCIMT) program, on upper extremity function and occupational performance in children and youth with hemiplegia following an acquired brain injury.

Methods/Analysis: A pretest- post-test retrospective design was used to evaluate the impact of repeat participation in a group-based mCIMT program. Data from 13 children ages 3 to 13 years with hemiplegia following an acquired brain injury that participated twice in the two week mCIMT program was analyzed. Upper extremity function was measured by assessment of grip strength, the Assisting Hand Assessment (AHA) and subtests from the Quality of Upper Extremity Skills Test (QUEST). Occupational performance and satisfaction in self-care, productivity, and leisure goals were assessed using the Canadian Occupational Performance Measure (COPM). Data was analyzed using non-parametric Friedman's and Wilcoxon signed-ranks tests.

Results: The Friedman's Test revealed a significant effect of time on: upper extremity function including Grip Strength, (n=9, $\chi^2=10.15$ df=3, p=0.017), the AHA, (n=14, $\chi^2=13.621$ df=3, p=0.003); and on the QUEST's grasp subtest score, (n=13, $\chi^2=8.280$ df=3, p=0.041). Although not significant, a clinical trend was observed on the QUEST's dissociated movement score (n=13, $\chi^2=6.702$ df=3, p=0.082). In addition, a significant effect of time was revealed for occupational performance and satisfaction with performance (COPM Performance, (n=12, $\chi^2=22.261$ df=3, p=0.000); COPM Satisfaction (n=12, $\chi^2=12.595$ df=3, p=0.006). Post-hoc Analysis demonstrated significant changes between outcome administrations.

Conclusions: This study is an initial step in evaluating and providing preliminary evidence supporting the effectiveness of repeat participation in a group-based mCIMT program for children with hemiplegia following an ABI. The results show improved upper extremity function and occupational performance with repeated participation in a group-based mCIMT program.

How this research impacts clients and families: This research provides clients with acquired brain injuries and their families with initial evidence supporting the use of repeated trials of mCIMT in a group format and a foundation for future research exploration.

The Role Serotonin in the Mental Recovery After Severe Traumatic Brain Injury in Children; And of Its Correction

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It is known that the neurotransmitters involved in the process of recovery of consciousness after TBI. In this regard, the use of selective serotonin reuptake inhibitors (SSRIs) for the treatment after brain injury of possible. Data on the use of antidepressants in the treatment of traumatic brain injury are contradictory; children's age has not been studied.

Objectives: To investigate the efficacy of SSRIs (Sertraline) in the mental recovery in the early period of the neurorehabilitation after TBI in children.

Materials and Methods: 40 children (5-18 years) with sTBI (GCS \leq 8) admitted to the Institute. All children had interdisciplinary approach and standard medications in early rehabilitation. Group 1 (23 children) - in the early period of rehabilitation additionally administered sertraline. Group 2 (17 children) - without sertraline. Methods: psychiatric and neurological examinations; neuropsychological data, radiological studies, scales. Monitoring the dynamics of recovery: Rancho Los Amigos Scale (Hagen C., Malkmus D., 1989), Coma Recovery Scale-Revised (Giacino J.T., Kalmar K., 2004), Scale mental recovery by Dobrokhotova T. (1985), Scale Communication Activity by Bykova V, Lukyanov V (2011).

Results: Group 1: The clinical status was: a vegetative state - 4 (children), minimal consciousness - 6, minimal consciousness «+» (mutism) - 7, amnestic confusion - 3, cognitive and emotional deficits - 3. The purpose of SSRIs was: to improve motor and emotional activity, to correct the motivation, to improve cognitive disorders, to increase sociability. Sertraline administered 12.5 mg/day in the morning, with increasing dose over 3 days to 25-50 mg/day. Duration of reception - an average of 3-4 months. All patients tolerated Sertraline without adverse events. Positive treatment was in all children.

Group 2: a vegetative state - 4 (children), minimal consciousness «-» - 5, minimal consciousness «+» (mutism) - 3, amnestic confusion - 3, cognitive and emotional deficits - 2.

Mental recovery to a stage of emotional and cognitive deficits was in 48% of children with sTBI during treatment with Sertraline, compared with 35% in the control group. Positive dynamics was diagnosed by neuropsychological scales.

Conclusion: Selective serotonin reuptake inhibitors have a positive effect on recovery from traumatic brain injury in children. SSRIs (Sertraline) improves mental functions - to increases the motor activity and emotional activity, motivation, cognitive functions. Early rehabilitation becomes effective in children.

Mental Health and Quality of Life in Children Twelve Months After Traumatic Brain Injury

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Objective: To compare mental health and quality of life (QoL) among children with Traumatic Brain Injury (TBI) and healthy controls twelve months after the injury.

Methods: Thirty children with mild-to-severe TBI (Glasgow: 10.47) and 30 age and education matched healthy controls from Guadalajara, Mexico completed measures of mental health (anxiety and depression) and QoL 12 months after TBI. Anxiety and depressive symptoms were measured with the Anxiety Scale for Children Revised (Physiological Anxiety, Restlessness/Hypersensitivity, Social Concerns/Concentration, and Total CMAS-R) and Children's Depression Inventory (subscales of Self-esteem, Dysphoria and the total score of CDI). QoL was measured using the Pediatric Quality of Life Inventory (PedsQL), which is composed by four subscales: physical, emotional, social and school functioning. The majority of the TBI sample was boys (63%) and the average age was 11.10 (SD=2.7) years. For controls 80% were boys with an average age of 11.10 (SD=2.26) years.

Results: Manova analyses showed significant differences between the groups on the measures of Physiological Anxiety ($F = 16.63, p < .001$), Restlessness/Hypersensitivity ($F = 15.17, p < .001$), Social Concerns/Concentration ($F = 9.46, p < .01$) and Total Anxiety ($F = 18.01, p < .001$). There were also significant differences between groups on the measures of Self-esteem ($F = 32.75, p < .001$), Dysphoria ($F = 46.27, p < .001$) and total CDI ($F = 52.15, p < .001$). On QoL, significant differences were found in the measures of Physical ($F = 6.66, p < .05$), Emotional ($F = 51.63, p < .001$), Social ($F = 10.09, p < .01$), Scholar ($F = 131.32, p < .001$) and Total QoL ($F = 68.26, p < .001$). In general, compared with healthy controls, children with TBI scored significantly higher on measures of anxiety (p 's $< .001$) and depression (p 's $< .001$) and lower in QoL (p 's $< .001$).

Conclusions: Symptoms of anxiety, depression and poor quality of life are common in Mexican children with TBI 12 months after injury. Psychological interventions should be implemented after hospital discharge in order to improve the mental health and quality of life of these children on year post injury.

Cognitive Functioning in Children Twelve Months After Traumatic Brain Injury

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Objective: To compare cognitive functioning among children with Traumatic Brain Injury (TBI) and healthy controls twelve months after the injury.

Methods: Thirty children with mild-to-severe TBI (Glasgow: 10.47) and 30 age and education matched healthy controls from Guadalajara Mexico completed a comprehensive neuropsychological battery 12 months after TBI. The battery include measures of learning and verbal memory (the Rey Auditory Verbal Learning Test (total RAVLT and total RAVLT recall)), attention (Trail Making Test (total time TMT A and B) and Stroop test (Total words, total colors, total word-colors and Interference)), Vocabulary (Peabody Picture Vocabulary Test (total PPVT score)) and viso constructional skills (Rey–Osterrieth Complex Figure (total FCRO copy and FCRO three minutes recall)). The majority of the TBI sample was boys (63%) and the average age was 11.10 (SD=2.7) years. For controls 80% were boys with an average age of 11.10 (SD=2.26) years.

Results: Manova analyses showed significant differences between the groups in the measures of the total RAVLT ($F = 32.28, p < .001$), total RAVLT recall ($F = 132.03, p < .001$); total time TMT-A ($F = 16.32, p < .001$) and B ($F = 48.77, p < .001$); total Stroop Word ($F = 20.15, p < .001$); total PPVT ($F = 11.40, p < .001$); in total FCRO copy ($F = 95.6, p < .001$) and FCRO three minutes recall ($F = 52.10, p < .001$). In general, compared with healthy controls, children with TBI scored significantly worse on these test. There were not significant differences between groups in Stroop Color, Word-Color and Interference (p 's $> .05$).

Conclusions: Learning and verbal memory, attention, vocabulary, viso constructional skills problems are common in Mexican children with TBI twelve months after the injury. In Mexico children with TBI usually don't receive any psychological or neuropsychological services after TBI. Therefore, neuropsychological rehabilitation programs are needed to improve the cognitive functioning of these children.

Quality of Life of Caregiver of Children with Traumatic Brain Injury Twelve Months After Injury

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Objective: To compare the quality of life (QoL) among caregivers of children with Traumatic Brain Injury (TBI) and healthy control twelve months after the injury.

Methods: Thirty caregivers of children with mild-to-severe TBI and 30 healthy control completed the MOS 36-Item Short Form Health Survey (SF-36) 12 months post injury. This survey is composed by eight subscales: physical functioning, role limitation due to physical problems, role limitation due to emotional problems, energy/fatigue, emotional well-being, social functioning, pain and general mental health. The Student T analyzes showed significant differences between the groups in the variables age ($p > .05$), education ($p < .001$) and sex ($p > .05$).

Results: Mancova analyses showed significant differences between the groups in the measures of role limitation due to physical problems ($F = 38.07$, $p < .001$), role limitation due to emotional problems ($F = 19.54$, $p < .001$), emotional well-being ($F = 8.15$, $p < .01$), social functioning ($F = 28.47$, $p < .001$), pain ($F = 25.22$, $p < .001$) and general mental health ($F = 4.15$, $p < .05$), such that caregivers of children with TBI scored significantly lower than healthy controls. There were not significant differences Energy/fatigue and Physical functioning subscales ($p > .05$).

Conclusions: Caregivers of children with TBI living in Mexico report having poorer quality of life across various domains, including role limitation due to physical problems, role limitation due to emotional problems, emotional well-being, social functioning, pain and general mental health. These findings suggest the need for rehabilitation health professionals to develop and implement interventions to improve caregivers' QoL.

Learning Parental Network and Learning Youth Network on Facebook

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BarnRehab Skåne (BRH) – a resource centre within Region Skåne’s Child and Youth Habilitation, specialised in rehabilitation after acquired brain injury.

Background and objective: BarnRehab Skåne (BRH) has started two different Facebook groups with the intention of creating learning networks for teenagers with acquired brain injury and their parents. In these groups parents and teenagers are able to discuss and share their experiences while having access to professional knowledge and support if needed. The families are in a particularly difficult position and often have thoughts on how life will become for their children and teenagers in different areas like school, leisure time, social interaction, adulthood and future working life. Parents and teenagers have on several occasions expressed wishes to get in touch with other families in the same situation.

Method: In August 2014, BRH created a Learning Parental Network as a closed Facebook group for parents with ABI children aged between 13 and 20, registered at BRH. In this group parents can discuss any subject they like while at the same time having the opportunity to take part of tips, advice and links posted by professionals from BRH. They can also take part of information about different activities at BRH and sign up for these activities. In September 2015 the group was extended to also include parents of children aged between 0 and 12.

In August 2015, BRH created a Learning Youth Network. It is a closed group for teenagers between 13 and 20, registered at BRH. The setup is basically the same as in the Learning Parental Network.

BRH has a team who actively participates in this network by publishing posts every week and contributes with knowledge and support if needed. The team consists of an occupational therapist, a psychologist, a special educational needs teacher and a counsellor.

Results: The group Learning Parental Network was evaluated in December 2014 by using a questionnaire answered by the parents combined with a structured follow-up interview with the professionals. Although the group by then was still small in number the preliminary results showed that the parents appreciated the discussions and got new ideas on how to support their children in their everyday life. The parents regard Facebook as an appropriate forum to get in touch with other parents. The professionals experience a positive response from parents and teenagers. Both groups are continuously growing with new members. The conclusion is that the Facebook groups, so far, have been a positive experience for both parents, teenagers and professionals.

Culture as a Lifelong Consideration in Neuropsychological Assessment, Formulation and Rehabilitation

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Culture impacts on every aspect of neuropsychological assessment, formulation and intervention and it remains a life-long consideration for a child with acquired brain injury (ABI) who may require long-term neuropsychological involvement. Challenges arise in test selection, administration and interpretation of results, as well as in the effective planning and delivery of rehabilitation, frequently within social frameworks unfamiliar to the neuropsychologist. Psychological factors relating to trauma or cross-cultural adjustment, for example, need to be considered in differential diagnoses. In the UK, linguistic and cultural diversity is rapidly evolving, incorporating complexities from European and world-wide migration. While interpreters can bridge a gap in understanding between healthcare professionals and patients from diverse backgrounds, implications of cultural differences go beyond language barriers. We highlight that cultural challenges to neuropsychological assessment, formulation and intervention vary depending on the multifactorial aspects of the child's cultural background.

We present data on the typical and specific challenges affecting assessment, formulation and rehabilitation of Central European migrants contrasted with world-wide migrants, based on our case-work. For illustration of the marked differences in the challenges faced by the paediatric neuropsychologist, we outline the cultural complexities raised in assessment and rehabilitation planning surrounding a Central European migrant with traumatic birth injury and a Central African migrant post traumatic brain injury (TBI).

Neuropsychological assessments (Wechsler Intelligence Scale for Children, Children's Memory Scale, Rey-Osterrieth Complex Figure Test, Delis-Kaplan Executive Function System and Wechsler Non-Verbal Scale of Ability, Strengths & Difficulties questionnaire) were administered; when possible, tests were administered in the child's native language. Both children showed impairment on measures of intelligence, memory and executive function.

The Central European child showed severe difficulties with language on tests delivered in their native language and English. The underlying theme of the cultural complexities surrounded the child's split residence. This had to be taken into consideration when preparing written correspondence and when developing a rehabilitation package. Other challenges surrounded validity, competence and cost of translation, for example of medical notes.

The results from the Central African child were confounded by a bias towards the requirement of knowledge of a Western culture. Formulation involved disentangling the effects of pre-existing poorly documented developmental concerns and pre-migration psychological trauma from the effects of the TBI. Religious considerations and core beliefs were crucial to formulation and intervention. Significant ethical issues were identified.

In each case, cultural differences had a powerful influence on how each child and their family responded to disability and adjustment, and this impacted upon the assessment protocols and delivery of rehabilitation. Clinical recommendations are made highlighting factors essential for planning support for the child with ABI towards adolescence and adulthood within the context of complex cultural diversity.

Procedures for Early Intervention after Acquired Brain Injury - From Hospital and Return to School/Kindergarten

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Statped is a national service for special needs education within four regions of Norway and a main office located in Oslo, capitol city. Schools, kindergartens and local school-authorities may need guidance and competence. Statped provides special teaching services at individual and system level in areas where the country's 430 local authorities do not have sufficient competence.

The Day Care Institutions Act and the Education Act provide for these services; no costs for the municipality to consult Statped even for a longer time.

No segregated schools for special educational needs:

Inclusion in mainstream schools is a very important objective of Norwegian educational policy.

To help the transition into re-entry in School/Kindergarten, Statped have established a procedure of early intervention offering support as an out-reach service in the municipality.

Aim: 1) To give support and guidance with an easy access for the parents and others in the kindergarten/school. 2) To provide support and knowledge about the consequences of ABI for children/students in order to get a joint understanding for the educational needs and to set adequate educational goals

Procedure:

- When the child/student is discharged from hospital and returns home for re-entry in kindergarten/ school, the hospital can contact Statped
- The parents, the teacher and other professionals responsible for the child`s re-entry can contact Statped directly
- Statped works close to the educators and school-authorities
- The service given is two meetings
- If additional needs, The Educational and Psychological Counselling Service (PPT) must send Statped an application

The procedures will be presented as a diagram on the poster

The Childhood Stroke Clinical Guideline - Using an Evidence Based Collaborative Approach

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Introduction: Approximately 400 children in the United Kingdom have a stroke every year. Stroke in childhood is very different from adults and the results of a stroke can be wide reaching, presenting young people with challenges that persist as a lifelong condition. The Royal College of Paediatricians and Child Health (RCPCH) UK with the support of the Stroke Association are updating and expanding the national Childhood Stroke in guidelines (2004). These guidelines address the pathway of care for children from diagnosis through to long term health, education and social care needs.

Patients and Methods: A Guideline Development Group (GDG) was established with stakeholders across health professional groups and parent representatives. Subgroups were formed to concentrate on key components of the care pathway including diagnosis, acute care, rehabilitation and transition into and through education. The expanded guideline included both ischaemic and haemorrhagic stroke. The GDG agreed the scope and questions. Literature reviews were undertaken; data extracted and synthesised to support recommendations. Two parent and young person workshops were run and data qualitatively analysed to support inclusion of preferences around information, support and transition processes. Elements of acute management were subjected to Delphi methodology.

Results: Research evidence was combined with GDG expert consensus and parent feedback/experiences. Recommendations have been drawn from a combination of best-evidenced practice, Delphi studies, parent and young person feedback and expert consensus. The guidelines have been subject to extensive stakeholder review and the anticipated publication is in May 2017. A summary guidance document designed by and for families will accompany the full guidelines.

Conclusion: The new Childhood Stroke Guideline will provide health, education and social care professionals with robust and comprehensive guidance to inform integrated support and intervention for this group of children/young people. Whilst the guideline will focus on young stroke survivors, many of the recommendations will be applicable to children and young people with other acquired brain injuries.

The Unmet Needs of Pediatric Stroke Survivors

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Background: Paediatric stroke has the potential for long term impacts on the lives of children and their families. Child-centred intervention depends on understanding of needs from diagnosis onwards. Little however is known about the support, health and care needs of this population. This study aimed to describe the nature and extent of needs (met and unmet) in daily life of paediatric stroke survivors and their families and compare these findings with previously reported unmet needs of adult stroke survivors.

Methods: The survey was conducted with parents of children who had a stroke diagnosed between age 1 day – 18 years, and young people surviving a stroke aged 12 to 18 years old. Participants were recruited from three tertiary level paediatric stroke clinics in England. Levels and type of needs, and self-reported neurological impairment were captured. Comparisons of needs according to sociodemographic groups and neurological impairment were explored using Chi-square test as appropriate.

Results: Of 44 participants (39 parents, 5 young people), over two thirds reported at least one unmet need. Over half had difficulties in school-related activities, and over one-third in leisure activities and social relationships. Compared to adult stroke survivors, paediatric stroke participants reported different levels and types of health problems and unmet needs and a higher proportion of unmet needs in emotional health. Greater severity of neurological impairment was associated with more diverse and higher level needs.

Conclusions: Higher levels of unmet needs and problems were reported by pediatric stroke survivors and their parents compared to adult stroke survivors. This information indicates the need for targeted individualised services to support this population over time.

“Some Semblance of Normal”? A Qualitative Study of Parents’ Experiences of Paediatric Stroke

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Introduction: Paediatric stroke is an important cause of mortality and disability but research in this area is relatively undeveloped. There are no published studies of patient and family experiences and needs in this population. This information is required to inform the development of appropriate services.

Patients and methods: Parents of children with stroke were recruited from three regional specialist services in England. Semi-structured interviews using a topic guide aimed to explore parents’ experiences. Interviews were conducted with 12 parents whose children had been diagnosed with stroke < 1 year, 1-5 years and > 5 years before. Interviews lasted between 1-2 hours; they were audio-recorded and fully transcribed for thematic analysis.

Results: Parents reported a wide range of consequences for their children, beyond those identified in the literature. They were satisfied with specialist acute care but less satisfied with primary/community, citing low professional awareness of paediatric stroke, and difficulties accessing services. Parents reported a wide range of information needs that were variably met. The impact on parents and families was considerable, including financial problems and consequences for health and well-being. Existing social networks were a supportive resource for some. Contact with other families experiencing childhood stroke was beneficial.

Conclusion: The experiences and types of unmet needs participants reported are not dissimilar to those identified by family carers of adults with stroke, and by parents of children with other long-term conditions. Strategies to address these needs should be developed in collaboration with children with stroke and their families.

Chronic Traumatic Encephalopathy in Pediatric Population with History of Abuse or Sports Related Mild Traumatic Brain Injury - A Post-Mortem Study

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Chronic traumatic encephalopathy (CTE) is a progressive neurodegenerative disease characterized by abnormal tau deposits in the brain and thought to be caused by multiple concussions. This pathology has been described in professional athletes with a known history of repetitive mild traumatic brain injury. The existence of this unique pathology has never been explored in pediatric population with known history of multiple head injuries due to abuse or sports. Here we present 10 cases with ages ranging from 3-17 years with history of "chronic" non-accidental and sports related traumatic brain injury and 10 controls with history of chronic cardiac disease due to malformations. All cases had a general autopsy and all brains were retained for full neuropathological assessment. All brains were sampled thoroughly and examined for presence of tau, axonal damage (APP) and neuro-inflammation (gliosis- microglial activation). Additionally, all cases were probed with the Nanostring Counter Immune Profiling Panel. This gene expression array enables to develop profiles of the human immune response in formalin-fixed paraffin-embedded tissue. The 770 gene panel combines markers for 24 different immune cell types and populations, 30 common immune antigens and genes that represent all categories of immune response including key checkpoint blockade genes.

Our results show that in a small number of cases, CTE-like tau pathology can be detected in pediatric age with history of repetitive mild traumatic brain injury. There was no correlation or predictive value linked to severity or frequency of brain trauma but only brains with a certain pattern of inflammatory reaction as shown by nanostring had CTE-like pathology.

In conclusion, CTE can be seen in pediatric population with history of mild traumatic brain injury and certain pattern of inflammatory response is speculated to be the driving force in the development of this tauopathy.

Continued Improvements in Children's Executive Functioning Four Years After Mild TBI in Childhood: Findings from the BIONIC Study

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Introduction: Traumatic brain injury (TBI) is a common injury during childhood and adolescence with recent estimates indicating rates of 1300/100,000 and 818/100,000 in children aged <5 and 5-14 years, respectively. Over 95% of these injuries are mild (mTBI), but some children experience longer term difficulties. Executive functions (EFs) are a group of cognitive abilities that are crucial for purposeful, goal-directed, problem solving behaviour and play a key role in social behaviour. EFs develop from infancy through late adolescence, and TBI during this period may disrupt normal developmental processes leading to poorer long-term academic/vocational outcomes. The aim of this study was to examine the effects of childhood mTBI on EF between two and four years post-injury and to examine factors related to EF outcomes at the same time points.

Method: Children (<12 years at injury) with mild TBI were identified as part of a prospective longitudinal study of TBI incidence and outcomes (BIONIC study). Parents completed a range of questionnaires including the Behavioural Rating Inventory of Executive Function (BRIEF) at two years (n = 116, 62% male, mean age at injury = 4.43 years) and four years post-injury (n= 93, 61% male).

Results: Repeated measures analysis of variance (ANOVA) revealed significant improvements in overall EF (Global Executive Composite, $p < .01$) between two (M = 55.50, SD=11.85) and four years post-injury (M= 52.27, SD = 11.56). More specifically, significant improvements were observed for Inhibition ($p = .03$), Shifting ($p < .01$), Working Memory ($p < .01$), and the Planning / Organisation sub-scales ($p = .05$) and the Metacognition Index ($p < .01$). The number of children with scores in the clinically significant range reflected the overall improvement in EF, with 24 (21%) children above the clinical cut-off at two years post-injury and 11 (12%) children meeting the criteria four years post-

injury: Correlations were undertaken to examine factors related to EF outcomes at two and four years post-injury. At two years, there were no statistically significant correlations between demographic variables (i.e., gender, SES) or age at injury and EF outcome. However, at four years post-injury overall EF (Global Executive Composite) showed a significant correlation with family SES ($r = .28$, $p = .02$), where higher SES was associated with better outcomes.

Conclusion: There were significant improvements in overall EF, between 2 and 4 years post-injury, suggesting that recovery may continue for several years post-mTBI. In spite of these improvements, a small (but significant) proportion of children had clinically relevant EF difficulties at 4 years post-injury. Furthermore, low SES (and associated issues) appears to place children at risk of longer term negative outcomes of mTBI. In light of these findings and age-related changes in the acquisition and application of higher order EF skills, longer-term monitoring of children following mTBI in childhood is warranted.

Patterns in Children's Health Recovery Between 1 and 4 Years Following a Mild Traumatic Brain Injury: Findings from the BIONIC Study

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Introduction: Pediatric traumatic brain injury has an estimated annual incidence of 100-300/100,000 population each year, with 70-90% classified as mild in severity. Post-concussive symptoms (PCS) are common even following mild injuries, and involve a range of cognitive, behavioral, emotional and somatic complaints. While symptoms are expected to resolve shortly following injury, these can persist for months in some children. Prolonged exposure to PCS may have adverse consequences for children's quality of life. Little is known about children's patterns of recovery beyond one year post-injury. The aim of this study was to determine whether children's PCS and quality of life improved, deteriorated or remained stable between 1 and 4 years.

Methods: This prospective, longitudinal follow-up study examined PCS and health-related quality of life in 74 children (mean age 5.34 years at injury [range: 0-11 years]; 59.5% boys) with mild TBI. In-person follow-up assessments took place at 1 and 4 years following injury. At each assessment, parents completed the Pediatric Quality of Life Inventory (Peds-QL) and Rivermead Post-Concussive Symptoms Questionnaire (RPQ). The first three symptoms of the RPQ (headaches, nausea/ vomiting, dizziness) assess early onset symptoms (within 2 weeks of injury) associated with post-concussion syndrome. The remaining 13 RPQ items reflect later onset symptoms that are considered more likely to persist.

Results: While group mean RPQ scores reduced over time for early and late onset PCS, a within-subject repeated measure analysis of variance revealed general stability in symptoms over time ($p > .05$). Similarly no significant within-subjects changes were found for PedsQL scores, with the exceptions of declined school function ($p < .001$) and improved emotional function ($p = .004$). Specifically, nearly 64% of children declined in school function and 44% improved in emotional function. Compared to 1 year, those groups of children whose performance in school and emotional function improved, declined, or remained the same at 4 years did not differ by age, gender, or mechanism of injury ($p > .05$). Total number of TBI and family socio-economic status at 4 years were also similar across all groups.

Conclusion: As a group, the extent of children's recovery from mild TBI appears to be generally stable from 1 to 4 years post-injury. Parents and practitioners should be aware of potential longer-term risks for children's quality of life due to increasing difficulties in functioning at school. Future research should examine patterns of recovery in larger samples to increase sensitivity to detect changes over time and to identify those underlying mechanisms that contribute to differences in children's patterns of recovery.

Aiming High – Increased Participation After Return to School with High-Level Difficulties After ABI

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Introduction: Successful reintegration to school for children after ABI is considered essential for the success of intervention (McDougall et al. 2006) but the service provision for the paediatric population can vary greatly (McKinlay et al. 2016). Children may have residual higher level difficulties that are known to be ongoing and long term (Feeney & Ylvisaker 1995), but they may often not qualify for local therapy services in the UK. Literature highlights the need to focus on a child's functioning in everyday activities (Bedeall et al. 2005) and the importance of specialised ABI input to school (Glang et al. 2004).

Method: Single-case study methodology of community based rehabilitation; ABI age 9 years (AVM), intervention aged 10-12 years, pre-morbidly high achieving student. An individualised collaborative approach to intervention included: inter-professional assessment, support and training to home and school, 1:1 sessions with the child, classroom observations and provision of strategies, supporting transition to secondary school. Progress was monitored with quantitative and qualitative outcome measures using the Child & Adolescent Scale of Participation (CASP), Child Occupational Self-Assessment (COSAS), La Trobe Communication Questionnaire, teacher and sibling questionnaire feedback, observations of participation in school, parent report.

Results: Increased participation in school demonstrated by: increased scores in the CASP scale score 80→100; positive change in 8 COSAS areas, including 'finishing work on time' 'getting homework done'; classroom observations of increased participation; positive teacher and parent report; increased participation in clubs. Increased awareness of high-level cognitive and communication difficulties and strategies: positive teacher and sibling questionnaire feedback 'understanding that X finds making decisions hard so giving her fewer options'; sister: 'if she were to suddenly get annoyed at me I understand she's probably tired or something else is causing it; I find it a lot easier not to get annoyed at her'. Reduced reporting of cognitive-communication difficulties demonstrated by reduced frequency scores in the La Trobe in 3 communication areas and parent/teacher feedback.

Conclusion: This intervention demonstrated positive outcomes over 2 years post-injury. School participation can be positively influenced for a child with high-level difficulties following ABI. Schools can benefit from specific support to help them understand the high-level needs of a child with an ABI who is performing within the average range but requires extensive support to aim high and meet their potential. Good practice includes collaborative working, provision of specialist support and intervention to the child or young person at home and school level, and during the transition period to secondary school. This approach can be challenging to deliver but had a positive outcome within the education system in the UK and is in line with the current literature and IPBIS service recommendations for the paediatric population after brain injury.

Brain Injury in Children and Young People: Does A Holistic, Multidisciplinary Approach Lead to Refocused Expectations and Hence Equitable Outcomes?

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Objective: Both traumatic (TBI) and other acquired causes of brain injury (ABI) are associated with worse than expected health and wider outcomes in children and young people. Domains previously studied include quality of life¹, emotion, behaviour, cognition^{2 3} and participation⁴, with TBI patients demonstrating longer-term sequelae into adulthood⁵. Evidence exists to show outcomes depend on the degree of severity of injury⁵. Equally, adult data suggests cultural factors may affect patient/family experience⁶.

The Royal London hospital is a major trauma centre serving a culturally diverse local population. The neurorehabilitation team includes clinicians, a clinical nurse specialist in neurology, psychology and psychiatry liaison, and a committed team of therapists. Our inpatient service includes weekly multidisciplinary meetings with goal-directed therapy. At a point of safe discharge, patients continue to receive appropriate input, largely community-based, depending on assessed needs in each discipline.

This evaluation looked to assess if there was any difference in perceived brain injury outcomes within our patient group, based on: ethnicity, type of injury or severity of injury. Our hypothesis was that there would be no difference, based on the holistic and equitable nature of our service.

Methods: Patients attending Paediatric Neurology follow up outpatient appointments between January 2015 and May 2016, at least 1 month after a diagnosis of ABI/TBI, were included. Parents/caregivers completed a validated questionnaire (Child and Family Follow-up Survey - CFFS), alongside demographic/clinical details (age, ethnicity, date of injury, type of injury and severity). Responses were scored and comparative statistics performed, comparing ABI/TBI (Student's t-test), ethnicity and mild/moderate/severe injury (ANOVA).

Results: Nineteen children were included, with no significant differences in demographics. There was a statistically significant difference in parental rating of physical health with ABI versus TBI (poorer in ABI group, $p = 0.009$). However, this did not translate to statistical differences in function, participation, impact or service experience. There was no statistical difference in any domain when grouping by ethnicity or injury severity.

Conclusion: This evaluation suggests our service offers uniform provision following brain injury, independent of ethnicity, injury type or severity. The latter finding, contrary to previous studies, may be explained in large part by patient/family adaptation post-injury, including refocused expectations. It is our belief that the holistic design of our service, as well as providing appropriate individualised interventions, also facilitates this adjustment, and so leads to equitable outcomes. This study had limitations in numbers and length, and further specific work is needed to interrogate this potentially important finding.

References: 1) Limond et al (2009) 2) DeMatteo et al (2014) 3) Lloyd et al (2015) 4) de Kloet et al (2015) 5) Sariaslan et al (2016) 6) Simpson et al (2000)

Children with Severe Traumatic (TBI) or Non-Traumatic (N-TBI) Brain Injury Hospitalized for Sub-Acute Specialized Treatment and Rehabilitation at Department of Neurorehabilitation, Unit of Traumatic Brain Injury (TBI Unit), Rigshospitalet/Hvidovre Hospital, Denmark

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Introduction: In Denmark rehabilitation of patients with severe brain injury consists of three phases: acute phase with neurosurgical treatment; sub-acute phase with intensive hospital rehabilitation; rehabilitation phase provided by the municipality. Advances in intensive care have led to reduction in mortality after severe TBI and N-TBI. As a result 30–40 children need sub-acute rehabilitation each year. The unit has 4 beds for children and receives patients approximately 28 days after the acute phase. Admission criteria: Patients <5 years old with a Glasgow Coma Scale (GCS) from 3–9; patients ≥5 years old with a GCS from 3–11; patients with a GCS >9 with severe neurological deficits. Patients daily receive interprofessional team rehabilitation. Weekly meetings with the team and the parents focus on rehabilitation goals. The parents are coworkers receiving information and psychological support. A coordinator from municipality participates in monthly meetings to be prepared for the patient's discharge. Before discharge the coordinator receives a rehabilitation plan describing the patient's needs. 1 year post injury the patient and the parents are invited to follow-up at the outpatient clinic.

Data: Demographic and clinical data were registered for patients admitted to the unit and outpatient clinic: Data from 90 patients from 2005 to 2016 were available; TBI (38%); N-TBI (62%); boys (54%); girls (46%); age range 4 months to 17 years old and 11 months (mean=7 years old and 6 months); length of hospitalization 17 to 284 days (mean=113 days). Follow-up data were registered on 20% (n=18) of the 90 patients. After discharge some did not respond, others received rehabilitation elsewhere, and two children had died. At follow-up 22% (n=4) were not in kindergarten/school; 17% (n=3) were in kindergarten/school with special needs; 39% (n=7) were in kindergarten/school at regular terms; 22% (n=4) had not specified activity. The Visual Analog Scale (range from 0 (very low) – 10 (very high) was used to evaluate quality of life. 94% (n=17) answered between 1-10 (mean=7).

Conclusion: Experience and data indicates that rehabilitation of children with TBI and N-TBI is a complex interprofessional challenge:

- Children with severe injuries have long hospitalization.
- Cooperation between the acute/sub-acute phase and municipality is important.
- Cooperating with the parents is important. They take care of the child during and after hospitalization.
- Rehabilitation must continue after discharge as some children at follow-up still need support.
- Follow-up is important as the rehabilitation plan at discharge cannot predict the need for long-term rehabilitation.
- Ongoing individualized rehabilitation affects quality of life.

Future focus is needed on systematic registration of data from hospitalization and follow-up. This may be of value in rehabilitation planning in the different phases. The registration may contribute to a better prediction of intensity and frequency of rehabilitation.

Epidemiology of Traumatic Brain Injury in Children in Russia

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Purpose: To study TBI pediatric epidemiology in Russia in 2008-2014, to study the Quality of Life in children who survived mild TBI and to evaluate economic losses due to TBI.

Materials and methods: Morbidity and mortality levels in children with TBI (aged 0-17) were studied in 2003-2014 using the database of the State Statistics Registry. QL of children with mild TBI (mTBI) was evaluated with the Russian version of the total questionnaire Pediatric Quality of Life Inventory – PedsQL™4.0 (Varni et al., USA, 2001). The studied group included 67 children (aged 5-18) at the acute period of mTBI; the control group included healthy children comparable by sex and age. Economic losses were calculated by direct and indirect costs. Social aspects were studied with a sociological survey.

Results: In Russia every year 250000 children seek for medical help because of TBI; about 100000 are hospitalized; about 1500 die; about 5000 become disabled. The analysis performed has shown a general decline of TBI death rate (by 58%) in children; in infants - by 55.3%. Currently, we have 3.9 death outcomes per 100000 of pediatric population. Every tenth child who died because of head trauma was less than one year. During the studied period, TBI in children has increased by 1.4 %: in girls increased by 22.2%; in boys decreased by 12.5%. At TBI accident sites half of the children-victims were with adults, and only 13% were alone. A socio-demographic portrait of a patient with TBI is like this: It is a healthy or rarely sick child. This is his first TBI trauma. He lives in a complete family, in a flat, in a city. We studied the quality of life of children with mild head injury. The questionnaire PedsQL-4.0 was chosen as a tool. Groups of risk for various long-term consequences after mild TBI: about 37% of children aged 5-7 and up to 16.7% of children aged 13-18. Annually, economic losses caused by pediatric TBI mortality are 476 milliard USD; by pediatric TBI morbidity - 70 milliard USD.

Conclusion: TBI in children has an important and multivectoral character.

Our Experience of Early Staged Rehabilitation of Children with Severe Neurotrauma in a Pediatric Surgical Department

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Actuality: The Clinical and Research Institute of Urgent Pediatric Surgery and Trauma is a modern center for pediatric trauma in Russia. More than 3 000 children with neurotrauma are admitted to our hospital; 4% of them have severe traumas.

Purpose: To develop a complex multi-staged rehabilitation model for providing aid to children with severe neurotrauma.

Methods: A step-by-step complex work by the interdisciplinary team which depends on patient's consciousness level, degree of cognitive, motor and somatic disorders.

Results: A four-staged rehabilitative model for helping children with severe neurotrauma has been developed. The first rehabilitation stage begins at the resuscitation unit. Its main goal - prophylactics and treatment of complications in pulmonary, cardio-vascular systems; prophylactics of contractures and deep vein thrombosis, preservation of motion volume in the joints. If any indications, a surgical rehabilitation takes place at this stage so as to remove anatomic disorders and to expand organism's compensatory mechanisms. Besides, breathing gymnastics, passive joint gymnastics, psychological support to parents, etc. After returning the independent breathing and stabilization, patients are transferred into an intensive therapy ward. At this stage, goals, tasks and rehabilitation potentials are defined; the interdisciplinary rehabilitation team is formed; measures for long-lasting care are defined. It is important to support nutrition status, to provide care for thracheostoma and gastrostoma. An interdisciplinary team consists of various specialists: surgeon, reanimatologist, pediatrician, otoneurologist, traumatologist, defectologist, neuropsychologist, speech specialist, specialist in kenesotherapy, physiotherapist. Psycho-pedagogical rehabilitation develops skills for self-service living, tactile and olfactory sensitivity, restores swallowing and speech, involves parents. Active motor rehabilitation is prescribed. Patient's socialization is the final aim of early rehabilitation. After the hospital, the child is followed-up out-patiently in the Consultative-Diagnostic Department. An individual rehabilitation program which includes necessary diagnostic, surgical and rehabilitation procedures is developed.

Conclusion: The discussed complex rehabilitation system considerably improves functional outcomes in children with STBI.

Follow-Up Issues in Children with Mild Traumatic Brain Injuries

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Objective: Concerns about mild traumatic brain injury (mTBI) have increased in recent years, and neurosurgical consultation is often requested for patients with radiographic abnormalities or clinical findings suspicious for mTBI. However, to the authors' knowledge, no study has used the Acute Concussion Evaluation (ACE) tool to systematically evaluate the evolution of symptoms in patients with mTBI during neurosurgical follow-up. The goal in this study was to evaluate symptom progression in pediatric patients referred for neurosurgical consultation by using the ACE, as endorsed by the Centers for Disease Control and Prevention.

Methods: The authors performed a retrospective review of records of consecutive pediatric patients who had presented to the emergency department, were diagnosed with possible mTBI, and were referred for neurosurgical consultation. Outpatient follow-up for these patients included serial assessment using the ACE. Data collected included the mechanisms of the patients' injuries, symptoms, follow-up duration, and premorbid conditions that might potentially contribute to protracted recovery.

Results: Of 91 patients identified with mTBI, 58 met the inclusion criteria, and 33 of these had sufficient follow-up data to be included in the study. Mechanisms of injury included sports injury (15 patients), isolated falls (10), and motor vehicle collisions (8). Ages ranged from 5 to 17 years (mean age 11.6 years), and 29 of the 33 patients were male. Six patients had preinjury developmental and/or psychiatric diagnoses such as attention deficit hyperactivity disorder. Seventeen had negative findings on head CT scans. The first follow-up evaluation occurred at a mean of 30 days after injury. The mean number of symptoms reported on the ACE inventory at first follow-up were 3.2; 12 patients were symptom free. Patients with positive head CT findings required longer follow-up: these patients needed 14.59 weeks, versus 7.87 weeks of follow-up in patients with negative findings on head CT scans ($p < 0.05$).

Conclusions: The data suggest that patients with mTBI, particularly those with developmental and/or psychiatric comorbidities and concurrent cerebral or extracranial injury, often report symptoms for several weeks after their initial injury. Serial ACE assessment permits systematic identification of patients who are experiencing continued symptoms, leading to appropriate patient management and referral.

Use of the Canadian Occupational Performance Measure (COPM) to Document Patient and Family Centered Outcomes in Children with Traumatic Brain Injury Admitted to an Intensive Day Rehabilitation Program.

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Objective: Children admitted to an intensive day rehabilitation program following traumatic brain injury (TBI) have a wide range of family and patient centered goals. As the program at Kennedy Krieger serves a wide variety of ages, backgrounds and ability levels, measuring program outcomes was a challenge. The program initially used the Functional Independence Scale for Children (WeeFIM) to track functional progress; however, this assessment did not fully capture family/patient centered goals and outcomes. In an effort to quantify these domains, the program began using the Canadian Occupational Performance Measure (COPM) to document patient outcomes. The COPM provides a quantitative measure of patient progress towards their goals. Patient goals are identified through semi-structured interview in the domains of self-care, productivity and leisure. The importance of each is then rated and the most important are assigned a value for current performance and satisfaction with that performance.

Methods: As part of the admission process, the COPM was administered for a total of 26 admissions of patients (2-19 years of age). Nine patients participated in the program several times. Treatment days ranged from 15 to 151 days. Longer stays were for the initial admissions following acute TBI, shorter stays were for a boost of therapy services to improve a child's functional independence. The use of this assessment tool involved the patient and the family in the goal setting process for admission. At the end of the program each participant was asked to again rate the performance and satisfaction for each of the identified goals. The difference in admission and discharge scores indicated the patient or parent perception of their progress toward their goals.

Results: All children received physical, occupational and speech therapy services for three hours per day, 5 days per week. All children demonstrated improvement in both their performance and satisfaction scores of their identified goals on the COPM measure. Gains were between .5 to 6.75 points with a mean change of 2.8 for performance, and 3.1 for satisfaction. An improvement of 2 points is considered clinically significant. These improvements were across all domains including activities of daily living and motor skills. Children who attended the program multiple times continued to make gains with performance of their identified goals after subsequent admissions. The COPM allowed the rehabilitation team and family to create patient centered goals and track satisfaction with goal attainment or improvement of a specific skill.

Conclusions: In a group of children with TBI, the COPM is used to document program performance and patient outcomes. Patient and family perception of progress towards goals can be measured and tracked. The COPM can be administered across many admissions allowing for long-term tracking of outcomes and family satisfaction with progress toward their identified goals.

EEG Connectivity During Dual-Tasking as a Diagnostic and Rehabilitation Tool in Traumatic Brain Injury Patients

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Background: Traumatic brain injury (TBI) is the most common cause of social desadaptation in young people. Some symptoms may persist more than more one year after TBI. The aim of this study was to determine brain mechanism disorders during dual-task processing in young TBI patients in comparison heathy volunteers.

Methods: Twenty-three TBI patients (26 ± 3.5) and forty healthy volunteers (25.6 ± 2.3) participated in studies. Participants performed cognitive (C1 – verbal, C2–visual-spatial) and motor (M - postural) tasks on force platform isolated and simultaneously (dual-task). Data analysis was focused on outcome estimated by EEG coherence (connectivity), stabilographic parameters and clinical scales (MMSE, MPAI, Berg balance scale).

Results: In healthy subjects EEG data demonstrated coherence increase for slow (delta and theta) spectral bands and predominantly in left hemisphere during C1 tasking while additionally in right hemisphere during C2 task. Postural task performance was accompanied by functional coupling increase in fast spectral bands (alpha and beta). EEG-marker of successful dual task performance was EEG conectivity increase at distant diagonal pairs between associative (frontal-posterior) brain areas together with EEG connectivity decrease for local networks. In TBI patients poor quality of dual-tasking was accompanied by EEG connectivity increase for local pairs vs a decrease for distant connections. We founded speciphic changes of EEG connectivity in TBI patients with predominant left-hemispheric disfunction during C1-M dual-task and with right-hemispheric decline during C2-M dual-tasking.

Conclusions: So, EEG study showed that in healthy subjects successfulness of dual-task performance is provided by frequency-spatial and hemispheric diversity with recruitment of distant diagonal connections between associative brain areas. An increase of functional connectivity in short networks during dual-tasks was observed in TBI patients. Specific disturbances of EEG connectivity were shown in patients with predominant left- or right-hemispheric disfunction. We proposed that dual-tasking may be used as a special diagnostic and rehabilitation tool after TBI.

The Use of In-Bed Cycling in Paediatric Acute Acquired Brain Injury

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Introduction: Early mobilisation has been proven to be key in recovery for patients with acute acquired brain injuries (ABI)¹. Regular physical training animates brain activity and promotes neuroplasticity. Furthermore, it has been associated with a decrease in hospital and intensive care unit length of stay, and better functional outcomes at hospital discharge in critically ill patients². Early mobilisation options in fully ventilated and sedated ABI patients are limited. MOTomed lotto² is an in-bed cycling machine which was introduced into Glasgow's Royal Hospital for Children to promote early mobilisation within the Paediatric Intensive Care Unit (PICU). It is designed to work in a supine position with active or passive pedalling. Here we describe 3 cases using the MOTomed with paediatric acute ABI patients.

Case examples: Patient A was a 12 year old boy with a hypoxic-ischaemic injury following prolonged cardiac arrest. Patient B was a 4 year old boy with a right sided cerebral infarct. Patient C was a 12 year old boy who sustained a brain injury following prolonged seizure activity. All were deemed to be stable by the medical team and risks assessments completed. The patients used the pedals for 10 minute sessions, set up by a physiotherapist, whilst in PICU. Patient A used pedals whilst on non-invasive ventilation; patients B and C were intubated and ventilated. All patients had an initial PEDI score of 0 and were level 1 on the Rancho Los Amigos Level of Cognitive Function Scale. No adverse effects were noted when using the MOTomed pedals. Heart rate, blood pressure and oxygen saturations were monitored throughout sessions and remained stable with all patients. Active movement was recorded by MOTomed in patients A and C, and passive only in patient B.

Discussion: Early mobilisation has been identified to improve patient outcomes in the adult population but research in the paediatric population remains in its infancy. Of clinical interest, active and intentional cycling was detected by the machine prior to spontaneous functional movement being observed in all patients. Active cycling may be a potential early indicator for rehabilitation potential, however this area requires further research. These case studies suggest use of in-bed cycling as part of routine early physiotherapy mobilisation for paediatric ABI is safe and may improve patient outcomes.

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Rehabilitation Outcomes for Severe Childhood Stroke

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Introduction: In the UK, approximately 400 children each year have a stroke, leading to physical, communication, cognitive and emotional difficulties. These difficulties impact upon the child/young person's ability to participate at home, school and in the community. When the child/young person's difficulties are severe they may require an individually tailored, child centred residential rehabilitation placement. NHS England fund such placements and require data to be submitted to the UK Rehabilitation Outcome Collaborative (UKROC) as part of the agreement.

Aims of the study: To understand the outcomes for children and young people with severe stroke following residential rehabilitation.

Methods: Analysis of routinely collected UKROC outcome data from one specialist rehabilitation centre. Rehab Complexity Score (RCS) and UK Functional Independence Measure + Functional Assessment Measure (UK FIM+FAM) completed by child's rehabilitation team on admission and discharge for all children aged 8 years and over. Both descriptive analysis and statistical analysis using the Wilcoxon test were conducted on scores of children admitted between 2012 and 2016.

Results: Twenty six children (mean 12.5 years, range 8-17 years; 12 girls: 14 boys) accessed residential rehabilitation programmes with a median length of stay of 23.2 weeks (range 8-40 weeks). There was a significant difference between RCS scores on admission and discharge ($p \leq 0.05$, $z = -2$). In addition, the overall change in UK FIM+FAM scores were statistically significant for the total score, motor and cognitive subsections ($p \leq 0.05$, $z = 3.48$, 4.37 and 4.46 respectively). On discharge the mean UK FIM+FAM was 135.8 (range 32-189) and the mean RCS on discharge was 12 (range 7-18). These scores indicate that children and young people continue to have reduced functional abilities, and have standard complexity needs on discharge. On discharge, the areas of the UK FIM+FAM that the group scored lowest were community mobility and safety awareness (mean=3). Further interrogation of the data showed that children who have a specific hemispheric stroke ($n=14$) had a mean UK FIM+FAM admission score of 106.6, those who had cerebellar strokes ($n=5$) of 70.8, and those with global/diffuse involvement ($n=6$) of 85.3. All groups improved during rehabilitation, by a mean of 41, 41 and 35 respectively.

Conclusion: Following residential rehabilitation, children/young people with severe stroke show significant increases in functional independence and reduction in rehabilitation complexity. Those with stroke involving subcortical areas are more severely affected, with more ongoing difficulties than those with solely hemispheric strokes. For all children, difficulties are still noted across all domains of the UK FIM+FAM on discharge, that will affect their developmental trajectories, and ability to participate in all areas of their life. Ongoing rehabilitation and long term follow up are indicated, particularly to enable them to manage safety and increase community participation.

Predicting Goal Attainment for Children and Young People with Acquired Brain Injuries in Residential Rehabilitation: Do Therapists Get It Right?

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Introduction: Goal setting with the child and family allows rehabilitation to target the areas that are of highest importance to the child and family. These goals can then be used in goal attainment scaling light (GAS) to provide a meaningful and sensitive way of capturing the outcomes of a residential rehabilitation programme. Goal setting discussion, and the subsequent use of goals as an outcome demand that therapists predict the child's level of achievement for their rehabilitation period.

Aims of study: This study reviewed goals set using GAS light for children/youth in residential rehabilitation following severe ABI. This enabled evaluation of therapists' accuracy in predicting outcomes in areas which children and families have identified as important to them. These outcomes can be compared to studies of goal attainment in other neurological rehabilitation settings.

Patients and method: All children/youth admitted to a residential rehabilitation programme following a severe ABI between September 2013-2016 (n=122, mean 9.3 years (1-17 years) were included. Goal setting interviews were held between the child and/or parent, and treating therapist. Expected achievement levels were set by therapists. All goals were retrospectively mapped onto the International Classification of Functioning, Disability and Health. Visual analysis of goal achievement level was conducted. The findings were compared to published results of studies that occur in other neurorehabilitation settings.

Results: 859 goals were set. Overall 70% of the goals were achieved: 46% at the expected level, 17% at a little more than expected, 7% at a lot more, 25% at partially achieved, 5% at no change and 0% got worse. 82% of all goals were within the activities and participation domains of the ICF, with 9% each in body structure and function and environmental domains. Mobility (29% of total goals), self-care (19%) and communication (11.8%) sections have the greatest number of goals. The levels of achievement across the different types of goals were consistent. The results were comparable to studies conducted in paediatric community cerebral palsy rehabilitation (60% achieved) and adult ABI rehabilitation (74% achieved).

Conclusion: Children and their families consistently identify mobility, self-care and communication goals as their priorities following ABI. Across all areas of goals set, therapists get the expected level of achievement right less than 50% of the time, indicating the difficulty involved in this skill. This challenge is not unique to ABI rehabilitation, as similar levels have been found across different neurorehabilitation settings. Greater understanding of the difficulties of outcome prediction will enable therapists to have more realistic conversations with children and their families regarding prognosis for rehabilitation.

Performance of Typically Developing Very Young Children on Coma Recovery Scale-Pediatric

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Background: Disorders of Consciousness (DOC), including vegetative state (VS) and minimally conscious state (MCS), can occur following severe brain injury. Assessment of DOC is challenging in all patients due to questionable and inconsistent responses. Evaluation is particularly challenging in very young children because of their limited repertoire of developmentally-expected behaviors. In this study, we sought to examine the performance of typically developing infants, toddlers, and preschool-aged children on a modified version of the Coma Recovery Scale-Revised (CRS-R). The CRS-R is a validated assessment of DOC in adults. The psychometric properties of the CRS-R have not been explored in children of any age. The purpose of this study is to better understand the expected functioning of very young typically developing children to determine if a modified version of the CRS-R can be used with young children in DOC.

Methods: Typically developing children ages 6 months through 4 years were recruited. Children were eligible if born full term, typically developing, and having a parent who is conversant in English. The original CRS-R was modified into the CRS-Pediatric (CRS-P) by incorporation of age-appropriate items and instructions. The underlying skills assessed were not modified. Children were administered the CRS-P in one office visit by a trained research assistant. All interactions were videotaped and scoring was reviewed by a neuropsychologist with expertise evaluating children with DOC.

Results: Thirty-one children ages 8 months to 59 months, (51% male) were recruited for participation. Percentage of children at each age obtaining full credit were 7/7 (100%) of 4 year olds, 3/4 (75%) of 3 year olds, 1/6 (17%) of 2 year olds, 1/10 (10%) of 1 year olds, and 0/4 (0%) of those under the age of 1 year.

Conclusions: Typically developing infants, toddlers, and preschool-aged children display better performance on the CRS-P with age. While all 4 year olds and most 3 year olds demonstrated full credit on the CRS-P, less than 50% of children under the age of 3 years achieved full credit on the CRS-R. Thus, the CRS-P may be useful for children as young as 4 years of age with severe brain injury and possible DOC; however, the CRS-P may not be appropriate and needs to be used with caution with younger children. Further research is needed to explore the psychometric properties of the CRS-P with children with DOC. Additionally, research is needed to better understand the behavioral manifestation of DOC in infants and toddlers.

Incidence and Mortality of Moderate and Severe Traumatic Brain Injury in Children: A Prospective Population-Based Cohort Study in Norway

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Background: Traumatic brain injury (TBI) is one of the leading causes of mortality and morbidity in children globally. Reported incidence and mortality in children vary widely between countries and few studies are population-based.

Objectives: To estimate the population-based incidence rate and mortality of moderate and severe TBI in children in Norway.

Methods: All children aged 0-16 years with moderate (Glasgow Coma Scale (GCS) score 9-13) and severe TBI (GCS < 8) were included. Data were collected from a region in Norway between 2004 and 2014. The region consists of both urban and rural areas with seven local hospitals in addition to a Level 1 trauma centre. Out of 702,869 inhabitants (2014) 145,395 were children aged 0-16 years. Three different sources were used; 1) Trondheim TBI study: Prospectively including all patients with moderate and severe TBI admitted to St. Olav's Hospital, Trondheim University Hospital; the Level 1 trauma centre (2004-2014). 2) Mid-Norway

Trauma study: Prospectively including all trauma patients admitted either to the Level 1 trauma centre or to one of the seven local hospitals (2007-2010). 3) National Cause of Deaths Registry: Including all cases of fatal TBI, both in-hospital and pre-hospital deaths (2004-2014). We calculated crude and adjusted (standardized according to the world standard population) incidence rates of severe, moderate and total TBI per 100.000 person years (py), as well as the crude and adjusted mortality from TBI per 100.000 py.

Results: A total of 69 children with moderate, severe and fatal TBI were identified. Adjusted incidence rate of moderate TBI was 2.8 (95% CI 1.2-4.4) and adjusted incidence rate of severe TBI was 2.8 (95% CI 2.2-4.3) per 100.000 py. Adjusted incidence rate of severe hospitalized TBI was 1.5 (95% CI: 0.8-2.1) per 100.000 py. Adjusted mortality from TBI was 1.5 (95% CI 0.7-2.2) per 100.000 py, and 88 % of deaths from TBI were pre-hospital deaths. In-hospital case fatality rate of severe TBI was 6%.

Conclusions: Our study is one of very few population-based studies worldwide, and we found low incidence rates and mortality of moderate and severe TBI compared to other countries. The low incidence rates indicate that, to some extent, Norway has succeeded in the prevention of TBI in children. Most deaths occurred before hospital admission; hence to obtain an additional reduction of deaths from TBI further prevention of accidents is needed.

Use of the Lokomat® Robotic Gait Trainer in the Early Stage Rehabilitation of Children and Youth Following Acquired Brain Injury (ABI): A Feasibility Study

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Background: Children with acquired brain injury (ABI) can present with significant motor deficits that persist long-term and affect their quality of life. In the early stages of rehabilitation, a common goal for children with ABI is to regain the ability to walk independently. Thus early physiotherapy (PT) treatments frequently involve gait retraining and address related gait-based function. Robotic-assisted gait training devices, such as the Lokomat (LOK), target gait retraining in neuromotor conditions such as cerebral palsy (CP) and ABI. For children with an ABI, the use of robotic-assisted gait training allows earlier exposure to ambulation due to the extensive support and physical guidance the device provides. The use of LOK has been extensively studied in children with CP but there is limited research in pediatric ABI, with only one study published in Italy concluding that LOK+PT resulted in greater gross motor and gait gains than PT alone. While promising, that study's treatment protocol lacks generalizability to pediatric rehabilitation in Canada because the treatment intensity was far greater than what is possible in our healthcare system.

Objective: The purpose of this study is to evaluate the feasibility of a LOK/PT intervention protocol in a paediatric rehabilitation setting for children with ABI. Upon completing a single group evaluation of a 'clinically realistic' LOK/PT intervention, an estimate of the effect size for key outcomes will be obtained.

Study design: The single-group pre- and post-test pilot study will assess intervention feasibility, outcomes, and user satisfaction associated with an integrated PT/LOK intervention provided during early/mid-stage rehabilitation post-ABI.

Results: Seven children (4 GMFCS IV at enrolment, mean age 16 years, from 13 to 18; five males) have taken part in the study. 6 patients have completed the study at time of writing this abstract and early results show our protocol's suitability as well as gross motor skills gains (GMFM mean scores were 50% at baseline and increased to 70.1% at follow-up ($P < 0.05$), and individualized gait goals were accomplished overall. In terms of feasibility, the experience of acclimatisation and early setup often posed greater challenge post-ABI than in children with CP (due to the ABI-related impairments such as fatigue that need to be accommodated within the LOK sessions). However, for some participants, the level of fatigue and setup times decreased in subjects over the 8-week study. All participants completed their LOK session series and there have been no adverse events.

Conclusions: Preliminary analysis suggests that our protocol is feasible for the evaluation of pediatric LOK intervention in early/mid-stage rehabilitation post-ABI. This study will form the basis of a larger RCT assessing LOK intervention in pediatric ABI.

Web-Based Interventions for Pediatric Brain Injury: Lessons Learned From 3 Randomized Control Trials

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Given the lack of specialized care and follow-up available in many communities across the world, the internet may provide an important tool for linking families of children with brain injuries with evidence-based training, information and state-of-the-art psychosocial care. Recent studies have examined the efficacy of web-based interventions that include tailored video-based training. With this approach, users actively interact with the materials rather than passively receiving information as with traditional print material or video instruction. In addition to offering an evidence-based and standardized approach, web-based interventions can reduce potential physical and psychological barriers (e.g., distance, scheduling and time constraints, and stigma). Findings from several recent studies suggest that web-based training is as effective as face-to-face training, with participants demonstrating increases in knowledge, skills, satisfaction, and engagement.

This presentation will provide an overview of 3 randomized controlled trials examining the efficacy of web-delivered interventions for children with TBI. These include 2 training programs for educators supporting children with ABI: Transitions, training for teachers and parents supporting youth with TBI as they transition to adulthood and In the Classroom, a web-based training on TBI for educators working with school-age children. A third program, Brain Injury Partners, provides training on effective educational advocacy skills for parents of children with ABI.

Dr. Glang will discuss key findings and lessons learned in the development and evaluation of these interventions. The presentation will focus on challenges to developing efficacious and engaging web-based interventions. It will include an overview of the instructional design elements that lead to mastery of training content, including the use of video, graphic and animated media. A key focus of the presentation will focus on important elements of effective knowledge translation strategies for ensuring that web-based interventions reach parents, educators and children with ABI.

Recovery Assessment from Severe TBI Using Multiple Technologies

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Introduction: In the United States, approximately 2.5 million people sustained a traumatic brain injury and 5.3 million Americans are living with a Traumatic Brain Injury (TBI)-related disability. A non-fatal severe TBI may result in an extended period of unconsciousness (coma), and for those hospitalized after a TBI, almost half (43%) have a related disability one year after the initial injury (CDC, 2010). Based on the Glasgow Coma Scale, persons with a score between 3 to 8 are classified with a severe TBI (Teasdale, G. & Jennett, B., 1974). Longitudinal assessment of recovery of cognitive function, motor function, and different sensory functions can identify the long-term (>1 year) needs of individuals who suffer from severe TBI post-hospitalization. **Objectives:** 1) Track and monitor symptoms post-severe TBI; 2) Longitudinal assessment of vestibular, cognitive, and executive functioning; 3) Return individual back to daily life and learning activities.

Methods: Individual was a 22-year old male who suffered a severe-TBI due to assault. The mechanism of injury resulted in the individual's head hitting a concrete pathway posteriorly inducing multiple hemorrhages and fractures, along with an extensive diffuse axonal injury to the frontal lobes, splenium of the corpus callosum, and mid brain tegmentum. Post-Injury baseline information and progressions were collected approximately two-years post-injury utilizing C3 Logix Comprehensive Concussion Care (Neurologix, Inc.), VSR-Sport (Natus/Neurocom), and HeadRehab Virtual Reality System (HeadRehab, LLC).

Results: Progressive analysis of vestibular, cognitive, and executive functioning indicated a strong recovery back to normative values (>1 year). Moderate to strong reductions were recorded in number of BESS errors (R=0.52), Trail Making Test A time to completion (R=0.78), Limits of Stability Directional Control (%) (R=0.36), and Limits of Stability Movement Velocity (R=0.89). First to Last Month data analysis showed a significant decrease in Trail Making Test A time to completion (p=0.035) and foam surface sway velocity (deg./sec.) (p=0.049). Trail Making Test A returned to normative values for the individual based upon a study completed by Tombaugh, 2004 (Tombaugh T.N., 2004). Strong progressions were recorded for the Virtual Reality realms of spatial memory, balance, and reaction time.

Discussion: Longitudinal assessment can be effective to help limit the impact of severe TBIs. These measures include early management, continuous monitoring of symptoms, and overall treatment of said severe TBI. Progression of each individual can be self-determined based on rate of recovery, but periodic assessment can yield new focus on the life span of neuroplasticity of the human brain.

A Survey on Traumatic Higher Brain Dysfunction in Children at An Emergency Center

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Objective: To epidemiologically reveal the traumatic higher brain dysfunction (THBD) in children at emergency center in Japan.

Method: We conducted a questionnaire survey for 46 children who had suffered from traumatic brain injury (TBI) and were discharged home during the period from April 2012 to March 2015. In addition, we estimated the pediatric population who suffered from THBD after discharge from emergency centers in Japan using this survey result and the data of TBI children who were registered in the Japan Trauma Database (JTDB) from January 2013 to December 2015.

Results: Twenty-six children and their families were eligible for this study and 12 children (46.2%) met the criteria for THBD. The results suggested that 182 children suffer from THBD after TBI every year in Japan predictively. There is little difference between this result and the estimated number of children consulting about THBD in rehabilitation institutes in Japan.

Conclusion: To identify and support children with THBD, more attention should be paid to long-term outcome of TBI in children.

Proactive Intervention in The Return to School Process After Childhood Brain Injury: An Innovative, Inter-Agency Pathway

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Objectives: Clinical work and small-scale research with families of children and young people (CYP) with acquired brain injury (ABI) highlighted significant issues with returning to school. The process was often delayed and extremely stressful for CYP, families felt schools were frequently underprepared and slow to respond to CYP's needs, and teachers reported limited understanding of brain injury. Given the crucial long-term role of schools in neurorehabilitation, the need for a detailed, inter-agency return to school pathway and guidance was recognised. We present the early evidence of the pathway's efficacy, and discuss future developments.

Methods: A return to school pathway and guidance document was created collaboratively by a regional paediatric neuropsychology service, the local Educational Psychology (EP) service, and a young man with an ABI and his parents. Contributions were also sought from key professionals, including teaching staff, involved in supporting CYP with an ABI. A return to school pathway and guidance document for local education services was produced. This outlines the involvement and responsibilities of key agencies, and provides information for schools around preparing staff, pupils and the environment for the CYP's return. Best practice examples and a checklist for school actions are also included. A county-wide annual review process aims to ensure a CYP's ABI is not forgotten as they progress through the education system.

Results: The pathway was launched within Nottinghamshire, UK in January 2016. All CYP treated at the regional centre for moderate/severe ABI are automatically placed on the pathway, and their school, local EP and other key agencies involved in discharge and rehabilitation planning from the outset. To date, 12 CYP have been included in the pathway. We present case examples demonstrating the benefits of this proactive, rather than reactive approach. Feedback from professionals and families on the pathway also highlights increased empowerment of parents and CYP, higher levels of confidence in teaching staff, and lower rates of non-attendance at school.

Dissemination and training events have proven successful, and have led to teams looking at developing similar pathways in other areas, and a national children's cancer charity requesting to share the document with their social workers across the country.

Conclusions: Concerns about the poor return to school experience of many CYP after ABI led to the development of a pathway document. Early results are encouraging with case examples providing evidence of more efficient and effective return to education. Feedback from families and professionals has been extremely positive with the pathway promoting good practice and inter-agency collaboration, while also acting as a safety-net for families where school-return has been more challenging. Similar pathways are evolving in the wider region. Future plans include development of early-years and post-18 education guidance, and further dissemination to neurorehabilitation and education professionals.

Management of Mild TBI in Children: Ambulatory or Inpatient Management. A Single Institutional Experience

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Introduction: Diagnosis and treatment of children with mild traumatic brain injury (mTBI) remain a challenge since initial signs and symptoms do not always indicate the severity of the trauma. The goal of our study was to investigate if the standard that was allied from the PECARN rules and is applied in this study can ensure that patients with clinically important brain injury are recognized and leads to outcomes with a low complication rate, a high patient satisfaction and minimal post-concussion syndrome incidence.

Methods: 478 children with mTBI were enrolled and contacted their families with a questionnaire. Out of these, 267 valid questionnaires were received. Patient records and questionnaires were analyzed yielding a number of 140 ambulatory and 127 hospitalized patients.

Results: Patients with mild TBI were admitted according to the above-mentioned guidelines or sent home for observation through their parents after thorough patient examination and information. Among ambulatory patients only 13 children (9%) underwent any imaging procedure; however, none of those showed any pathological findings. Next, in 41 of 127 hospitalized patients (32.2%) an imaging study was performed and of these only 3 according to 2.4% of hospitalized patients showed pathological findings, namely a skull fracture, two of them in combination with an intracranial hemorrhage. The duration of inpatient observation was 48 h in most cases (55.3%). Moreover, a majority of all patients (72.4%) did not seek any follow-up visit and did not need any further treatment. Of all patients in the study, only 10 patients according to 3.7% developed a post-concussion syndrome. Patient satisfaction was very high in both, the ambulatory and hospitalized patient group.

Conclusion: This study confirms that PECARN rules as administered in this study can ensure safe decision-making regarding ambulatory or inpatient treatment.

Cognitive and Goal-Oriented Training for Children and Adolescent with Acquired Brain Injury (ABI)

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Background: Children and adolescents with ABI can experience a wide variance of sequelae including gross and fine motor problems, cognitive and executive dysfunctions. These sequelae commonly affect (the) performance in daily activities and participation.

The paediatric rehabilitation team at Karolinska University Hospital, Stockholm assess/meet/treat children with ABI in a hospital setting. After medical treatment and the initial phase of rehabilitation, the children are assessed for need of further/continued rehabilitation, which may lead to referral to a school-based rehabilitation unit – Alviksstrandsskolan. At this unit, for Sweden a unique form of rehabilitation, a multi-disciplinary team offers individualized therapy and group rehabilitation to children and adolescents from 3 – 18 years on period of 30 weeks for preschoolers and 20 weeks for school-aged children and adolescents.

Purpose: The purpose of this study is to perform and evaluate a meta-cognitive and goal-oriented method in a school based rehabilitation environment for improving and acquiring everyday skills in children and adolescents with ABI.

Method: A pilot study is planned using the Cognitive Orientation to daily Occupational Performance (CO-OP) in school based rehabilitation. The CO-OP is a meta-cognitive and goal oriented method developed for children with Developmental Coordination Disorder (DCD) but has proven to be effective for both children and adults with other diagnoses, including ABI. In Alviksstrandsskolan CO-OP will be used in training activities in daily living such as personal care, school or leisure activities. The children should have a cognitive function within normal range and be well motivated to participate actively through-out the therapy, including goalsetting, activity analysis, planning and developing training strategies as well as in the final evaluation. The parents will be asked to sign a document for consent. The training will be performed for ten weeks with a minimum of five days training per week, including a session for guiding discovery with the therapist. A consecutive selection of school-aged children and adolescents with ABI in Alviksstrandsskolan that meet the inclusion criteria and accept the terms of the therapy will be offered participation. The study will continue for one year or until a minimum of five individuals has followed CO-OP.

Child Occupational Self Assessment (COSA) will be used in identifying goals and the CO-OP will also be evaluated with Canadian Occupational Performance Measure (COPM) for the children and Performance Quality Rating Scale (PQRS) for the therapist. The parents will be informed and actively included if the training partly will be home-based.

In this study the occupational therapists have the objective to find a method for child-centered training of everyday activities, that could be a valuable complement to the school based rehabilitation at Alviksstrandsskolan.

Assessment of Executive Functions in Children and Adolescents with ABI Using a Novel Complex Multi-Tasking Computerized Task – the Jansari Assessment of Executive Functions (JEF-C©)

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Childhood is a time of enormous neural development so Acquired Brain Injury (ABI) during this period can have severe impacts on everyday life. Particular difficulties can be found in Executive Functions (EFs) but current assessments are limited in their sensitivity. We evaluated the feasibility of a new ecologically-valid test, the Jansari assessment of Executive Functions for Children (JEF-C©) comparing a group of children with ABI against age-matched controls. Twenty-nine children with ABI and 30 age- and gender-matched controls, aged 10-18 years were assessed on JEF-C© as well as paper and pencil EF tests from the BADS-C while parents completed the BRIEF questionnaire. JEF-C© uses non-immersive virtual reality and resembles a computer game in which the child has to organise and run their own birthday party multitasking a number of competing concurrent demands. We found significant differences between the groups on 3 out of the 11 BRIEF subscales but only the Six Elements subtest of the BADS-C. However, there were significant differences between the groups on JEF-C© total score $t(58)=4.49$, $p<.001$, $\eta^2=.32$ and on five of its eight individual measures: planning, selective-thinking, and event-based, action-based and time-based prospective memory (all $ps<0.05$). Our findings support the evidence of significant executive difficulties in children and adolescents with ABI. JEF-C© appears to be a feasible and playful complex task, allowing a thorough assessment of children's performance in a multitasking situation. It has good discriminant validity; further studies are needed to determine factors influencing performance on this task.

International Survey on Diagnostic and Prognostic Procedures in Pediatric Disorders of Consciousness

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Background: In recent years, ongoing efforts have focused on the development of consensus as well as evidence based guidelines for clinical assessment, treatment, and prognosis of adults with disorders of consciousness; however, to date no international guidelines or consensus recommendations are available. International practices appear to be quite heterogeneous and care occurs in a variety of different settings across the continuum including community based care in some locales. Recently, the IBIA (International Brain Injury Association) DoC (disorders of Consciousness) Special Interest Group (DoC-SIG) launched an international, multicenter survey to identify international practices in adult DoC care. The original survey did not include questions specific to pediatric patients with DoC. The purpose of our study was to survey international practitioners working with pediatric patients with DoC to assess practices and use of specific guidelines and recommendations.

Objectives: 1. To explore which specific diagnostic protocols and prognostic indices are adopted in the care pathway for children with DoC in different countries and if national guidelines provide specific recommendations. 2. To propose international guidelines and recommendations for pediatric patients with DoC.

Methods: Individuals on the IBIA and IPBIS (International Pediatric Brain Injury Society) mailing lists received an e-mail invitation to respond to a questionnaire focused on diagnostic and prognostic procedures adopted in the routine management of pediatric patients with DoC. The draft of the questionnaire was based on the DoC-SIG survey for adults and has been elaborated by Drs. Beth Slomine and Erika Molteni. The pediatric survey has been discussed among DoC-SIG members during several call meetings. The DoC-SIG diagnostic and prognostic pediatric survey was organized in two distinct sections. The first section included questions investigating clinical and instrumental (e.g. neurophysiological evaluation and neuroimaging exams) tools and involvement of family-caregivers in the diagnostic procedures. The second part included questions on clinical, anamnestic, instrumental markers and possible interfering factors for recovery of consciousness (e.g. previous comorbidities, medical or neurosurgical complications) routinely used by clinicians to provide prognostic information. Each section allowed for different responses by pediatric age group.

Conclusions: The draft of the questionnaire was posted on the LISTSERV platform (<http://groupspaces.com/IBIADOC/SIG/>), for discussion amongst DoC-SIG members. The final version of the questionnaire (in which comments and suggestions from the LISTSERV forum were taken into account) was launched in April 2017 on Survey Monkey. Results of the survey will be presented examining international practices across treatment settings for pediatric DoC patients following acquired brain injuries.

Visuo-Behavioural Outcome in Early Occipital Brain Damage in An Infant

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A case study of a traumatic brain injured infant who sustained a subdural haematoma in the occipital area of the brain following a fall from a bed is presented. A CT brain scan revealed significant and rapid expansion of the subdural blood accumulation with associated loss of alertness although primary pupillary responses were intact. After undergoing an emergency craniectomy procedure to remove the haematoma, the infant was assessed to have suffered severe loss of visual-motor eye and hand tracking function with severe deficits in his primary early social interactions observed. As a consequence, patient's praxis in his immediate environment especially during interactions with his primary caregiver in the period of early developmental milestones was severely disorganized. This. behavioral interventions aimed to re-establish head orientation, hand coordination, finger-face touching and later crawling and exploratory behaviors was systematically rehabilitated. In addition, maternal training in guiding these early rehabilitative initiatives were undertaken. This case study provides insight into the reorganization of visual-motor behaviours essential for the development of early praxis essential for the establishment of motoric skills requisite for early concept development using the sensation of touch.

Self-Reported Fatigue and Psychological Symptoms Among Young Adult Survivors of Pediatric Brain Tumors

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Aim: The aim of this study was to investigate levels of psychological distress and symptoms of fatigue among young adult survivors of pediatric brain tumor (PBT).

Methods: 71 former PBT-patients at Oslo University Hospital, Norway, completed the Fatigue Questionnaire (FQ) and Symptom Check List 90- Revised (SCL- 90- R), as well as a questionnaire on demographic information.

Results: Levels of obsessive-compulsive symptoms were significantly higher in both female ($p = .01$) and male participants ($p < .05$) compared to normative data. Male participants reported significantly more phobic anxiety compared to female participants ($U = 392$; $z = -2,517$; $p < .05$), and normative data ($p < .05$). Fatigue caseness in PBT survivors was almost twice as frequent compared to the normal population (21,7% and 11%, respectively). 16,7% of male participants and 5% of female participants met the criteria for caseness of overall psychological distress (caseness of Global Severity Index [GSI], defined as T-score ≥ 65). Level of mental fatigue were higher in PBT survivors treated with radiation treatment ($U = 234,5$; $z = -2,136$; $p < .05$), and shunt surgery ($U = 167,5$; $z = -2,885$; $p < .01$). Supratentorial location showed higher levels of anxiety ($U = 362,5$; $z = -2,746$; $p < .01$), GSI ($U = 394$; $z = -2,357$; $p < .05$), obsessive-compulsive symptoms ($U = 402$; $z = -2,26$; $p < .05$), interpersonal sensitivity ($U = 405$; $z = -2,226$; $p < .05$), and psychoticism ($U = 427,5$; $z = -2,124$; $p < .05$) compared to non-supratentorial location. Epileptic seizures were significantly associated with interpersonal sensitivity ($U = 257$; $z = -1,988$; $p < .05$) and anxiety ($U = 255$; $z = -2,014$; $p < .05$). Radiation significantly predicted fatigue caseness ($p = .022$), as well as shorter time since treatment completion ($p = .011$).

Conclusion: The increased level of obsessive-compulsive symptoms in PBT is most likely a reflection of increased subjective cognitive impairment, as a majority of items in this SCL-90-R index basically cover cognitive function. Overall findings indicate normal levels of fatigue and psychological symptoms in young adult survivors of PBT compared to normative data. However, certain factors, i.e. treatment factors, PBT-location, and epileptic seizures, were significantly associated with higher levels of psychological distress compared to the normal population. Furthermore, findings indicate several associations between fatigue and overall psychological distress levels. This knowledge underlines the need for long-term interdisciplinary follow-up, and forms a basis for advising health and educational professionals on suitable strategies in the follow-up process.

Social Participation AND Navigation (SPAN): Pilot Test of An App-Based Coaching Intervention with Teenagers with Acquired Brain Injuries

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Teenagers (teens) with acquired brain injuries (ABI) often experience limitations in social participation. Evidence-based interventions to promote social participation for teens with ABI are lacking despite evidence that social participation is critical for successful outcomes across the lifespan. To address this need we developed and pilot-tested an app-based coaching intervention for teens with ABI: Social Participation And Navigation (SPAN).

Research aims: To examine the feasibility and usability of SPAN and the extent to which teens with ABI make improvements on measures of social participation and related constructs at completion of SPAN.

Methods: SPAN consists of three components: iPhone goal setting-planning app, website with tips and topics, and up to 10 weekly videoconferencing sessions with trained college student coaches. Pre- and post-test measures included the Child Behavior Checklist (CBCL)/Youth Self-Report (YSR), and social participation measures designed for this study. Post-SPAN usability surveys also were completed. Participants (n=13) were ages 14-19.5 (8 female/5 male); 9 with moderate/severe traumatic brain injury (TBI) and 4 with brain tumor (BT). Descriptive statistics were used to examine usability survey results and number of goals achieved. Cohen's d effect sizes were used to examine pre- to post-test changes.

Results: Overall, teens with TBI improved (small to large effect sizes) on measures of social participation (increased confidence and satisfaction); and the CBCL/YSR (increased social competence; decreased social behavioral problems), but there were mixed results for teens with BT (parent measures showed improvements and teen measures did not). All but one teen achieved at least one goal (Mean=3 goals achieved). Teens and parents reported that coaching sessions were beneficial for providing emotional support and helping teens identify and achieve social participation goals. Many participants found the iPhone app to be challenging to use and parents of teens with BT thought the tips and topics did not fully address their teens' needs.

Conclusions: Pilot results suggest that the SPAN coaching was feasible to implement and viewed favorably by participants. All but one teen achieved at least one goal despite challenges reported with the app. Pre-to-post-test results were promising based on measures completed by teens with TBI and parents of teens with TBI and BT. It is possible that teens with BT did not show improvements on most of the pre- post-test measures because their baseline scores indicated less challenges or they might have become more aware of their challenges during SPAN. Also, SPAN was originally designed for teens with TBI and not all of the SPAN content (tips, topics, training) were geared to teens with BT. Future modifications are needed to tailor SPAN for teens with BT and other populations and to improve the app's usability.

Demographics, Injury Characteristics, and Cognitive and Somatic Symptoms After 6 Months in A Norwegian Pediatric Traumatic Brain Injury Sample

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Objectives: Data regarding occurrence, outcome, health services utilization, and unmet treatment needs following pediatric traumatic brain injury (pTBI) has been lacking in Norway. The study presents preliminary demographics and injury characteristics, along with self- and parental reported symptoms six months post-injury.

Methods: From Jan. 2015-Dec. 2016, children aged 1-16 years admitted with TBI to the trauma referral center (Oslo University Hospital) have been enrolled in a European follow-up study; CENTER-TBI (<https://www.centertbi.eu/>). This provides a representative sample of hospitalized pTBI in need of neurosurgical assessment in the South-East health region of Norway, covering a population of 2,8 mill. In extension of the CENTER-TBI study, functional, emotional and neurocognitive outcome was assessed. Demographics and injury characteristics were extracted from medical journals. Children over 7 years and their parents completed a 20-item questionnaire addressing a variety of cognitive and somatic post-concussive symptoms (Health and Behavioral Inventory – HBI) six months post-injury. The HBI is rated on a 4-point scale from 0 to 3, ranging from “never” to “often”.

Results: Fifty-three children have been enrolled (19 girls and 34 boys). At the time of injury, forty children (75 %) were 7 years or older. Thirty-one (62 %) were classified as having mild TBI, 10 moderate (20 %), and 7 severe TBI (14 %), according to Glasgow Coma Scale (GCS) score in the acute phase. Length of stay in the trauma unit ranged from 1 to 60 days, with a median of 4. Causes of injury were transportation accidents (n=22), falls (n=17), sports accidents (n=10), and four due to other causes. For the children under 7, the most common cause was falls (53 %), with transportation accidents being most frequent for the older children (48 %). By April 1st, 2017, 33 children between 7 and 16 years (18 boys and 15 girls) and their parents have completed the HBI 6-months post injury. Symptom reports were overall low, but the children reported most problems regarding forgetfulness (mean 1.37), concentration (1,15) and distractability (1.08). The parents rated their children highest on concentration (1.37) and distractability (1.37), followed by attentional challenges (1.22), and the somatic symptoms headache (1.15), increased tiredness (1.07) and being easily tired (1.15).

Conclusions: The present sample of pTBI has a proportion of mild TBI (62%) similar to hospitalized children in previous studies (1). Six months after-injury, both parents and children reported attentional problems as the most troubling sequelae. Additionally, the children reported memory problems. Interestingly, the parents tended to report more somatic problems in terms of headache and fatigue than the children.

1. Crowe L, Babl F, Anderson V, Catroppa C. The epidemiology of paediatric head injuries: data from a referral centre in Victoria, Australia. *J Paediatr Child Health* 2009;45(6):346---50.

A Family Intervention Designed by Families: Developing an Online Problem-Solving Intervention for Children (9-12 Years) Who Have Survived a Brain Injury

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Background and aims: Wade et al. developed an online problem-solving intervention, Teen Online Problem-Solving (TOPS), to enhance coping strategies in children who have survived a traumatic brain injury (TBI) and their families. To date, research has shown promising outcomes, however, Wade et al. consistently find that children under the age of 13 have difficulty engaging with, and benefiting from, TOPS. To help address this evidence gap, and to optimise intervention gains for younger children with TBI and other types of brain injuries, the current study aimed to develop an intervention for families of children with acquired brain injury (ABI) aged 9-12 years.

Method: An intervention mapping approach was utilised. Phase 1 (reported here) involved: completing focus groups with parents of children with ABI aged 9-12 years (n=3), children with ABI aged 9-12 years (n=2), clinicians (n=5), and education professionals (n=5). Focus group data were coded and analysed using a thematic approach in NVivo10.

Results: Needs were identified for cognition, communication, peer relationships, emotion, and behaviour. Themes related to domains of attitude of others (to disability), loss (of what could have been), and independence (of child from family) were also identified. Suggested modifications to TOPS included: separate content for parents and children, delivery in school and home, sessions for specific aetiologies, less text, and more activities.

Conclusions: Children with ABI, their parents, health and educational professionals identified common domains of need for children with ABI aged 9-12 years. Parents and health professionals also identified the limitations that other people's attitude and understanding of ABI and disability can have on child participation. Based on these findings, adaptations and modifications to TOPS will be piloted using single case experimental design (SCED) in Phase 2 of the study.

A Review of Smartphone Apps for Concussion and Traumatic Brain Injury: What is Available and What is the Evidence?

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Background: Numerous smartphone apps for individuals who have sustained a traumatic brain injury (TBI) have been developed over the past several years. Importantly, apps are not pre-screened for quality prior to release to iTunes (for iPhones) or Google Play (Android phones). As a consequence, apps may make unsubstantiated claims, such as stating they will improve functioning after a concussion. Overall, a hodgepodge of apps relevant to TBI is available on the marketplace, and few existing guidelines are available for patients, families, coaches, and clinicians to critically evaluate whether a TBI app is grounded on valid tools and evidence for clinical benefit.

Aim: We have three aims: (1) to map the number and type of smartphone applications available for concussion and TBI, (2) to evaluate whether the apps are based on recognized and valid methods, and (3) to investigate whether claims made by apps are supported by empirical evidence.

Methods: To identify smartphone apps, we searched iTunes and Google Play using keywords: “concussion”, “traumatic brain injury”, “TBI” and “head injury”, and also completed a web search. The purpose of each app and any claims made about it were extracted, and a search for best available evidence was performed.

Results: In total, 71 apps met our inclusion criteria. 36 apps were related to assessment of whether a concussion had occurred, 11 related to education (e.g. prevention and information about common symptoms following injury), 9 related to treatment/management of symptoms following a concussion, 8 related to impact sensors to detect and estimate the amount of force applied to the head, and 7 related to tracking symptoms over time post-injury. To the best of our knowledge, no randomized controlled trials have been published demonstrating that the use of any particular concussion app leads to clinically meaningful benefits compared to not using the app. Other critical problems include the failure to cite sources of information and inappropriately marketing established methods and tools validated for use by healthcare professionals to laypersons who are not properly trained to interpret the findings.

Conclusions: The lack of evidence to support the use of concussion apps provides an opportunity for clinicians, scientists, and developers to create apps and conduct research that demonstrates the ability of apps to improve the care of individuals following concussion.

Erythropoietin Attenuates the Brain Edema Response Following Experimental Traumatic Brain Injury

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Background: Injury mechanisms in brain trauma (TBI) include several cascades of events such as release of excitotoxic molecules, metabolic challenges, inflammation, breakdown of the blood-brain barrier (BBB) and cell swelling, which can finally lead to cell death. There are currently no available pharmacological treatments that convincingly counteract secondary injuries and/or improve long-term functional recovery after human TBI. The aim of this study was to explore erythropoietin (EPO) as a therapeutical intervention in experimental traumatic brain edema. EPO has neuroprotective effects in multiple injury models, however the effect on edema and mechanisms involved are less well explored.

Method: Male SD-rats were subjected to blunt, controlled TBI. Animals were randomized to EPO 5000IU/kg (EPO-group) or saline (control group) intraperitoneally within 30 minutes after trauma and once daily for 4 consecutive days. Brain MRI, immunohistofluorescence, immunohistochemistry and quantitative protein analysis were performed at day 1 and 4 post trauma.

Results: TBI resulted in persistent midline-shift and a decrease in apparent diffusion coefficient (ADC) post-TBI, indicating hemispheric enlargement mainly due to cytotoxic edema. The tight junction protein zona occludens 1 (ZO-1) decreased by 25% and was associated with an 18% increase in IgG permeability, indicating BBB dysfunction following focal TBI. AQP4 protein was decreased 20% at day 1 post injury. Disrupted BBB integrity was still present at day 4. EPO treatment significantly prevented the loss of the tight junction protein ZO-1. Further, EPO attenuated the decrease in ADC after trauma, suggesting a reduction of cytotoxic edema. EPO treated animals demonstrated a significant reduced IgG leakage, indicating that EPO contributed to preserve BBB integrity and reduce vasogenic edema. AQP4 protein expression in the perilesional area was conserved in the EPO-group.

Conclusion: We show that post TBI administration of EPO decreases early cytotoxic brain edema and preserves structural and functional properties of the BBB, leading to attenuation of the vasogenic edema response. The data support that the mechanisms involve preservation of the tight junction protein ZO-1 and the water channel AQP4 and indicate that treatment with EPO may have beneficial effects on the brain edema response following TBI.

Traumatic Brain Injury in Childhood - Stockholm Statistics and Follow-Up Using MPAl-4

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Management of TBI in children <18 in the Stockholm region, with a population of >2 million, takes place at Astrid Lindgren Children's Hospital at the Karolinska University Hospital. The aim of this ongoing study is to measure outcome after childhood TBI in Stockholm. The neurorehabilitation program was reconstructed 2007 to include three integrated multi-disciplinary teams - all offering individualized rehabilitation based on injury severity and neurological dysfunctions. Here we report the first part of the study on patients prior to 2007.

Method: Review of medical records of previous healthy individuals 1- 18 years that suffered a mild, moderate or severe TBI during 1993-2007 and received rehabilitation assessment/interventions. These patients were 2013-2014, by a personal letter, invited to participate in a telephone interview using the Mayo-Portland Adaptability Inventory-4 (MPAI-4). The study was approved by the Stockholm Regional Ethical Review Board.

Patient data: 74 pediatric patients received rehabilitation for TBI. Calculated incidence based on population: 1,2/100000. 65% male, 35% female. Mean age 12 (range 3,5- 16,3). Causes: traffic 50%, falls 16,2%, sports 14,9%, assaults 2,7%, "other" 16,2%. GCS > 8 or =8: 63,5%. GCS <8: 36,5%. Mean ICU stay: 4,7 days. Mean in-patient ward: 14 days. The major brain injury location was registered in 73%: Frontal 35,2%, central/deep 22,2%, temporal 22,2%, occipital 16,7%, parietal 3,8%. DAI was detected in 27%.

Follow-ups: 16/74 patients agreed to participate in the survey; 15/74 were available for a telephone interview. The distribution of injury cause, brain injury localizations and GCS scores were similar to the whole group. Eight females (53%), seven males (47%) responded.

Outcome: In our follow-up group, the mean total MPAI-4 score was 21, indicating an overall relatively good outcome (distribution -38 and 45). Mean scores in the Ability and Adjustment areas were 31 and 32, respectively, indicating mild difficulties in both areas (-4 to 57 in Ability, -6 to 58 in Adjustment). In the Participation area the mean score was 21 (7 to 39).

Discussion: Patients suffering childhood TBI in Stockholm report relatively good outcomes when assessed at least 7 years after injury. Outcomes are compared to the MPAI-4 standard Sample population with moderate to severe brain injuries. In particular, the Participation index indicates that societal participation in our group is overall good, although scores both for Ability and Adjustment indicate mild difficulties. Limitations in our material include low number and response rate (20%). The study cohort was young and included exclusively TBI.

Scope: We are now extending the study to include TBI patients from 2008 and onward. Results will be stratified into cohorts prior to and after 2007 to analyze whether the extended neurorehabilitation program established 2007 affects long-term outcome after childhood TBI.

30 Year Outcomes after Severe Traumatic Brain Injury in a Pediatric Population

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Background: The pediatric traumatic brain injury (TBI) population may have pronounced and persistent deficits in neuropsychological, behavioral, adaptive and academic outcomes. Interruption of normal developmental capabilities may occur in a pediatric TBI patient as they age, which is not appreciated in the adult TBI patient. However, long term follow up of pediatric samples has been limited. The question remains whether these deficits continue to be more pronounced and persistent years after the injury. The purpose of this study is to describe the functional outcomes of subjects less than or equal to 18 years old at the time of severe TBI (pediatric-onset) relative to those subjects greater than 18 years old at time of severe TBI (adult-onset) approximately 30 years after injury.

Methods: Thirty-two patients with severe traumatic brain injury (GCS \leq 9) who were previously enrolled in a study at a Level One Trauma center during the 1980s were re-contacted. Participants completed a detailed health questionnaire and underwent the Telephone Interview for Cognitive Status-modified (TICS-m) to evaluate cognitive function. Statistical analyses were calculated for group differences using a Pearson's Chi-Square test where all cell values remained five or above, and where this was violated Fisher's Exact test was used instead. Statistical significance was accepted as p value < 0.05 ; all tests were two-tailed.

Results: Of the 32 participants, 19 (56.25%) were over 18 years old at time of injury (mean age 30.5 years) and 14 (43.75%) were less than or equal to 18 years old at time of injury (mean age 13.7 years). Follow-up duration was 30 years (mean 29.66, median 29.00) from date of injury. Fifty-three percent of the population had abnormal cognitive status (TICS-m score \leq 32) with the mean TICS-m score for the pediatric-onset group being 29 and the adult-onset group being 34 ($p=0.0852$). With regard to the pediatric-onset participants, 62% had completed at least some college, 50% reported working either full or part-time, 64% handled their own finances (vs 83% of adult-onset), and 79% could climb one flight of stairs (vs 94% of adult-onset). However, patients with adult-onset TBI were more likely to report at least one arrest compared to pediatric TBI patients ($p=0.048$, 66% vs 31%).

Conclusion: This study provides functional outcomes of severe pediatric TBI patients 30 years after injury and compares them to their adult counterparts. Of the two groups, pediatric-onset TBI patients reported more severe functional outcomes. Though within the margin of error, the overall trend suggests there may be a difference between pediatric-onset TBI patients and adult-onset TBI patients 30 years after injury. Certainly, further research is needed to help clarify long term functional outcomes of severe pediatric-onset TBI patients and how they differ from the adult-onset TBI patient.

A Case Review: 4 Hours of Rehabilitation a Month Over Three Years - What Can Be Achieved! Transition from Adolescence to Adulthood

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Introduction: AB was a 19 year old pedestrian involved in an RTA. She suffered a severe traumatic brain injury (GCS 5/15). Initial assessment for home-based rehabilitation was completed 3 months' post injury. Assessment indicated she had significant yet subtle difficulties. These impacted on her educational, vocational, social and leisure participation. Symptoms included fatigue, irritability, reduced cognitive processing, difficulties with concentration and difficulties with verbally mediated information. A home-based programme started with intervention from a rehabilitation support worker. This moved to less intensive intervention delivered by an occupational therapist once AB had returned to a more structured routine. Ongoing support to the family focused on adjustment, understanding brain injury sequelae and teaching strategies to support their daughter.

Method: The number of hours delivered in the programme were recorded and analysed to determine the level of support provided to AB, her family and other agencies. The family completed the Measure of Process of Care ¹ and rehabilitation goals were reviewed.

Results: Analysis of hours - Total 148.50 hours of intervention were delivered. AB had direct contact time of 57.50 hours (\bar{x} 1.70 hours per month). Family received direct support of 60.75 hours, (\bar{x} 1.80 hours). Liaison with college/university lecturers, psychology, and SLT = 30.25 hours (\bar{x} \leq 1 hour per month).

Functional outcomes achieved by AB:

- Completion of Level 2 college course in Beauty Therapy
- Independent travel to college using public transport
- Completed second year study of University course
- Independent living in shared accommodation with peers
- Part-time job in prestigious make-up store for professionals
- Contributed to hair and make up for a video shoot for a well-known singer

C) MPOC 20

- Indicated we were family centred

Discussion: Limited intervention enabled AB to achieve goals improving her educational and vocational participation. Critical reflection on the case indicated that using SMART goals would allow for better outcome measurement. A baseline for family centred care would allow us to measure change over time and not just at the end of the programme. We propose having a consistent professional to support AB and the family with their understanding of brain injury and the consequences in everyday life was important to the successful outcomes of the programme. Equally important was the family centred approach taken. We hypothesize that working less intensively but for longer facilitated AB's increased insight around fatigue and social communication. A significant aspect of the programme was liaising with her university to ensure AB was supported as she studied at a higher level. AB hopes to transition to third year of university to top up her course to a degree and gain work in the field of TV hair and Makeup design.

References: King, S., Rosenbaum, P., & King, G. (1995).

Automatic Classification of Adolescents with Sports Related Concussion

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Introduction: A major challenge in the management of concussion stems from the lack of knowledge of the relationship between symptoms, cognitive function, and the evolving changes in brain physiology and function. This is due, in part, to the lack of inexpensive, accessible, objective brain-based tools that provide information about the underlying brain recovery on which to base return to normal activity. Although EEG has been used for more than 80 years to study cognitive processing, recent technological advancements have renewed interest in using EEG to understand the dynamics of brain activity. High-density EEG systems combined with machine learning algorithms are increasingly recognized as powerful tools for non-invasive evaluation of dynamic brain activity

Objectives: We used recent advances in the application of pattern recognition algorithms and machine learning to classify adolescents with and without concussion using resting state EEG. The objective of this study was to evaluate the accuracy of classifying adolescents with concussion within one month of injury using resting state EEG data.

Methods: A total of 53 adolescents took part in this study. The control population comprised of 33 healthy athletes (all male; mean age: 15.8 ± 1.3 years) recruited from the Whitecaps FC Residency soccer program in Burnaby, British Columbia, Canada during 2014. The concussed population comprised of 22 athletes (all male; mean age: 16.0 ± 0.9 years) from the same soccer program and through minor league ice hockey teams in Vancouver during the same year. All concussed athletes had a clinical diagnosis of subacute (≤ 3 months previously) sports-related concussion as determined by a physician.

Results: The classifier separated the datasets into 2 distinct clusters: concussed and controls. The leave-out validation process resulted in a mean overall accuracy of $97.80 \pm 13.88\%$, with a mean sensitivity and specificity within 4% of the overall accuracy. We found higher specificity in correctly identifying control subjects than in correctly identifying concussed subjects.

Conclusions: We present a novel approach to classifying concussion using a machine learning approach based on 5 minutes of resting EEG data from 27 locations on the scalp using a combination of EEG metrics. The results from this pilot study with a limited set of EEG features is promising and suggests that 5 minutes of resting state EEG combined with machine learning has the potential to accurately detect sports related concussion. Using resting state signals is advantageous for children and adolescents who are prone to getting distracted easily and may not be able to stay on task for long periods of time that are usually necessary for evoked based protocols. Future work will focus on identifying sources most sensitive to change in the concussed population.

Sunnaas Rehabilitation Hospital - A Presentation of Unit for Children and Youth

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Introduction: Sunnaas Rehabilitation Hospital is Norway's largest specialist hospital in the field of physical medicine and rehabilitation. The hospital provides multidisciplinary rehabilitation for patients with complex functional impairment following illness or injury. The hospital provides services at both regional and national levels.

Patients and rehabilitation team: Unit for children and youth was opened in the fall of 2015, as the only rehabilitation unit in Norway of its kind. Service is offered to children and youth under 18 years of age with acquired spinal cord injury (SCI) or acquired brain injury (ABI). The unit has a capacity of five in-patients at a time. Since the opening of the unit, we have had 46 pediatric patients with SCI and 53 with ABI. Average length of stay for rehabilitation following injury or illness was 57 days. Follow-up treatment lasting 5 – 10 days was given to 36 children. The multidisciplinary team consists of medical doctors, pediatric neurologist, medical nurses, physiotherapists, occupational therapists, social worker, psychologist/neuropsychologist, special ed. teachers, speech therapists and dietitian.

Programs: Rehabilitation following injury or illness can last up to 3 months for ABI, and up to 6 months for SCI. The ABI-group is offered a short follow-up stay, usually one year after the incident. In addition, we offer second opinion and problem-solving assessment stays for ABI. The SCI-patients are offered life-long follow-up service at Sunnaas rehabilitation hospital.

Discharge: Preparing the children and their families for everyday life at home is considered to be of great importance. Therefore, we always contact their home community and ensure that further rehabilitation and follow-up of the health care needs we consider important are continued at home, by for instance physiotherapists and occupational therapists. We also contact the patient's school, and plan the child's return to school carefully. We strive to facilitate the return to home by giving the family extended weekend-leaves with school-visits regularly before discharge.

Experiences and future plans: Rehabilitation services for children with SCI and ABI is highly needed. The importance of providing a multidisciplinary rehabilitation program as well as involving the patients family and home community, are factors we consider to be of great value.

The multidisciplinary team experiences a need for long term follow-up also of the ABI-group, similar to the life-long service offered to the SCI-group which is well established at Sunnaas Rehabilitation Hospital. The ABI-patients need reconsideration and advice on how to live with the injury-related symptoms, as the manifestation over time often changes in an ABI acquired in childhood. In the future, we wish to offer specialized follow up stays with programs offering cognitive training, intensive hand training, spasticity assessment, coping and learning strategies for families and local health care services for these vulnerable children.

Integration of Youth with Brain Injury Acquired Early in the Childhood into the Society

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Brain-injury is the most frequent cause of death for children in Estonia as well in the whole European Union. 32 000 children and youngsters get deadly injuries as pedestrians, while riding a bike or a motorcycle or simply as the results of a fall every year, millions of children are injured every year and have to suffer the consequences of irreversible changes in their status of health, being the basis for lifelong disability. The cases of death and injuries, resulting in difficult defects for long years or even for the rest of the life, could be mostly prevented. The children's traumatism could occur in various cases: medical, social, juridical, psychological, bound to handicap, constant deflection in the health of a child or a youngster. Unfortunately the theme given above, has met poor feedback in Estonia. Baltic States belong to the group of European Union countries with the highest level of children's traumatism. Brain-injury could cause long-lasting or irreversible changes in personality, characteristics, speech, analysing, moving and succeeding with everyday life tasks. It is hardest to understand and cope with the consequences of the brain-injury of a lover family member.

The research concentrates on examining the outcomes and effects of a long-lasting brain-injury acquired in childhood and the integration youth to the society. The focus of the work was placed on children who have experiences a brain-injury in the age of a preschooler, while in school or as a teenager. It is important to evaluate the educational possibilities, learning a profession, managing with everyday social life and becoming independent, examine the choice of hobbies and state of health. The interviews in the empirical part of the thesis were carried out on the basis of half-structured questionnaires.

As it appears in the research that the life-quality and independent subsistence of the youngsters who had went through a difficult brain injury is rather low, on the other hand children with moderately difficult or light brain-injury are integrated on a bigger scale to the society, are educated and mostly satisfied with their life.

Hypothesis raised has found its proof that going through a difficult brain injury in early childhood causes long-term disability and poor integration to the society, however children with moderate or light injury could live a usual life, besides frequent somatic disturbances and emotional lability.

The practical goal of the study was to inform the society of consequences of brain injury experienced in early childhood and apply arrangements to better the networking between various institutions (social insurance, educational, health care and local municipalities' social welfare organisations).

Keywords: severe, moderate and mild traumatic brain injury in childhood, outcome of TBI, educational and vocational background, activity daily living, life quality, social inclusion

Shaken Baby Syndrome (SBS), Prevention Through Better Knowledge

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SBS is the most severe paediatric non-accidental head injury. It can lead to death or to permanent handicap. It constitutes a major public health risk that concerns all the medical, social, legal, judicial and educational fields. In spite of a better scientific knowledge on SBS based upon an important literature of peer-reviewed studies, severe dysfunctions are still observed: Diagnosis is lately made: more than 25% of the children have previous symptoms before the diagnosis. If the diagnosis is not made, the child will not be adequately looked after, this child and other children may be left unprotected. Finally, according to French law, the child's rights as a victim of abuse will not be safeguarded. The hypothesis tested was that these dysfunctions are due to a lack of knowledge on SBS by the professionals.

Method: A questionnaire was drawn up to assess the knowledge on intensity of the movement, frequency of the recurrence, existence of sequels and their evolution over time, knowledge that SBS is a penal offence resulting in France into financial compensations, knowledge of guidelines to professionals issued by the French Authority of Health. 1-2 155 physicians, 93 judges and 640 professionals of childcare went through this test.

Results: Whatever their specialty, most professionals were not able to answer correctly. Typically, they thought that the mechanism was not necessarily violent (43 à 52%), lesions can be induced by game (48 à 60%), most often shaking is not repeated (55 à 79%), it does not trigger sequels (43 à 52%) and that sequels vanish with time. As well, they ignored that shaking is a penal offence resulting in to financial compensation (35 à 55%) and did not know the existence of official guidelines on SBS either (41 à 61%).

Discussion: Lack of knowledge in this field is detrimental to children. For instance detecting the first signs of violence is crucial to prevent reiteration. Taking adequate care of the brain-injured children is crucial to prevent sequels. Better training for everyone is the key.

1- A public hearing "Shaken baby syndrome: Guidelines on establishing a robust diagnosis and the procedures to be adopted by healthcare and social services staff". Guidelines issued by the Hearing Commission. Laurent-Vannier A., Nathanson M., Quiriau F. Et al. *Annals of Physical and Rehabilitation Medicine* 2011; 54: 600-625.

2 -A public hearing. "Shaken baby syndrome: guidelines on establishing a robust diagnosis and the procedures to be adopted by healthcare and social services staff". Scoping report. Laurent-Vannier A, Nathanson M, Quiriau F et al. *Ann Phys Rehabil Med.* 2011 Dec;54 (9-10):533-99.

Diagnostic Criteria of Shaking: A Crucial Advance into Knowledge on the SBS

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SBS is the most severe and often repeated non accidental head injury in children. Guidelines were proposed in 2011 by the French Authority of Health to help professionals make this diagnosis.

Diagnostic criteria were established based exclusively on both the lesions and the history related by the caretaker and not on the risk factors.

The method used to establish these criteria was:

- To determine which lesions are induced by mechanism often pointed out by the adults when the child is brought to hospital that is: no history, fall from a low height, play, resuscitation, hypo anoxia, childbirth, shaking with no impact.
 - and to compare them with the most frequent lesions observed in SBS: subdural hematoma (SDH) which is a key diagnostic clue and retinal haemorrhages (RH).
- Either the lesions induced are the same as those of SBS and therefore the mechanism is acceptable, either they are absent or different and therefore the mechanism is not acceptable.

The diagnostic criteria were:

In a child under one, and a history that is absent, incoherent, changes over time or is incompatible with the observed lesions or the child's age.

after differential diagnoses have been ruled out,

- a diagnosis of head injury inflicted by shaking is highly probable or even certain in case of:
 - o multifocal SDH and/or subarachnoid haemorrhage.
 - o AND RH profuse or extended to the periphery.
- a diagnosis of head injury inflicted by shaking is probable if:
 - o multifocal SDH and/or subarachnoid haemorrhage with or without any type of RH.

Moreover, from 2011 it has been possible to go further: other mechanisms have been brought forward: vaccines, apparent life-threatening events (ALTEs).

Also, knowledge on the type of lesions has improved: better knowledge of the type and location of the SDH/ lesions newly described (CT, MRI) as the rupture thrombosis of the bridging veins, the possibility of intra thecal SDH. A working group has been set up by the French Authority of Health to update the guidelines. Some lesions appeared of crucial importance:

- Diffuse subdural hematoma /with some localizations suggestive of SBS (falx cerebri, tentum cerebelli, vertex) very suggestive of SBS.
- Ruptured bridging veins.
- retinal haemorrhages multi-layered and or extended out the posterior pole to the periphery of the retina; macular rétinosis; circumferential retinal folds.

All these lesions highly specific for severe traumatic injury (SBS, fatal car accident/ crush head injury, fall from a great height) offer in a non-accidental context a significant element in favour of shaking.

The diagnosis criteria were updated from these results and will be published by the end of 2017

In conclusion, because shaking is often recurrent, these updated criteria should help professionals make an accurate and early diagnosis of shaking and therefore prevent new episodes of violence.

Skill Learning Following Severe Traumatic Brain Injury is Associated with Child's Phase of Recovery: Preliminary Findings

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Background: Skill learning is learning as a result of repeated exposure and practice, which encompasses independent explicit (response to instructions) and implicit (response to hidden regularities) processes. Childhood traumatic brain injury (TBI) often causes widespread deficits in cognitive functioning which tend to vary according to child's phase of recovery. Considering the importance of skill learning in daily functioning, the topic of skill acquisition should be a primary focus when addressing consequences of TBI in children. However, little investigation has been done to understand the implications of childhood TBI on skill learning abilities and whether the ability to acquire skill learning is related to short and long term recovery processes.

Methods: Participants were 24 children following severe TBI (41% girls) aged 9-17 (M= 12.34; SD=3.1). Participants were recruited from the Pediatric Rehabilitation Department at the Edmond and Lily Safra Children's Hospital, Israel. Half of the children were examined during the acute stage of recovery (i.e., 3-6 months post injury) and half were examined during the more chronic stage of recovery (i.e., 1-4 years post injury). All children performed two different skill learning tasks: (1) the serial reaction time (SRT) task, a simple motor-perceptual task, in which learning is examined via a repeated sequence of finger movements, and (2) the probabilistic classification learning (PCL) task, a cognitive learning task in which cue-outcome associations are gradually learned over many trials.

Results: Children in the acute group were slower in reaction time and did not demonstrate implicit learning in both skill learning tasks; however they did show an improvement in reaction time throughout performance on the SRT indicating that they have learned the explicit component of the task. In contrast, children in the chronic group demonstrated a learning pattern indicative of implicit and explicit learning in both tasks.

Conclusions: The insult of childhood TBI may cause depressed ability to acquire implicit skills during the initial phases of recovery. During these phases children are also slower in response time; however they do seem to possess a general mastery of the task indicating an ability to improve performance across repeated learning trials. In contrast, long-term ability to acquire such skills is not diminished and implicit skill learning is relatively preserved among children in the chronic phase of recovery. Understanding of these differences in skill learning abilities among children following severe TBI is essential to guiding such children on their track towards recovery. Further work to assess the effects of the time since injury and the changes occurring during the stages of recovery is needed to broaden this picture.

Cross-Cultural Pediatric Acquired Brain Injury Cases

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The two case studies will be compared in terms of cross-cultural differences that may affect methods of assessment, case conceptualization and treatment plans.

Case One: The following refers to a case study of a brain-injured child with an initial Glasgow Coma Scale (GCS) score of 6/15, a depressed skull fracture with underlying brain contusions and punctate hemorrhages, small extra-axial collections in the subarachnoid space and mildly raised intracranial pressure is presented. Patient was four years of age when she was knocked down by a motor vehicle. She was taken to theatre for wound debridement and was given an anti-seizure prophylaxis. However, neurosurgeons found that she was not a candidate for surgical intervention.

Patient regained consciousness after one month and full orientation after two months. At the time of her discharge, she was unable to articulate speech in full sentences, had difficulty identifying family members and showed an unsteady gait pattern. In addition to an extended period of physiotherapy, patient continues to show persistent right hemiparesis. Neuropsychological assessment showed that the severity of the right hemiparesis correlated with the severity of aphasic symptoms she evidenced in her expressive speech. However, whilst she was unable to regain her vernacular speech patterns, her parents reported that an alternate language was easily acquired by the patient suggesting that permanent language pathways that were initially formed in early childhood were damaged and collateral pathways facilitating the acquisition of an alternate language was becoming apparent. The implications for rehabilitation for young children with language disorders after brain damage are discussed.

Case Two: The following is a case study of a 10-year-old male who suffered from a severe traumatic brain injury just a few hours post-birth. He suffered a fall that went unreported for a few hours. Later it was discovered that he had suffered a head injury resulting in a subdural hematoma and facial contusions and treatment was administered.

The patient was brought in for an evaluation to assess his neuropsychological functioning 10 years post-injury. Neuropsychological assessment revealed deficits in the areas of psychomotor speed, complex attention, cognitive flexibility, executive function, motor speed and simple attention. The patient's presentation during the testing was characterized by qualitative observation of behavioral disturbances that could have been viewed as oppositional. Teacher and parent reports provided indications of real-world behavior corroborating difficulties in the neuropsychological areas of functioning noted above. The results of the neuropsychological assessment and behavioral observations were used to plan specialized treatments for the patient targeted at attention, executive functioning, and behavior.

Memory for Autobiographical Events Following Severe Paediatric Traumatic Brain Injury: A Case of Selective Deficits That Gradually Emerge from Childhood into Adolescence

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Background and aims: Episodic autobiographical memory (AM) involves recollection of personally experienced events that are rich in contextual episodic details and scaffolded by personal factual (semantic) details. AM develops through childhood and adolescence, and serves as a reference library that guides our current and future actions. The integrity of AM is mediated by the very brain structures and cognitive skills that are vulnerable to traumatic brain injury (TBI), yet no published study to date has examined AM in paediatric TBI. The aim of this study is to examine the impact of severe paediatric TBI on recall of AMs and examine whether outcomes relate to developmental factors (age at assessment and age at injury) and residual cognitive deficits (IQ, anterograde memory and executive skills).

Method: This cross-sectional study included children with severe TBI (n= 14) and healthy control participants (n=20) comparable in age and sex. All participants completed the Child Autobiographical Interview and a battery of neuropsychological tests.

Results: Compared to control children, children with TBI recalled significantly fewer episodic details (U (59) = 209.50, p=.04, d=0.56), but the groups were comparable in the number of factual details recalled. Moreover, the phenomenological qualities (i.e., emotional change, visual intensity, strength, etc.) of re-experienced AMs were comparable in the two groups. Deficiency in recall of episodic details emerged over the course of development, as the number of episodic details increased with age in typically developing children ($\rho=.68$, $p<.001$), but not in children with TBI ($\rho=-.01$, $p=.97$). Moreover, recall of fewer event details was related to poorer anterograde verbal memory and lower FSIQ ($\rho=.60$, $p=.02$) in the TBI group. The deficits in recall of episodic details, however, were eliminated when specific prompts were provided.

Conclusions: Our study reveals that children who have sustained severe TBI are at risk of deficits in recall of AM, which emerge from childhood to adolescence. These deficits may have significant functional implications, as AM is purported to guide our behaviour, play a significant role in social interaction and provide a sense of self-continuity. Implications of these deficits for adaptive living and approaches to remediation will be discussed.

Performance on A Brief Computer-Based Cognitive Screening Test for Adolescents and Young Adults: Preliminary Data Collected with An Acute Injury Sample

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Mild traumatic brain injury, has increasingly been recognized as an international healthcare crisis. Recent research has emphasized that timely identification of the injury can lead to improved outcomes. Identification of injury is dependent on early identification. However, there are currently few validated screening tools developed to identify concussion, particularly when the injury is mild. ImPACT Quick Test (QT) was developed specifically to identify both cognitive and self-reported symptom elements of concussion. This IPAD based test can be administered in under ten minutes and provides immediate feedback on performance of the patient in comparison to a large age-referenced database. Furthermore, ImPACT QT evaluates the cognitive domains of cognitive speed as well as attention and memory.

Procedure: a total of 58 concussed patients between the age of 12 and 18 (mean age= 15 years) were evaluated within 2 to 7 days post injury. The performance of the injured group was compared to an age-matched control group. The performance of the injury group was compared to the normative group by the calculation of standard (z) scores with a mean of 0 and a standard deviation of 1. Our hypothesis was that more acutely injured patients would perform more poorly compared to an aged matched normative sample.

Results: The concussed group performed more poorly on both time-based reaction time measures and memory-based indices of ImPACT QT. Performance was particularly poor for patients who reported symptoms or who demonstrated signs of concussion at the time of injury. Poorest performance was also demonstrated for patients evaluated closer to the time of injury.

Discussion: Cognitive performance during the acute phase of injury following concussion (from the day of injury to one week post-injury) can be documented via a brief, tablet based screening test that evaluated both cognitive speed and memory. Patients with either observed signs OR self-reported symptoms obtained lower scores than patients who, although referred for evaluation, did not display signs or symptoms of concussion.

A Novel Device to Simulate Traumatic Brain Injury in Children

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Traumatic brain injury (TBI) is a major health concern in children and young adults as it has been proposed as a risk factor for the development of subsequent neurologic diseases that often lead to irreversible brain damage or death. A meta-analysis of TBI identified several key associations, notably etiological pathology and complications from the nature of the injury and various clinical presentations. The exact mechanism of cellular injury is not well understood. This novel device allows for varied shockwave propagation to simulate cellular injury and independently study the role of shockwave pressure change and shear force damage.

The purpose of this novel device is to determine the overall consequences of traumatic exposure to brain tissue, and to provide a system in which tissue could be directly observed during and immediately after exposure to shockwave propagation.

Pneumatic air-gun based device that can deliver a blast via a quick release valve directly to the 96-well culture plate positioned on top of a microscope. Modulating the volume of fluid in the well allows for independent control over shear forces generated by the blast shockwaves. Laboratory controlled system with high temporal and spatial resolution. Real-time cellular imaging and analysis.

Figure A. Sequential fluo-4 calcium imaging of a dissociated primary human fetal CNS cell culture without shear.

Figure B. Sequential fluo-4 calcium imaging of a dissociated primary human fetal CNS cell with shear.

Figure C. Delta F/F in time of the cells shown in Figures A and B for 10 minutes before, during, and after the blast.

Figure D. Normalized response of two cells shown in Figure B, panel 1, indicating that the calcium response does not occur simultaneously in cells but sequentially.

Figure E. Integrated Ca²⁺ response, integral of delta F/F over time following the blast, without and with shear forces in the same well.

Figure F. Correlation ($r^2=0.99$) between integrated Ca²⁺ response following a 11 atm peak pressure blast and well fluid volume for the 3 volume conditions evaluated.

Pressure shockwaves alone, in the absence of shear, are not sufficient to trigger a response. Velocity and shear stress derived from the derivative of time dependent trajectory. Pressure measurement of the simulated field blast shockwave compared to Friedlander curve of the same peak pressure and positive phase duration.

Real-time observation of cellular response to explosive shockwaves. Screening for pharmacological compounds that may ameliorate the effects of a brain trauma. Testing materials capable of protecting cells from trauma. Identifying the best treatment and diagnostic path based on injury from head trauma.

System use to study pharmacological effects of calcium signaling in response to trauma. Search for additional signaling pathways in response to varying intensities. Expand the system to allow for study of entire organs.

Can We Make It Seamless: The Transition Process of Paediatric Rehabilitation Patients from An Acute Setting to A Non-Acute Residential Rehabilitation Unit

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The Starship Paediatric Rehabilitation Service at Auckland District Health Board and the Child Rehabilitation Service at Waitemata District Health Board – both situated in Auckland, provide a unique national rehabilitation service, in the way we work together to provide acute and non-acute rehabilitation care for patients at two different locations.

It is widely acknowledged that during a patients' rehabilitation journey, they will experience numerous delivery processes and interactions with multiple healthcare professionals, as they transition from an acute setting to the non-acute setting. The implications of this transition can be daunting for the patients and their families. It has been noted that processes at a patient and organisational level can facilitate or impede a safe and seamless transition.

Our goal is to identify that the paediatric rehabilitation service is providing an effective transition process, and if there are any other actions that would improve our current process. During this quality improvement project, we have examined the processes across both District Health Board's for paediatric rehabilitation patients, from a patient and organisational perspective. The objective was to identify factors that may be facilitating or hampering the transition of patients across services and sites. We have analysed current guidelines and transition methods, as well as carrying out patient and family surveys related to their transition experience.

When evaluating the current transition process, we discovered that there were limited guidelines and pathways around transition with little consistency noted in transition methods. The patient and family surveys revealed that families and patients felt the process was disjointed, and that there was little information around the transition process and what to expect next, resulting in feelings of anxiety and apprehension about the transition.

From our findings, we have identified that a paediatric rehabilitation pathway is beneficial. A key coordinator is required to manage the transition process for all paediatric rehabilitation patients from admission to discharge. In addition, digital technology and innovative online resources have been developed to help engage healthcare workers, patients and families with the transition process, enabling a seamless transition from one District Health Board to another.

This experience established that continuity of care is critical during the transition process; as well as clear communication between healthcare providers, external agencies and the patient and their families.

In order for success to be achieved alongside the above, a comprehensive transition pathway and care plan is essential.

Item Error Analysis in ABI Strategy Development for School Re-entry

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This presentation will illustrate the importance of utilizing both Psychoeducational and Cognitive Linguistic Evaluations in transitioning students with acquired brain injuries back to school from the acute inpatient rehabilitation hospital. The role of the Inpatient School Psychologist/Special Educator and Speech and Language Pathologist in collaborative consultation in identifying effective classroom instructional strategies, as well as accommodations and modifications necessary for a successful school return will be shared.

Further this presentation will focus on the fact that some of our pediatric patients even after having a rather serious traumatic brain injury will score on standardized tests at above average levels. However, in spite of these scores looking quite impressive on the WIAT-III, the TOMAL-2 and the S-FAVRES or FAVRES the patients are displaying some rather obvious difficulties in executive functioning skills. Therefore, at Spaulding Rehabilitation Hospital we have developed an extended testing item error analysis model of analyzing our patient's tests in addition to the traditional scoring of the tests. We have found this model to clearly and consistently show the patients deficits on at least one of the instruments mentioned, if not all of them. Having this "hard" evidence of impairment, in psychological processing skills as well as in cognitive linguistic skills that affect their communication skills is important. It allows us to document the patient's need for an RTI, IEP, and/or 504 Accommodation Plan utilizing an alternative form of assessment. Likewise, this information is helpful to the families of our patients and the child's schools. It allows us to utilize a task analysis approach to the errors and to develop as well as recommend specialized instructional and behavioral strategies needed by the patient in their home and school re-entry programs. A case study utilizing our model of item error analysis will be shared and a handout of suggested strategies for helping patients with Executive Function Disorders upon school return available.

Objectives:

1. To explain the system of Item Error Analysis of standardized test results for patients with ABI as an enhancement of hospital to school transition planning.
2. To review a case study highlighting the results of item error analysis.

Methods: Retrospective Case Study.

Results and conclusions:

1. An enhanced Psychoeducational and Speech and Language hospital discharge report is instrumental in positive hospital school transitions.
2. Parental guidance and understanding of their child's educational needs after hospital discharge are crucial in successful reintegration of the child with ABI back into the school setting.

Changes in Brain Network Organization in Children and Adolescents with Sports Related Concussion: 1 Year Follow Up

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Introduction: The relationship between symptoms and the dynamic and evolving changes in the brain is one of the major challenges in our understanding of the long term effects of concussion. Little is known about how the brain changes over a 1 year time span.

Objectives: (1) to evaluate changes in resting state functional brain networks in individuals with sports related concussion using graph theoretical approaches over a 1 year time span, (2) to evaluate whether children and adolescents differ in their pattern of recovery during this time.

Methods: A total of 21 children (mean age: 10.60 years old) and 18 adolescents (mean age: 15.17 years old) participated in this study. The concussed sample comprised of 14 athletes (mean age: 12.57 years). All concussed athletes were observed to have sustained a blow to the head and showed a change in their SCAT-3 scores. All participants took part in SCAT-3 assessment by trained research assistant at each time point. Resting state EEG was recorded using a 64-channel Hydrogel Geodesic SensorNet (EGI, Eugene, OR). EEG was recorded with a Net Amps 300 amplifier at a sampling rate of 250 Hz. Five minutes of resting data were collected while participants sat quietly with their eyes closed. A graph theoretical approach was used to characterize global and local network features. Data collection occurred at 1 week, 1 month, 3 months, 6 months and 12 months post-injury for the concussed group. Healthy controls were tested at baseline and 1 year post initial testing to account for developmental changes.

Results: Group comparisons revealed significantly increased connectivity in the (R)-frontal gyrus in the concussed group compared with age matched controls ($p < .05$) within one week of the injury similar to our previous report (Virji-Babul et al, 2014). Analysis of the trajectory of network connectivity revealed that children and adolescents showed a different pattern of recovery: Concussed adolescents showed increased connectivity within the first week of injury in the (R)-dorsolateral prefrontal cortex (DLPFC) in comparison with age matched controls and returned close to control values by 1 year post injury. Children also showed increased connectivity in the (R)-DLPFC at 1 month compared with age-matched controls but showed decreased connectivity over time with much lower values in comparison with the healthy controls at 1 year post injury.

Conclusions: We present a novel approach to identify changes in brain network connectivity following concussion using graph theory analysis based on resting EEG data. The results from this pilot study suggest that the adolescent brain continues return to control values of network connectivity in the (R)- DLPFC 1 year post concussion. In contrast, children appear to have a slower recovery and do not return to baseline values even 1 year post concussion.

The Demographics and Impact of Brain Injury in a Functioning Community Population

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Introduction: Most studies assessing the consequences of brain injury are performed via recruitment of patients seeking medical attention or retrospective review of their clinical records. Thus the consequences of brain injury have been better studied among individuals who seek medical care than among those who do not. Estimates suggest that approximately 75 to 80% of brain injuries are not treated by medical personnel, with many of those injuries occurring in childhood, and potentially repetitively through sports exposure. The purpose of this study was to investigate the demographics and consequences of brain injury in a community population.

Methods: A booth was set up within the health fair tent of the Minnesota State Fair. 653 subjects (425 female) were recruited. All subjects were assessed with an abridged version of the BAT-L screen, near point of convergence testing and an eye tracking task which has been demonstrated to correlate with oculomotor dysfunction in concussed subjects.

Results: The youngest recruited subject was 5 and the oldest was 90 years old. The mean age of recruited subjects was 47.5 (females) and 49.7 (males), with a reported level of education greater than the mean for the general population. 83% of the 653 subjects reported at least one lifetime brain injury. 11% of subjects reported greater than 8 brain injuries. Males were more likely to report a higher total number, type, motorcycle or ATV crash, being hit by a vehicle, falling from a high place, bicycling, sports or military exercise injury. There was no significant difference between males and females for injury from being physically abused, skiing, skydiving or roller-blading. Near point of convergence gradually increased with age in subjects assessed without glasses. Only 63 individuals reported ten or more injuries. Comparison of eye tracking metrics between those individuals and controls reporting zero lifetime brain injuries revealed 5 significantly different eye tracking metrics, however some of the individuals reporting numerous injuries had normal NPC and no abnormal eye tracking metrics.

Conclusions: The assessment of individuals at a state fair who enter a health tent predisposes to a selection bias for subjects interested in health maintenance. The incidence of self-reported brain injury in this functional community population (83%) is higher than previously reported in the literature, however is likely due to self-selection. Nonetheless our data suggests that many educated people with brain injury may not seek medical care, and may have spontaneously recovering injury. Most types of brain injury were more common in males, with the notable exception of injury from being physically abused. Additional study investigating innate susceptibility and resilience is needed to understand why some individuals reporting numerous injuries remain well while others are affected.

Transcortical Motor Aphasia Due to Left Subcortical Arterial Ischemic Stroke in A 9-Years- Old Girl: Subtle Persisting Cognitive Impairments After a Two-Years Longitudinal Follow-Up

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Acquired childhood aphasia (ACA) due to subcortical ischemic vascular infarcts occurs rarely. A review of the very few case descriptions of school-aged children reveals that ACA is most often characterized by a non-fluent aphasic syndrome with initial reduction (or mutism) of oral production and more preserved language comprehension. Subsequent evolution is variable, ranging from a complete recovery to an “illusory” recovery followed by the resurgence of oral and/or written language deficits.

We present here the case of a 9-year-old girl who suffered from an acute left subcortical arterial ischemic stroke involving predominantly the globus pallidus and the posterior limb of the internal capsule. The initial clinical presentation was dominated by a severe transcortical aphasia associated with fatigue, and poor attention while minor facio-brachial motor deficit rapidly regressed.

After six months, her linguistic expressive abilities had much improved, but mild difficulties of lexical access (verbal phonemic fluency, verbal flexibility and verbal selective inhibition), syntactic/grammatical diversity in oral sentence production, and oral comprehension in noisy conditions were still observed. Connected speech analysis (CIU) revealed that verbal fluency (n words/minute) and informativeness were still reduced, whereas written language (reading, written comprehension and spelling) was normal.

After two years, our patient was still following a normal academic program but her performances have diminished. She complained of oral speech (word finding difficulties) in class and with her pairs. These residual deficits have justified school adaptations and psychotherapy was started due to emotional distress. This case illustrates that longitudinal follow-up is essential for brain damaged children with aphasia in order to detect possible long-term repercussions of fine cognitive disorders on subsequent formal learnings.

The present case is in accordance with the results obtained in adults concerning the role of subcortical structures in language production (Fridriksson et al., 2007).

Development of a Consensus Classification of Physiotherapy Interventions in Paediatric Neurorehabilitation

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Background and Aim: Annually, over 40,000 children are hospitalised in the UK with Acquired Brain Injury (ABI) resulting from both traumatic and non-traumatic disease processes. Many will go on to require multi-disciplinary rehabilitation, including physiotherapy. With the aim of capturing the dose and content of paediatric physiotherapy interventions in neurorehabilitation, a tool designed to categorise key physiotherapy 'ingredients' is under development.

Materials and Methods: Core ingredients of physiotherapy interventions within paediatric neurorehabilitation were identified through systematic literature searching. Ingredients were then categorised by two researchers to derive an ontology of 'approaches' based on common characteristics. As this method represents just one means by which such physiotherapy ingredients can be categorised, expert consensus from 15 paediatric physiotherapists will be sought using a modified-Delphi survey.

Experts will be identified through their membership of the Association of Paediatric Chartered Physiotherapists (APCP's) Neuro-Disability Group which is based in the UK and Ireland. They will then be invited to complete Delphi surveys in a two-round process.

Results: Expert consensus will inform the extent to which agreement exists on the initial development of the tool, and whether adaptations to subsequent versions will be required. Quantitative data will be analysed to indicate the degree of consensus which exists among experts, whilst qualitative data will be analysed to understand reasons for this level of consensus, as well as identifying any potential additions to be included in subsequent versions of the tool.

Discussion and Conclusions: This method of classifying paediatric physiotherapy interventions is designed to be comprehensive, easily understood and clinically meaningful. Whilst focusing specifically on paediatric physiotherapy, this method utilises similar principals to that of the PRISM tool (Paediatric Rehabilitation Ingredients Measure) in offering an approach to the analysis of dose and content of therapy within paediatric neurorehabilitation. The potential benefits of the current approach could be far reaching into both the clinical and academic fields. Furthermore, the underlying methodology may be applicable beyond paediatric physiotherapy and into adult neurorehabilitation settings also.

Olfactory Function in Paediatric Traumatic Brain Injury: Recovery Patterns and Functional Implications

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Background and aims: Recent research indicates that disruption of olfactory function after pediatric traumatic brain injury (pTBI) is common. Importantly, olfactory dysfunction (OD) is known to have significant functional implications in areas of health, safety and quality of life. Despite this longitudinal research investigating olfactory recovery and the functional impact of OD in pTBI is limited. This study aimed to track the recovery of olfactory function following pTBI and investigate predictors of early and late olfactory outcomes.

Method: The olfactory function of 37 children with TBI, aged 8-16 years, was assessed at 0-3, 8 and 18 months post-injury using the University of Pennsylvania Smell Identification Test. Data were collected on demographic and injury variables as well as the impact of OD on day-to-day function.

Results: Significant improvements in olfactory performance were evident over time in the group presenting with OD acutely. For the subgroup with the most severe OD only 16% showed recovery to normal olfactory function, with the remainder demonstrating ongoing olfactory impairment 18 months post-injury. While predictors of early and late olfactory outcomes varied, occipital site of impact was a significant predictor of later olfactory performance.

Conclusions: Our results suggest that while there is evidence of recovery of OD over time after pTBI, those children with more severe OD acutely are likely to have persisting OD. Given this limited recovery, understanding the functional implications of OD and implementation of appropriate management strategies is considered an important aspect of overall rehabilitation management of children with TBI.

Validation of FORAMENRehab Software for Assessing Attention and Visuospatial Functions in Children with TBI or Epilepsy

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Background: Children with traumatic brain injury (TBI) and epilepsy are prone to deficits in attention and visuospatial functions. Subtle deficits are often overlooked, causing long-term academic and social problems. As assessment methods need to be quick, precise and engaging to children, more computerized cognitive tests must be developed. Previously, FORAMENRehab software has been shown to be effective in pediatric cognitive rehabilitation and measuring progress in training. Our study aims to validate the attention and visuospatial modules' use in cognitive assessment.

Methods: 92 children aged 8-12 participated in the study: 60 were healthy children with no attention or visuospatial deficits and 32 were patients with TBI or epilepsy. The participants completed 9 attention and 7 visuospatial tasks with FORAMENRehab software. Age-specific norms were determined for each of the tasks using data from healthy children. Principal components analysis (PCA) was performed separately for attention and visuospatial tasks to test the modules' construct validity. To test criterion validity, participants' FORAMENRehab performance was compared to their performance on attention and visuospatial tasks of the neuropsychological assessment battery NEPSY. A subsample of patients were administered an alternative version of the FORAMENRehab tasks 5 weeks later to measure test-retest reliability.

Results: Results of the PCA showed children's performance was related to 4 components of attention and 3 components of visuospatial functions. Comparing patients' FORAMENRehab performance with NEPSY results displayed moderate correlations ($p < .05$). Diagnostic agreement of FORAMENRehab and NEPSY tests measured using Cohen's κ was high in the attention domain ($p < .01$) and moderate in the visuospatial domain ($p < .05$).

Conclusion: Initial validation revealed adequate construct and criterion validity of the FORAMENRehab tasks in attention and visuospatial assessment. Although more extensive research is needed, FORAMENRehab tasks can be considered suitable in computer-based cognitive testing of patients with TBI and epilepsy.

Integrating Cognitive-Behavioral Intervention and Drug Therapy in a Young Boy Presenting a Unique Complex Action Disorganization Syndrome (ADS) Following Severe Brain Injury

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Introduction: Childhood traumatic brain injury (TBI) often results in a diffuse axonal injury (DAI) including damage to the frontal lobes, and consequent damage to executive functioning (EFs). There is general agreement that EFs are comprised of three core constructs: (I) inhibition, (II) working memory (WM), and (III) cognitive flexibility and that the relationship between them is essential for adaptive functioning. Action Disorganization Syndrome (ADS) is an exceptional frontal lobe neuropsychological syndrome due to right frontal damage, characterized by deficits in performance of familiar sequential tasks in a fluent and organized fashion. In the absence of efficient EFs, actions are prone to being affected by disinhibited bottom-up activation and are lacking WM strategies to effectively guide behavior. To date, few studies of the rehabilitation of ADS have been reported. The current study describes a rare clinical case report of a young boy with severe impairment in EFs and in the ability to carry out routine actions.

Methods: Our patient was an 11 years old boy following severe TBI, with bilateral frontal DAI and a right frontal cyst. Upon entry to rehabilitation, patient's score on the Pediatric Evaluation of Disability Inventory (PEDI) self-care domain was 46%, mainly due to inability to perform simple routines. During this period the patient presented a clinical picture similar to that of severe amnesia, including major difficulties in attention and in performance of daily routines. He was unable to perform simple activities of daily living (ADL) such as grooming (hand washing), making tea, orientating in the department etc.

Intervention: Due to the severe functional impairment, formal assessments were not implied. Initial assessment was based on clinical observations indicating severe difficulties in attention and working memory, specifically difficulties in encoding and recalling information, and in the ability to follow simple routines. After applying methylphenidate therapy effective occupational therapy intervention was established. Therapy sessions included a special focused hands-on intervention based on structured time and environment. In addition, an external diary was used to compensate patient's WM deficits, allowing him to gradually manage daily routines.

Results: Over the course of approximately six months in rehabilitation, along with methylphenidate therapy, a significant improvement in orientation, encoding information and attention occurred. PEDI self-care score improved (reached 75.9%), however, close supervision was still needed. At one year post injury the patient was able to manage a fixed daily routine, yet only in a structured environment. Assistance was still required in an unfamiliar task or in a new environment.

Conclusions: Severe impairments in WM and inhibition control may appear clinically as general amnesia. Our study supports previous models of ADS resulting from disinhibition due to right frontal damage. Methylphenidate treatment and appropriate cognitive-behavioral interventions, contribute to patient's ability to perform daily routines independently.

Neurocognitive and Behavioral Outcome with Resuscitation After 43 Minutes of No Flow Time in a Drowned Children with Cardiac Arrest and Hypothermia: A Case Study

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Drowning is a leading cause of mortality in children between 1 and 15 years of age; although the management of accidental hypothermia related to drowning has made relevant progress over the last decades, for children with cardiopulmonary arrest exists a high uncertainty as regards their prognosis. In particular, two important risk factors were submersion duration greater than 9 minutes and cardiopulmonary resuscitation longer than 25 minutes. Furthermore, drowned children in whom return of spontaneous circulation is not achieved within 30 minutes of resuscitation have an extremely poor outcome.

In April 2015, a 15-year-old boy fell into a flooded river with a water temperature of 15°C. The firefighters extracted him from water 43 minutes after drowning and 29 minutes after the activation of the emergency system. At his arrival at hospital, extracorporeal life support was immediately started.

Twenty five days after the drowning, awakening with the execution of simple order was observed. Forty days after, the patients was admitted to our Institute. The rehabilitative hospitalization lasted on the whole 12 months and included physiotherapy, speech and neuropsychological therapy, psychotherapy. During this time interval, three global assessments of the clinical picture were planned, respectively 1.5 months, 7 and 12 months after the drowning.

The first cognitive assessment, which took place as soon as the clinical picture allowed it and that included the administration of the WISC-IV, suggested a neuropsychological functioning in the normal range (FIQ=94), although the operational skills and the working memory resulted compromised while the processing times had a reduced speed.

Seven months after the drowning, the response to speech therapy and the neuropsychological treatment appeared excellent, with a marked strengthening of the short-term memory and of the inference abilities. Twelve months after the drowning, WISC-IV was one more time administered and it suggested an increased level of cognitive functioning (FIQ=108) with a harmonious profile.

In consideration of the uncommonly long times both for submersion and for resuscitation, the outcome of this patients results exceptionally favorable.

This clinical case highlights the possibility that a child who survived to an exceptional event with prolonged submersion and resuscitation, cardiac arrest and hypothermia may recovery a condition compatible with a social and scholastic re-entry. Considering the crucial role of early rehabilitation treatments in determining this outcome, we stress the need to ensure an early medical and neuropsychological intervention for children who sustained drowning with cardiac arrest and hypothermia.

Presentation of a Protocol of Cognitive-Behavioural Intervention for Children with Consciousness Disorder

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Acquired brain injuries are a main cause of disability and mortality in childhood and adolescence and they can result from a variety of etiologies.

Research on outcome after severe brain lesion shows that one third of children with moderate to severe brain injury have a period of prolonged reduced responsiveness (4 weeks or more). In some cases, vegetative state (VS) and minimally conscious state (MCS) are possible outcome and they are included in the group of disorders of consciousness.

Consciousness cannot be directly observed and for this reason clinical assessment of children in a condition of coma, VS or MCS relies on observing behavior and on drawing inferences about the underlying state of consciousness. Diagnostic errors are not infrequent, and they may lead to premature termination of treatments and to missed clinical opportunities to promote communication, to identify pain manifestations and to promote clinical progress. This phenomenon has a very dramatic impact in particular for children, considering the relevance for them of early and well-timed intervention.

For this reason, it is fundamental to identify assessment scales appropriate for this age range. Furthermore, a lot of studies demonstrate the beneficial effects of early rehabilitation for profound acquired brain damage due to traumatic or non-traumatic events, and the initial intervention is generally believed to be crucial for the outcomes of these patients.

Overall, an appropriate assessment and a timely intervention have been shown to improve responsiveness in patients with altered consciousness in the early post-acute stage.

Besides physical rehabilitation and speech therapy, in our Institute young patients with disorder of consciousness also receive a daily cognitive-behavioral psychostimulation treatment (Liscio et al., 2008). The cognitive-behavioral psychostimulation protocol (in use since the late 1990s) associates the use of cognitive-behavioral techniques to global stimulation.

An accurate assessment is ensured by the weekly combined administration of three scales: Level of Cognitive Functioning Assessment Scale (Flannery, 1993), Coma Recovery Scale-Revised (Giacino et al., 2004), Coma/Near Coma Scale (Rappaport, 1992). The comparison of these scales allow to better describe patient's level of consciousness, define treatment aims and follow-up.

The primary goal of this protocol is to stimulate and reinforce the patient's responsiveness by optimizing resources and skills and turning them into means of communication and interaction with the environment. Cognitive-behavioral psychostimulation treatment relies on clear objectives and procedures; individualized rehabilitation goals are specifically related to the assessed level of functioning. Furthermore, this personalized approach allow a timely intervention also for younger preschool patients.

The Integration Between Neuropsychology and Special Psicopedagogy In Order to Support the Scholastic Re-Entry After a Severe Brain Lesion: 1 Year of Experience at the Scientific Institute “Eugenio Medea”

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Behavioral and cognitive sequelae after acquired brain lesions in developmental age are very common and they significantly affect the learning abilities of patients and their scholastic re-entry.

For this reason, our Scientific Institute always encourages a rigorous integration between neuropsychologists and pedagogists, in order to sustain children and adolescents in their scholastic re-entry after long periods of hospitalization.

More in particular, the neuropsychologist, at the end of the rehabilitative intervention, administers to all patients a specific protocol including: assessment of the functioning in the different function-specific domains, assessment of academic skills and/or of prerequisite of learning. The neuropsychologist collaborates with the Department of Pedagogy of our Institute and takes part in the elaboration of the projects related to the Hospital School.

The Department of Pedagogy, in turn, supports the teachers' team (both in the Hospital School, and in the schools attended by patients after the discharge) in order to define the aims of the Educative Individualized Programs and the Didactic Individualized Programs; provides indications for the didactic and educative activities; with the collaborations of psychologists and psychotherapists; supports the families increasing their awareness as regards the specific difficulties of the patients; provides indications for a possible scholastic orientation.

In 2015-2016 period, our Department of Pedagogy provided support to 251 students aged 5-18 years. Each patient received a first assessment of scholastic functioning and a detailed pedagogic report, with the administration of standardized instruments and qualitative examinations. When requested from families or from teachers, meetings were planned, in order to share the specific aims.

The integration of the different competences allows to globally take charge of patients, to give attention to the real needs of students and to encourage as much as possible their independence in a context of real scholastic integration.

Early Rehabilitation in Young Patients with ABI: Balancing the Priority of Intervention

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In the patients who have undergone an acquired brain lesions the complexity of the clinical, functional, cognitive and behavioural picture, makes a priority assessment necessary, in order that the rehabilitative intervention could be considered effective. Particularly regarding the age of the patient, the severity of the cognitive deficits and the phase of recovery, different rehabilitative objectives are outlined. From a holistic intervention point of view, in which the focus is not the sickness, the deficit, but the whole person, the objective of the intervention might be the reorganisation between emotional, cognitive, social and relational competences to promote a new psicosocial adaptation.

The research has demonstrated that the psychologic, behavioural and social difficulties are extremely common between the patients and significantly affect their familiar and educational life. The neuropsychological intervention, supplemented to that behavioural, becomes, then, the focal point of the rehabilitation for the young patient who have undergone an acquired brain lesion.

The methodological approach of our rehabilitative Institute promotes a constant work of monitoring the cognitive and behavioural picture in order to define, time after time, the therapeutic objectives. All the rehabilitative fields work together, according to a below common logic and having a dialog between them: the neuropsychological rehabilitation and the speech therapy are the technical most priority interventions during the first phases of the recovery, even from the acute event and the awakening phase; while those occupational, behavioural-psychologic, educational and social, represent often a more advanced phase, regarding specific individual life fields.

On the other hand, the different rehabilitative interventions are not necessarily sequential, but often, the progress in one sector promote the improvement in the most technical interventions too.

In the first phase of the rehabilitative intervention the objectives regard the progressive recovery of the temporal-spatial and individual orientation, the sustained attention to the environment and focused attention to the stimuli, the consciousness of themselves and of the traumatic event and its consequences. All the rehabilitation fields have common aims globally, but they reach them according to the own methodological specificities. On the other hand, the frequency of behavioural problems makes their management priority: to improve adaptive behaviour, to increase the collaboration and the respect of the rules, making specific cognitive rehabilitation possible.

The objective of this work consists in presenting our clinical-rehabilitation experience with young patients from the acute phase to the social reentry.

Collaborative Working Within Paediatric Nursing Sub-Specialties as Part of The Acute Inpatient Rehabilitation Team for Children with Encephalitis: A Case Review

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Introduction: Children admitted with an acute presentation of encephalitis, have a variety of complex symptoms which pose multiple challenges to nursing teams in the management of their care. Within the Neuro-rehabilitation team, the nursing role requires specialist nursing involvement from three key teams, to provide holistic individualised care management of these children.

Objective: To outline an individual case review of a 13 year old child presenting with Autoimmune Encephalitis, secondary to a previous Herpes Simplex Encephalitis. To discuss the role of the Psychiatric Nurse Therapist, Neurology Clinical Nurse Specialist and the Neurology Nursing Team, in the assessment and management of an inpatient child with Encephalitis, within the wider neuro-rehabilitation team. Each specialist nursing team provides an individualised approach to patient care, whilst collaboratively working to manage presenting symptoms.

Results: Throughout the journey to recovery, the nursing role developed alongside the complexity of symptoms presented. At initial presentation of the disorder, the management of symptoms: varying levels of consciousness, loss of physical function, seizures, were identified. This resulted in a prolonged admission to intensive care. Collaborative working within the nursing teams provided a holistic approach encompassing the child and family support and intervention needs. During the acute rehabilitation phase, the focus changed to a rehabilitation model of care. Ongoing assessment of the patients needs were identified: management of self care, activities of daily living, cognitive function and memory difficulties, psychiatric assessment and support, emotional lability, acute behavioural changes, verbal and physical aggression and sexual disinhibition. Each individual nursing team identified goals in order to collaboratively manage care and symptom control. The final phase of inpatient care, working within the rehabilitation model, focused on the multi-disciplinary discharge plan. Goals were identified across all three nursing specialties which included the management of: quality of life, access to education and social inclusion, assessment of risk, enabling families to identify individual strategies, ongoing rehabilitation and psychological support.

Conclusion: Children who present with Encephalitis require individualised specialist nursing care across Neurology and Psychiatry specialties, in order to maximise patient outcomes. Collaborative working within a multi-disciplinary rehabilitation team provides holistic approach to the care and management of children and families.

Minefields or Meadows? Current Issues in Cross Border Litigation and How to Choose the Right Path

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Abstract for proposed talk/ debate on cross border litigation issues.

This abstract sets out a proposal for a lively panel debate and/or presentation to explore the prevalence of legal disputes where injury arises out of an act of negligence in one country/jurisdiction but the child lives in a different country / jurisdiction and to consider the legal and practical challenges of pursuing a claim for compensation on the child's behalf.

Acquired paediatric brain injury encompasses birth or other injuries caused by the alleged clinical or medical negligence, injuries acquired in RTA [road traffic accidents] or other accidents in which a third party is at fault, such as falls or near drowning accidents. As the world shrinks and travelling to or working in different jurisdictions becomes commonplace, cross border disputes in acquired brain injury cases are bound to increase.

For injuries suffered within the EU there are currently mechanisms in place, for example Rome II, which dictate the forum and the law to be applied. With the UK set to leave the EU, however, there is fertile ground for change. What will such changes be and how will they affect procedure?

Outside the EU it is not uncommon for a victim to live in a different and more expensive jurisdiction to the one in which the injury was acquired. Costs of care, equipment, housing etc., can have a huge impact on damages and the method by which they are calculated is highly significant. At present there are specific strictures against English courts accepting jurisdiction for foreign torts. This is ripe for discussion in the light of the recent ruling by the Lord Chancellor with regard to the discount rate. From March 2017 the multiple by which future long term losses are calculated has been changed from 2.5% to -0.75%. The effect is vastly to increase the future damages award, making it far more attractive to the victim to have damages calculated on the UK basis as opposed to, say, the method applied in Vietnam. On the other hand, such a measure of assessment is going to be far more unattractive to the those who are obliged to pay the damages and will carry potentially serious repercussions.

It is envisaged that a panel of international practitioners could engage in a debate or I would offer a talk / presentation based upon the UK perspective. The debate / lecture can provide practical case examples as well as consider the question of whether now is the time for International Arbitration/Mediation of such disputes to take the place of litigation?

Postconcussive Symptoms and Its Predictors in Children and Adolescents Up to Six Months After Mild Traumatic Brain Injury

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Introduction: Postconcussive symptoms (PCS) common after Traumatic Brain Injury. PCS is also common after Mild Traumatic Brain Injury (MTBI), but especially in children and adolescents PCS has received relatively little attention in the literature. This is surprising, as the majority of all Traumatic Brain Injury cases is categorized as mild.

Aim: This study investigates PCS in children and adolescents after MTBI, and what factors predict an unfavourable outcome.

Methods: This study presents a preliminary analysis of the Brains Ahead! study, investigating PCS at two weeks and six months after MTBI. PCS was measured with the Health and Behavior Inventory – Dutch language version, which was filled out by children after MTBI and their parents (N=102) and by healthy children and their parents (N=113). It contains 50 items, divided over four domains (somatic, cognitive, emotional, behavioural PCS) that can be scored on a one-to-four point likert scale. Using one-way ANOVA's, outcome of children with MTBI on PCS was compared to the healthy controls. Percentages of children scoring PCS in the risk range – a score of at least 10 percent above the mean healthy score or higher - were calculated per PCS domain. Regression analyses were used to determine the predictive value of injury-related i.e. loss of consciousness, cause of injury, change in mental functioning or neurological abnormalities, child-specific, i.e. age at injury, gender, premorbid behavioural functioning and child-surrounding, i.e. social economic state (SES), and premorbid family functioning, factors for PCS at two weeks and six months post-injury.

Results: The results showed no difference on total PCS between children with MTBI and healthy children ($p=.560$). The calculated percentages of scoring in the at risk range per domain showed that 24-54% of the children with MTBI score in the at risk range on somatic, cognitive and behavioural symptoms at two weeks post-injury. At six months post-injury, 18-21% of the children with MTBI scored in the risk range of these domains. Premorbid behavioural- and premorbid family functioning (both $p<0.00$), SES ($p<.05$), and age at injury ($p<.05$) were found to be predictors for PCS after MTBI.

Conclusion: Children with MTBI do not differ from healthy children on total PCS. Although PCS tend to decline in children between two weeks to six months after MTBI, about 20% of the children with MTBI still suffer from PCS at six months post-injury. Therefore, it is advised to use PCS domain scores instead of PCS total scores to examine children on PCS after MTBI. Child-specific and child-surrounding factors were found to be predictors for PCS, while injury-related factors were not. These factors should be considered by general practitioners and emergency physicians before discharge, and should be taken into account for the direction and development of future (preventive) interventions.

The Role of Early Intervention in Improving the Level of Activities and Participation in Youths after Mild Traumatic Brain Injury: A Scoping Review

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Background: Mild traumatic brain injury (MTBI) in children and adolescents can lead to persistent cognitive and physical symptoms which can have a negative impact on activities and participation in school and at play. Because these symptoms are often not recognized and therefore not treated adequately, preventive treatment strategies are preferred. In this scoping review, clinical studies investigating interventions directed at activities and participation in pediatric MTBI are summarized, and clinical recommendations and directions for the future are provided.

Methods: Considering the limited resources on this topic, a scoping review was performed instead of a systematic review. Among others, decisions concerning the inclusion of studies and the extraction of data were: (1) definition of MTBI as defined by the American Congress of Rehabilitation Medicine, (2) clinical studies in which an intervention for children with MTBI was evaluated on the domains of activities and participation according to the framework of the International Classification of Functioning (ICF, WHO), (3) studies in which children with MTBI were part of larger studies on more severe pediatric TBI, (4) studies that investigated interventions for children with MTBI that might also be suitable for preventing problems with or improving the level of activities and participation. Studies measuring outcome solely in terms of physical or mental functioning, or measuring interventions aiming at biochemical and neurochemical changes, were excluded.

Results: Five studies investigating the effectiveness of interventions for activities and participation of children with MTBI, either as being part of a larger group of children with more severe TBI or not, were found. Six studies of interventions for children with MTBI that are not directed at activities and participation, but nevertheless might be suitable for achieving improvement in these domains, were also found. Various types of interventions, i.e. information and education, follow-up consultancies, online family problem-solving, cognitive and physical rest, and combined interventions, were examined.

Conclusions: The literature is scarce and more high quality studies are needed. Information and education about the injury and its consequences are recommended, with additional follow-up consultation, including individualized advice and reassurance. Ideally, interventions should be family-centered and return to activities and participation should be graded and done step-by-step. Currently we are conducting a randomized controlled trial (RCT) in which the Brains ahead! intervention is being evaluated in terms of effectiveness on participation in activities in comparison with standard care. The Brains ahead! intervention is a combination of screening for MTBI symptoms, psycho-education and follow-up. Outcome is measured three and six months post-injury. The primary outcome measure is the Child and Adolescent Scale of Participation (CASP); in addition, other measures of activities, participation, quality of life and child behavior are performed. We hope to have recruited 140 children by the end of 2017.

Incidence of Hip Displacement and Associated Risk Factors in Children Post Traumatic Brain Injury

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Introduction: Children who acquire brain injury (ABI) after birth from traumatic or non-traumatic causes have been identified as at risk of hip displacement (Kentish et al 2011). The specific incidence of hip displacement in children who sustained a traumatic injury to the brain (TBI) has not been reported. This report aims to investigate the incidence of hip displacement for a cohort of children post TBI and to determine whether incidence of hip displacement is influenced by severity of injury, age at the time of injury and mechanism of injury.

Methods: An audit of Queensland's state-wide hip surveillance database (HIPS-CCIS) was undertaken to identify children who had acquired a brain injury due to traumatic causes. The database and medical records were reviewed to confirm age at time of injury, mechanism of injury, severity of TBI, Gross Motor Function Classification System (GMFCS) equivalent, and Reimers Migration Percentage (MP). Progressive hip displacement (hips at risk) was defined as MP \geq 30% in one or both hips.

Results: The HIPS-CCIS database identified 197 children who had sustained a TBI. 135 children had no physical impairment and were deemed not to require pelvic x-ray. Children were classified into 2 groups: (i) "hips not at risk" MP remained $<$ 30% (n=49) and (ii) "hips at risk" MP of \geq 30% (n=13). For the "hips at risk" group, mean age at time of injury was 5.5 months (range from 1 month – 5 years). The average time from injury to progression of MP \geq 30% was 21 months and GMFCS equivalent was I=2 II=1, III=1, IV=2, and V=7. Non-accidental injury (NAI) was the most common mechanism of injury in this group, responsible for 54% (n=7). Further characteristics of the 'hips at risk group' include: 69% of children's TBI was classified as severe (n=9), three (43%) had progressed to dislocation and eight (62%) have undergone hip surgery.

Conclusion: While this report is limited by incomplete data collection, we have identified a number of children within the cohort (21%) with progressive hip displacement or dislocation. Based on the findings of this audit, factors that may influence risk of displacement include injury due to NAI, severe functional impairment (GMFCS), severity of TBI and age at time of injury. This highlights the need for systematic hip surveillance following traumatic brain injury. A population wide study is required to confirm incidence and relative risk of hip displacement in the TBI population.

References: Kentish, M., Wynter, M., Snape, N., & Boyd, R. (2011). Five-year outcome of state-wide hip surveillance of children and adolescents with cerebral palsy. *Journal of Pediatric Rehabilitation Medicine*, 4, 205-217

Preliminary Data on the Efficacy of a Home-Based Computerized Cognitive Training in Pediatric Patients with Brain Injury: A Comparison Between Patients with Traumatic Brain Injury and Brain Tumor

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Pediatric patients with a diagnosis of traumatic brain injury or brain tumor face cognitive challenges associated to possible deficits in overall intelligence and specific cognitive domains. Remote rehabilitation interventions have been proposed to these patients in order to continue the rehabilitation course at home, overcoming distance, local resource capabilities and family economic resources issues. The continuation of cognitive rehabilitation out of the medical setting is aimed at stimulating the neural plasticity of children's damaged brain for a longer interval than traditional time-limited rehabilitation approaches, possibly generating further benefits on functional outcomes.

In order to quantify benefits of a home-based computerized cognitive intervention in a sample of adolescents aged 11-16 with an acquired brain injury (10 presenting with a diagnosis of brain tumor and 10 with a diagnosis of traumatic brain injury), we evaluated changes in cognitive performance levels of participants before and after the training. The training was constituted by 40-sessions (5 days per week, for 8 weeks) and stimulated the following five cognitive domains: attention, memory, executive functions, speed processing and problem-solving. As outcome measures, we collected scores of cognitive proficiency directly provided by the program software and standardized scores from a battery of neurocognitive tests examining the same cognitive domains of proposed games, but presenting different tasks to be solved. Results showed that all patients with a traumatic brain injury improved in cognitive proficiency, while, among patients with a brain tumor, 7 (70%) improved and 3 (30%) exhibited a performance decrease. These data suggest that, globally, patients with a brain injury gain functional benefits from a remote cognitive stimulation delivered through a computerized training. However, as 30% of patients with brain tumor worsened after the training, it seems that survivors from this illness may face higher difficulties at recovering. This may be due to the long-term effects of the illness and oncological treatments, which may generate a progressive negative impact on cognitive competence. In conclusion, our preliminary study demonstrates that home-based rehabilitation may be a possible strategy for a cognitive intervention in pediatric patients with a brain injury, even if not for all types of patients. Future studies should further explore this issue and provide useful indications for programming tailored interventions.

Remote Cognitive Training for Italian Pediatric Patients with Brain Injury: A Feasibility Study

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Pediatric brain injuries may generate anomalies in neural plasticity and progressive modularization and specialization of cerebral networks, which in turn may cause deficits in global intelligence or specific cognitive domains, such as attention, memory, language, executive functions, problem-solving and visual-motor competences. Cognitive rehabilitation has been identified as crucial in order to minimize ongoing problems and limit long-term cognitive decay. Recently, new technology-based interventions to be delivered at home have been proposed in the clinical practice in order to increase rehabilitation opportunities. Delivering of remote cognitive interventions in pediatric patients with brain injury is still limited and not homogeneously distributed across different countries. Considering the promising results on this form of intervention reported by previous research, it seems to be worthwhile to propose home-based cognitive rehabilitation also in those countries where it represents a novel reality.

Given these considerations, we proposed a pilot study on feasibility and accessibility of a home-based cognitive training in a group of Italian adolescents with brain injury aged 11-16. The training selected for the study had a duration of 8 weeks and stimulated the following cognitive domains: attention, memory, executive functions, speed processing and problem-solving. It presented with the advantages to adapt to patients' performance level, to propose an intensive but time-limited daily stimulation and to allow an automatic registration of data on patients' adherence rates and performance. During the study, a member of the research team contacted the adolescents and their families weekly, in order to sustain patients' motivation in carrying out the training and to record the reasons of any possible drop-outs. Feasibility was assessed measuring training adherence, usability, accessibility and patients' motivation.

32 children, 28 with an acquired brain injury in a chronic phase and 4 with a congenital brain injury, were enrolled in the study. Results showed that the proposed computerized program was highly feasible: average training completion was > 95.0% after 8 weeks and no significant technical issue affecting training continuation emerged. Patients' retention rates were very positive, as only 1 adolescent dropped-out during the study. This indicates that patients with a brain injury are able to carry-out cognitive exercises at a distance. Moreover, adolescents referred positive evaluations on the program. As a distinctive aspect of our research was that the computerized program was presented with a web-platform in English within a population of Italian adolescents, findings demonstrates that language barriers can be surmountable through simple arrangements, that could easily be replicated in the clinical practice. Globally, our findings may provide important indications on resource investments in the field of cognitive rehabilitation in home environment.

The Micro-Structure of Cerebral Bridging Veins in Younger Patients – Data to Improve Head Injury Protection

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Background: Cerebral bridging veins (BV) are small vessels, draining blood from the brain cortex into the superior sagittal sinus (SSS). They have drawn the attention of few research groups in the field of head injury biomechanics as their rupture accounts for 1/3 of acute subdural hematomas (ASDH). Besides animal experiments (primates, rodents...), the investigations were performed on cadavers, using samples from either elderly patients (end-life donation) or infants (autopsy to elude Shaken Baby Syndrome). Thus, the variety in sampling methods may explain the conflicting results. Yet, in road accidents or recreational activities, older children and younger adults are mostly involved. These age-groups are also the one who can potentially more use and benefit from head protective gears. Moreover, the accuracy of the computer models used to simulate head injury and improve protective devices depends on the bio-fidelity of the data used as input. Therefore, aim of this work was to produce a detailed study of the micro-structure of cerebral bridging veins targeting these age-groups.

Material & Methods: The files of 30 patients with acute subdural hematoma as a postmortem diagnosis and without medico-legal access restriction, were retrieved from the database of the Department of Forensic Medicine. The final targeted group (from 10 to 50 years old), included 6 patients (median age 39.5y, min 24y, max 47y). The autopsy report (including the brain histology) was reviewed. From the available specimen (including the brain and its meningeal layers), additional samples were made including the SSS and the connecting BV, for detailed histology. Serial paraffin 5µm-slides were stained with Hematoxylin-eosin, Sirius red (collagen), Elastica van Gieson (elastin), immunohistochemistry for α -smooth muscle cells actin, desmin (muscles) and CD-31 (endothelium). Analysis was done with light microscopy (polarized and fluorescence lights) to identify the changes along the venous walls and the fiber orientation. The study was approved by the Faculty of Medicine Ethical Committee, KU Leuven.

Results: Variation in thickness and constitution along the BV wall were observed: a decrease in collagen amount and thickness from the SSS to the brain surface. The entrance into the SSS was covered by a stable fibrous multilayered structure providing dural protection. Next followed a “free” segment characterized by progressive loss of the dural layers, ending with a single longitudinal layer of collagen. Collagen fibers were also reorganized into multi-oriented bundles at the junctions between veins. No ampulla nor contractile structure were identified. Changes related to aging in the venous wall thickness and structure were absent.

Conclusion: BVs appear to be more exposed in the “free” segment (without meningeal covering), corroborating the clinical and anatomical observations. This data will implemented into computer models studying ASDH to allow more accurate predictions and improve head protective devices.

Trajectory of Recovery from mTBI in an Adolescent Ice Hockey Player

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Introduction: Diagnoses of sport-related concussion, a form of acquired traumatic brain injury (TBI), have been increasingly prevalent in pediatric and adolescent populations, and of increasing concern in female participants. Brain health during this stage of cognitive development is of utmost concern for medical professionals, researchers, and parents worldwide. Consequences of these concussive events (both short- and long-term) and the rehabilitative processes ensuing has made significant progress to the recovery of physical, cognitive, and behavioral deficits following TBI.

Objectives: 1) Assessment of concussive event and subsequent symptoms; 2) Rehabilitation of physical, cognitive, and behavioral discrepancies; 3) Return adolescent athlete to sport.

Methods: Patient was a 14-year old female who suffered sport-related concussion playing ice hockey (helmet and pads required). The mechanism of injury included blunt force trauma, resulting from posterior head area striking the ice surface. Baseline information was recorded using C3 Logix Comprehensive Concussion Care 1-month prior to injury and used for comparison through rehabilitative processes. Post-concussion assessment included: C3 Logix Comprehensive Concussion Care (Neurologix, Inc.), VSR-Sport (Natus/Neurocom), vestibular/ocular motor screening (VOMS), and comprehensive diagnostic vestibular test. The vestibular test battery included Computerized Dynamic Posturography (CDP), Neurokinetics Rotational Chair (NOTC), and Videonystagmography (VNG).

Results: Progressive analysis of cognitive, physical, and behavioral symptoms indicated a prolonged recovery (>21 days). Sway-velocity and error scores during balance examinations were comparable to age-related normative data ~30 days post-incident. Symptoms associated with VOMS assessment were last to resolve (6 weeks post-incident) with SAC, BESS, and Trails B–A returning to baseline norms (4, 6, and 6 weeks' post-incident, respectively). Physical and mental exertion no longer exacerbated symptoms by day 42 post-concussion. Vestibular test results revealed a peripheral vestibulopathy and otolith dysfunction, which agreed with patient's subjective complaints. Ongoing therapy was provided to patient until resolution of dysfunctions.

Discussion: Incidence of concussive events and the rehabilitative processes necessary to treat adolescent athletes may vary from case to case. It is not uncommon for females of this age range to have prolonged recoveries and a delayed onset of symptoms. Furthermore, it has been stated that increased cognitive and physical activity is associated with longer recovery from concussion. This was a concern when dealing with this adolescent athlete who was very active and participating in a contact sport. Restoration of fine motor control, executive function, and symptom resolution 3-6 weeks' post-injury agrees with Brown and colleagues' recovery timeline from a study of 335 pediatric concussion cases (Mean: age – 15 y/o; symptom duration – 43 days). It is important to note, that subtle vestibular and oculomotor deficiencies slowly resolved in this adolescent athlete.

Reference: Brown, N.J., Mannix, R.C., O'Brien, M.J., Gustine, D., Collins, M.W., & Meehan, W.P. (2014). Effect of cognitive activity level on duration of post-concussion symptoms. *Pediatrics*,133(2),299-304.

Long-Term Health Outcomes Associated with Traumatic Brain Injury in Childhood and Adolescence: An Italian Retrospective Study

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Background and Aims: Paediatric traumatic brain injury (TBI) is a major cause of death and long-term disability for children and adolescents. The identification of prognostic factors for young patients who suffered TBI is important for risk-profiling subjects and estimating later health outcomes. The Glasgow Outcome Scale-Extended Paediatric Revision (GOSE-P), a developmentally appropriate structured interview, was developed for children and adolescents who suffered TBI to measure outcomes overtime. In this retrospective study, we evaluated clinical information in young patients admitted to a rehabilitation unit in 2010-2016 and followed-up 3.8±1.8 years after TBI.

Methods: Retrospective study of a cohort of patients admitted to a highly specialised rehabilitation unit in Ferrara, Italy. The study included 35 children and adolescents who suffered TBI as per a Glasgow Coma Scale (GCS) score ≤ 8 in the initial 24 h following injury, and who were admitted to and discharged from the rehabilitation unit. Clinical information recorded included etiology (cranial traumatic encephalopathy or others including hemorrhage, ischemia, and hypoxia), presence of seizures and dysautonomic crises during hospital stay, as well as the functional independence measure for children (WEEFIM) and the disability rating scale (DRS) recorded both at admission and discharge from rehabilitation. TBI outcomes were assessed using the GOSE-P, which was administered to caregivers over the telephone by healthcare professionals at the time of follow-up.

Results: Patients with good-to-moderate (n=18) and severe-to-death (n=17) GOSE-P scores were aged 13.3±4.7 years and 13.8±3.8 years, respectively, at TBI event, without differences in GCS scores. GOSE-P scores were not different between patients who suffered cranial traumatic encephalopathy versus those with other etiologies. Higher WEEFIM and lower DRS (i.e. better function) both at admission and discharge from the rehabilitation unit were observed in patients with good-to-moderate than in those with severe-to-death GOSE-P. Dysautonomic crises during hospital stay were also more frequent in patients with severe-to-death GOSE-P scores at follow-up (53% vs 17%; p=0.035). Patients suffering seizures during hospital stay had much greater odds of displaying poor long-term outcomes as per GOSE-P scores [OR 18.9 (95% CI 2.6, 136.1)]. Poorer function at admission (lower WEEFIM and higher DRS) were associated with worse GOSE-P scores at follow-up, but greater predictive power was provided by poorer WEEFIM and DRS scores at discharge: OR 1.05 (95% CI 1.03, 1.08) and OR 2.21 (95% CI 1.46, 3.34) per unit change, respectively.

Conclusions: Our population of young patients with TBI shows that higher GOSE-P scores are observed in patients who displayed better functional and cognitive function at admission and discharge from the rehabilitation unit. Better long-term outcomes (higher GOSE-P scores) at follow-up were associated in particular with absence of seizure during hospital stay, and with higher WEEFIM and lower DRS at admission and discharge from the rehabilitation setting.

Postural Stability in Healthy Child and Youth Athletes: The Effect of Age, Sex, and Concussion-Related Factors on Performance

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Background: Postural stability plays a key role in sport performance, especially following concussion. Specific to healthy child and youth athletes, little is known about developmental and sex influences on postural stability performance, while considering other subjective clinical measures used in baseline/pre-injury concussion assessment. This study aims to describe age and sex trends in postural stability in uninjured child and youth athletes at baseline, while accounting for the presence of concussion-like symptoms.

Hypotheses: (1) Postural stability performance will increase with age, (2) females will display better postural stability compared to males, and (3) concussion-like symptoms will affect postural stability performance in healthy children and youth.

Study Design: Cross-sectional.

Methods: This study was comprised of healthy/uninjured child and youth athletes (N=889; 54% female, 46% male) between the ages of 9-18 years old. Participants completed pre-season baseline testing which included collection of demographic information (age, sex, concussion history), self-report of concussion-like symptoms (PCSI-Child version & PCSI-Youth version) and measures of postural stability (Biosway). Postural stability was assessed via sway index under four sway conditions of increasing difficulty by removing visual and proprioceptive cues.

Results: Results were based on versions of the Post-Concussion Symptom Inventory (PCSI-C: 9-12 year olds; PCSI-Y: 13-18 years old). In children ages 9-12 years there were significant age and sex effects on postural stability whereby performance increased with age and girls performed better than boys. For youth ages 13-18, postural stability also increased with age. In both child and youth subgroups, those who endorsed more concussion-like symptoms had poorer postural stability.

Conclusions: Results support the hypothesis that there are developmental and baseline symptom trends on postural stability performance.

Clinical Relevance: These findings provide a preliminary foundation for post-concussion comparisons and highlight the need for a multimodal approach in assessing and understanding physical measures such as postural stability.

Mindfulness-based Yoga for Youth with Persistent Concussion Symptoms: Bridging Functional and Neurophysiological Outcomes

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Background: Limited interventions address persistent concussion symptoms in youth in a way that targets functional and neurophysiological outcomes. Mindfulness-based yoga (MBY) is a mind and body intervention that focuses on the present moment, with a purposeful attention on breath and awareness of thoughts. Heart rate variability (HRV) is emerging in concussion research as a neurophysiological measure that captures an individual's ability to be flexible and adaptable in their environment. Examining HRV in the context of MBY can provide insights into a youth's ability to self-regulate in the context of persistent concussion symptoms.

Objective: Investigate the impact of MBY on participation, self-efficacy and HRV in youth with persistent concussion symptoms across pre-, post- and 3 months following MBY.

Methods: Case series design. Youth ages 13-17 years old (N=6) participated in an 8-week MBY intervention, 1x/week, for 45 minutes. Participation, self-efficacy and heart rate variability (24 hours) were collected pre-, post-, and 3 months following mindfulness-based yoga. Heart rate variability was also collected during each mindfulness-based yoga session.

Results: Trends towards increasing self-efficacy in academic, social and emotional domains were found following MBY and maintained at the 3-month follow-up. Trends of increasing HRV were also found following intervention and across the 8 sessions of MBY. Concussion symptoms across physical, cognitive, fatigue and emotional domains illustrated trends of significant decline following MBY and maintenance at 3-month follow-up.

Conclusions: MBY is a functional intervention that can potentially have a direct impact on youth with persistent concussion symptoms, improving their self-efficacy and neurophysiological function. Future research is warranted.

Implementing Group Based Parenting Interventions for Child Behaviours in Paediatric Rehabilitation Setting

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Background & Aims: Emotional and behavioural difficulties are common in children presenting to rehabilitation services. Parent training interventions are gaining increasing popularity for remediation of behavioural difficulties in these settings. A recent systematic review identified growing, though limited, evidence for the efficacy of such programs. The aims of this project were: (1) to report on the feasibility of implementing the “Signposts for Building Better Behaviour” parent training intervention within a clinical paediatric rehabilitation setting, and (2) to evaluate the efficacy of the intervention through questionnaire report of parental sense of competence and parental psychological symptoms and child behaviour.

Method: Thirty-eight parents of 37 children (aged 2-11) attending the Victorian Paediatric Rehabilitation Service (Royal Children’s Hospital and Monash Children’s Hospital, Melbourne, Australia) completed the 6 week program. Parent training intervention was administered by trained facilitators in accordance with program guidelines. Pre and post intervention measures included valid and reliable questionnaires given to parents measuring parent (parental competency, stress, depression, anxiety) and child (behaviour, and psychosocial strengths and difficulties) factors.

Results: Feasibility was demonstrated through satisfaction ratings, although retention and attendance varied. Significant improvements in parental sense of competence (increased satisfaction and efficacy in parenting) were observed at completion of the program. Parent ratings of child behaviours demonstrated fewer total problems (behavioural/hyperactivity difficulties) after intervention. No other immediate post intervention effects were observed for parental stress, anxiety or depression, or on other ratings of child behaviour (conduct, peer relation problems or prosocial behaviour).

Conclusions: Variable evidence was found for the efficacy of a parenting training intervention in our paediatric rehabilitation setting, with a significant improvement in parental competence and child behavioural difficulties evident post intervention. Retention and attendance varied, however, so specific factors related to the observed changes are unclear. Challenges of implementation and evaluation in a clinical setting are discussed.

Gross Motor Function in Schoolchildren with Self-Reported Subacute Symptoms After Concussion

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Background: Most children and adolescents who experience a concussion recover within a few days or weeks. However, a significant minority of concussed children experience persistent symptoms for many weeks, months or even years after the injury. To date the studies are too few to clarify the symptomatology of concussed children and adolescents with subacute symptoms. Furthermore only a few studies have investigated different domains of gross motor function in concussed children with prolonged symptoms.

Aim: The aim of this study was to investigate type, frequency and level of symptoms and also gross motor function in a group of schoolchildren with subacute symptoms, 1-4 months after diagnosed concussion.

Method: This cross-sectional study was conducted between February 2016 and January 2017 at Karolinska University Hospital in Stockholm, and included 13 children (7-16 yrs, boys n=6, girls n=7) with self-reported subacute symptoms after having sustained a concussion. The Rivermead Post Concussion Questionnaire (RPQ) was used to evaluate symptoms. The Bruininks-Oseretsky Test of Motor Proficiency 2nd edition (BOT-2) was used to evaluate gross motor function. Non-parametric statistics were used to present data.

Results: The results demonstrate that the most frequently reported symptoms were fatigue, poor concentration and headache. All children reported multiple symptoms of varying level. Gross motor function deficits were noted within the domains of balance (30% of the children), bilateral coordination (15% of the children) and upper limb coordination (8% of the children).

Conclusion: The results of the study contribute to surveying the symptomatology and gross motor function in concussed children in the post concussive phase. In order to obtain subjective and objective information of the effects of the concussion, two outcome measures were used. All included children reported remaining symptoms and some of the children presented deficits in gross motor function, 1-4 months after concussion.

Keywords: Concussion, schoolchildren, subacute symptoms, gross motor function.

Clinical Implementation of Manualised Everyday Memory Group Training for Children

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Background and objectives: Everyday memory difficulties are common in children with acquired brain injury (ABI). Children with ABI experience difficulties in the daily use of multiple aspects of the memory system including learning, recognition, and recall of past events, as well as other cognitive systems such as attention, working memory, and planning/organising. Memory deficits can persist for years after the injury, and impact everyday functioning, including participation, ongoing learning, psychological well-being, and social outcomes. Within a rehabilitation setting, the goal of intervention is to improve patients' everyday functioning. There is limited, but increasing, evidence for the efficacy of group-based memory training in children and adolescents with ABI. However, a structured evidence-based clinical rehabilitation program for memory is yet to be implemented into clinical paediatric rehabilitation practice, which is the aim of the current study.

Methods: Children and adolescents with ABI aged 11-18 years were offered to participate in a group memory training as a part of clinical care, across a statewide paediatric rehabilitation service, if they presented with reduced everyday memory on memory questionnaire (<1 SD). The study used an evidence-based, manualised group program originally developed and evaluated to be effective in reducing everyday memory difficulties in children with ABI by Ho, Epps, Parry, Poole & Lah (2011). The manual was reviewed, and updated for relevancy and local content. Additional internal and external memory strategies, and lifestyle education were added. The group treatment was delivered to children (5 weekly sessions), with weekly homework strategy practice. Parents were provided with psycho-educational on memory and strategies used to improve everyday memory. The memory group was evaluated for (i) feasibility (service utilisation & consumer satisfaction), dosage (attendance & homework completion), and (ii) efficacy in reducing everyday memory difficulties (child and parent memory and executive function/metacognition questionnaires), as well as strategy checklists and child goal attainment. Pre-and post-questionnaires were completed by parents and children.

Results: Seven children with ABI (age 12-17) enrolled in the program. Attendance rate was very high (89%). Homework completion was limited. Parents endorsed high satisfaction ratings with program content. Individual child questionnaire data (parent and child ratings) pre-post is described. On the everyday memory questionnaire, parental ratings of children's memory demonstrated clinically meaningful improvement in two participants who demonstrated clinically significant change in everyday memory from pre- to post- intervention. Children selected a range of preferred strategies, with external cues/supports being most commonly used. Child goal attainment ratings were variable, across various school/home domains.

Conclusions: The group memory training program appears feasible within the clinical setting, supported by high attendance and satisfaction. However, the group was heterogeneous and there was considerable variability in engagement in the program. Further evaluation in a larger sample size is required.

Fatigue: It's Course and Predictors 6-12 Months After Child Brain Injury

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Background and objectives: Fatigue is severe and common in the acute phase of recovery from childhood traumatic brain injury (TBI). Yet, fatigue outcomes over time are unknown. Fatigue is a general complaint, experienced as the subjective awareness of a negative balance between available energy and the mental and physical requirements of activities. It is believed to include multiple dimensions. The specific number and nature of fatigue dimensions vary throughout the literature. Most authors at least describe fatigue as having mental and physical aspects. We adopt a we adopt a model of fatigue that is developmentally sensitive and multidimensional – including physical, sleep/rest, and cognitive elements. We use a psychometrically robust, multidimensional fatigue measure to examine three dimensions of fatigue after child TBI, to achieve study aims: (1) examine fatigue over time (6- to 12-months post-injury) and (ii) explore factors predictive of worse fatigue on the fatigue measure at 12-months (parent perspectives) post-injury.

Methods: We included 159 children (0-17 years at injury) with mild, moderate or severe TBI, presenting to one of three participating sites (two Canadian, one Australia). At the time of child TBI, parents provided pre-injury child data based on retrospective report, including report of pre-injury fatigue and sleep difficulties. Parents rated child multidimensional fatigue at 6 and 12 months after injury. Secondary symptoms were also rated at 6 months (sleep, pain, mood, attention function), using parent rated questionnaires.

Results: Between 6- and 12-months post-injury there was no detectable improvement in fatigue. Sleep and general fatigue demonstrated plateau. Cognitive fatigue worsened over time. Fatigue was predicted by multiple variables, including pre-injury sociodemographic factors (female sex), psychological well-being (general fatigue) and pre-injury fatigue (sleep/rest fatigue). Symptoms after injury in multiple domains (physical/motor, pain, sleep psychological or inattention) additionally predicted fatigue 12 months post-injury – and specific symptoms were associated with each domain of fatigue. Pain was associated with worse general fatigue; sleep symptoms with sleep/rest fatigue; and inattention associated with cognitive fatigue.

Conclusions: Fatigue is a complex, severe and persistent complaint after child TBI. Interventions are required to help reduce fatigue after child TBI.

Traumatic Brain Injury During Early Childhood: A Systematic Review

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Overview: Pediatric traumatic brain injury (TBI) is one of the leading causes of mortality and invalidity in children. Young children are particularly at risk for brain injury due to physiological factors such as weak neck muscles and disproportional head/body weight. In addition, according to vulnerability theory, sustaining a TBI earlier in life may be associated with worse outcomes and prognosis because injury may disrupt the typical development of emerging cognitive and social skills. However, there are a limited number of studies investigating outcome after “preschool” TBI (i.e., before the age of six years) and thus the exact consequences of early TBI are not well documented.

Objective: To conduct a systematic review of the literature and document the cognitive, behavioral and psychosocial outcomes of preschool TBI (0-5 years).

Methods: Four data bases (PSYCNET, Medline, CINAHL, PubMed) were systematically searched from January 1990 to April 2017 for studies relating to TBI in preschoolers using the following keywords: preschool* or infant* or toddler* or neonat* or pediatric* or earl* or newborn* or child* AND brain injury* or head injury* or concussion* or head trauma* or brain trauma*. In phase 1, titles and abstracts were first screened to retrieve peer-reviewed articles that reported empirical data from paediatric TBI. In phase 2, selected studies met following principal criteria: age at injury < 6 years, inflicted or non-inflicted TBI (all type of severity), and reports of cognitive, neuropsychological, psychiatric, psychological, social or behavioral outcome.

Results: Preliminary results show that moderate-severe TBI groups present deficits in intellectual functioning compared to the mild TBI groups. They also show deficits in sustained and selective attention, general difficulties in executive functioning along with internalizing (e.g. withdrawal) and externalizing behavioural problems (eg. hyperactivity) persisting in the long term. Some studies show similar but less severe executive and attention difficulties after mild TBI. Others emphasize alterations in social functioning, such as reduced quality of child-parent interactions and altered theory of mind. Others report persistent difficulties in mathematics as well as in written language after preschool TBI, regardless of the severity, suggesting early TBI may place children on a pathway to learning difficulties. Higher risk of school failure and use of extra services (ex. special class, speech therapy) at school-age are also reported in the literature for children who sustain TBI before the age of six.

Conclusion: This review will contribute to understanding the effects of TBI when sustained during the first years of life and to identify potential gaps in the literature and possible loci for intervention in this young age group.

Beyond the Child-Family Centred Care. How the Role of Professionals Can Make or Break Positive Outcomes for Children with ABI Through Their Relationships with the Families Who Are Caring for Those Children. Learn, Inspire, Feel, Think.

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Behind every child with an acquired brain injury is the family who are raising that child. When you child receives a diagnosis of a brain injury, your world as their parent and caregiver is immediately turned upside down. The future success of that child is ultimately tied directly to the parents who are raising them. All the available medicinal and therapeutic interventions in the world won't make a difference if the family isn't supported, informed and respected appropriately.

Physician and clinicians need to ensure that they actively engage the parents of these children in effective ways. It can't just be in theory, it has to be in practice. This is the only way to ensure that children living with an ABI will have the most independent and fulfilled life possible.

The role of each and every professional that encounters a family during their journey of raising a child with an ABI is vitally important. And their impact on that family can either have a positive or a negative effect on the trajectory of that journey. The majority of professionals who work in pediatric care do not always weigh heavily enough the importance of relationships and partnerships in the outcomes for the child with and ABI. By exploring the use of LIFT (Learn, Inspire, Feel, Think) the professionals that work with our children can improve the way they interact with parents and families and ultimately improve the overall care that they are providing to the child.

Please don't just see the child in front of you, please see the family. Because if you support the family, the child will always win. Every single time.

Taking of Myself After a Stroke - Outcomes of Rehabilitation

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In the UK, approximately 400 children each year have a stroke, leading to physical, communication, cognitive and emotional difficulties. There is an impact on self-care independence as a result. Intervention to support children and young people in self-care is a key recommendation in UK Stroke in Childhood guidelines¹.

Self-care independence is a common goal for children, young people (CYP) and families². Nurses and therapists work collaboratively in the rehabilitation setting to support CYP's self-care goals enabling them to resource equipment, develop programmes and practice opportunities.

Aim: To understand the effect on self-care outcomes for children/young people with severe stroke following residential rehabilitation.

Methods: Analysis of routinely collected UK Rehabilitation Outcomes Collaborative (UKROC) data from one specialist rehabilitation centre. UK Functional Independence Measure + Functional Assessment Measure (UK FIM+FAM) and Northwick Park Nursing Dependency Scale (NPDS) completed by child's rehabilitation team on admission and discharge for all children aged 8 years and over. Descriptive and statistical analyses using Wilcoxon test.

Results: Twenty six children (mean 12.5 years, range 8-17 years; 12 F: 14 M) accessed residential rehabilitation programmes with a median length of stay of 23.2 weeks (range 8-40 weeks). The majority had self-care difficulties on admission requiring the assistance and support of 1 or 2 members of the nursing and care team. The total NPDS was 34.81 (mean) range 5-63 (NPND score >25 indicative of greater care needs and higher nursing dependency). Eight CYP were able to use the toilet independently to pass urine/have their bowels open, only two were able to dress themselves without assistance and just one was able to complete washing/ grooming, showering or bathing activities independently. The overall change from admission to discharge in UK FIM+FAM total score, motor and cognitive subsections scores ($p \leq 0.05$, $z = 3.48$, 4.37 and 4.46 respectively) and NPND score ($Z = -4.46$, $p < 0.001$) were statistically significant and reflected general improvement. While some CYP regained independence at discharge in many aspects of self-care (including bladder=11 and bowel function=12, washing=7, dressing=6 and bathing=4). Over 60% had ongoing care needs in relation to washing, dressing and bathing activities. Similarly, 34.6% and 50.0% respectively required care support to manage bladder and bowel function. A small number remained highly dependent reflected by the need for two carers to assist with self-care (bladder function=6, washing=4, dressing=4 and bathing=6) taking over ½ hour for each activity.

Conclusion: Children and young people with severe stroke make progress with self-care goals during a period of residential rehabilitation. However, a small but not insignificant proportion of young people return to the community with ongoing self-care difficulties, needing 1 or 2 carers to assist. This level of care is greater than expected for age matched peers and should be a priority for ongoing intervention in the community.

From Pump-Priming to Permanent Provision: An Effective, Cost-Efficient Model of Paediatric Neurorehabilitation for the NHS

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Objectives: Children and young people (CYP) who require rehabilitation after an acquired brain injury (ABI) often experience long lengths of stay (LOS) and poorer outcomes due to limited access to therapy and little proactive discharge planning. We describe the development, and early successes, of a multi-disciplinary paediatric neurorehabilitation team which has recently secured permanent funding within the NHS.

Methods: A multi-disciplinary team providing early assessment/intervention, integrated discharge planning and holistic outreach support for CYP requiring neurorehabilitation after ABI was formed after a successful pump-priming bid in 2014. All CYP admitted to hospital with an ABI or neurological injury requiring 7 days stay or more for paediatric neurorehabilitation were seen by the team. The primary aim was to reduce LOS, for which figures were collected after the team's formation and compared to baseline data. The secondary aims were to improve patient and family satisfaction. Satisfaction with the service was measured by the Commission for Health Improvement (CHI) Experience of Service Questionnaire and considered in comparison to patient/family feedback collected before the team's foundation. The data was analysed using descriptive statistics and the Mann-Whitney U two-tailed test. Linear regression models were used to investigate potential confounding variables.

Results: Prior to the neurorehabilitation team's formation, data collected in 2011 and 2012 showed that the 43 CYP requiring neurorehabilitation had a cumulative total LOS of 2642 days (median LOS = 31 days, interquartile range 16 and 69 days). In contrast, between October 2014 and September 2015, the new team supported 49 patients who had a cumulative total LOS of 2096 days (median LOS = 19 days, interquartile range 12.5 and 33.5 days). The difference between these two cohorts was statistically significant ($p=0.04$). This represented a large cost saving for the NHS Trust.

A qualitative survey conducted with families in 2011/12 highlighted themes of poor satisfaction, frustration with extended stays, and concerns about reduced quality of life and participation due to lack of ongoing post-discharge support. In the 2014/15 group, the CHI Experience of Service Questionnaire was returned by 26 families, a response rate of 53%. Overall, feedback was extremely positive, with families rating the support from the service at the highest level. In line with the hospital's Friends and Family Test, all families would recommend the service to others.

Conclusions: In light of the positive results from the team's first year, which demonstrated the benefits of this model of paediatric neurorehabilitation, commissioners agreed permanent funding from April 2016. Feedback and results continue to highlight the crucial role of early intervention, integrated discharge planning, and holistic outreach in contributing to improved outcomes, quality of life and participation for CYP treated for an ABI.

KidsBrainIT: Using Information Technology to Improve Childhood Brain Trauma Intensive-Care Management, Patient Safety and Outcome

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Introduction: Physiological monitoring in minute-resolution is the routine standard in paediatric traumatic brain injury (TBI) intensive-care management, but many paediatric intensive care units (PICU) only use lower resolution data (e.g. end-of-hour summary) for quality assurance and research purposes. This discards vital information, reduces data fidelity, and potentially compromises patient safety, clinical management, and outcome. We, therefore, aim to establish a new multi-centre, multi-disciplinary, multi-national data-informatics paediatric brain trauma research group (KidsBrainIT) to use high-resolution physiology data and information technology (IT) innovations to improve paediatric TBI patient care, safety, and clinical outcome.

Methods: KidsBrainIT is modelled upon the successful adult BrainIT group (www.brainit.org). Phase-1 is a proof-of-concept stage on the feasibility of linking 10 PICU from 4 countries within Europe to export anonymised prospectively-collected high-resolution physiological, clinical, and 6 month global outcome data to a central repository where abnormal physiology is quantified, using state of the art analytics such as intracranial pressure (ICP) dose-response, and its relationship to outcome determined.

Results: Minute-resolution physiological data of 89 TBI children were successfully exported from 2 contributing PICU within KidsBrainIT to-date. Using colour-coded dose-response plot, children with ICP above 20 mmHg longer than 8 minutes were associated with worsened clinical outcome. Furthermore, in a multivariate model, the cumulative ICP-time burden is independently associated with mortality.

Conclusion: KidsBrainIT brings together clinician and scientists from multi-centres to use high-resolution physiological data and IT innovations to improve TBI patient care, safety, and clinical outcome. Further studies are required to determine its long-term impact on TBI patient care and outcome.

Sleep Changes after Brain Injury: Lessons Learned from ABI and Melatonin Secretion Abnormalities in Children and Adolescents with Fetal Alcohol Spectrum Disorders (FASD).

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Introduction: There is growing evidence of negative changes in sleep after Acquired Brain Injury (ABI). We have studied such changes after various forms of ABI. Fetal Alcohol Spectrum Disorders (FASD) is the most common form of toxic prenatal brain damage and is caused by intrauterine alcohol exposure. FASD is associated with a wide range of somatic, cognitive and behavioural problems that pose extreme treatment challenges. According to parent/foster parent reports sleep problems affect approximately 85% of children with FASD; however objective data of sleep disturbances in this population is almost completely lacking. Circadian problems and melatonin secretion abnormalities are common in neurodevelopmental disorders in general. Although objective data concerning melatonin secretion in FASD is not available, rodent models have shown that prenatal alcohol exposure damages the suprachiasmatic nucleus and induces a chronic disruption of circadian rhythms. The aim of this exploratory study was to detect the features of melatonin secretion in children and adolescents with FASD in order to obtain preliminary, objective data of the biological underpinning of sleep disturbances in this population.

Methods: Twenty four children and adolescents with FASD (age M = 10.0, SD = 3.2, range 6-18; 55.6% females) participated in Dim Light Melatonin Onset Tests (DLMO). Hourly saliva samples were collected (for a total of 8 samples) according to a standard protocol. Partial melatonin curves were recorded.

Results: Seventy nine percent of the sample had abnormal melatonin secretion. The abnormal melatonin secretion profiles were classified into three main categories: delayed sleep phase syndrome (17%), advanced sleep phase syndrome (8%), or other melatonin abnormality (54%).

Conclusion: Abnormal melatonin profiles were common in this sample. Melatonin has been efficacious in managing sleep problems in other neurodevelopmental disorders as well as ABI and could be a promising treatment option for children and adolescents with FASD. The effective treatment of both sleep and circadian problems could optimize the development and everyday functioning of children after prenatal and/or ABI and ease the burden of their caregivers.

Health Related Quality of Life (HRQoL) after Pediatric Traumatic Brain Injury (TBI): Comparison Between Caregiver and Children Perspectives - A Focus Group Analysis

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Pediatric TBI might cause a series of different sequelae with potentially significant effects on patients' and entire families' functioning and HRQoL. No disease-specific HRQoL instrument exists for pediatric populations after TBI. The aim of the current project is to develop the QOLIBRI-KIDS/ADOS (Quality of Life after Brain Injury - Kids/Adolescents) instruments for concerned individuals aged 5-17 and their caregivers to assess subjective well-being of children and adolescents after TBI.

By focus group interviews we investigated aspects of HRQoL specific for children and adolescents and compared them to their caregivers' perspective. Half-structured interviews were conducted with separate groups of children and adolescents (N=19), sorted into three age-groups (5-6y, 7-12y, 13-17y) after mild, moderate and severe TBI and respective groups of caregivers (N=25) with the aim to discuss what matters for their daily life and HRQoL.

Preliminary results indicate that caregivers emphasize the importance of social and family support and how to care for/ treat their children after TBI. Traumatization of family members due to TBI was a further issue. Children expressed their desire not to be treated as "different". Additionally, feelings of guilt for being responsible for the TBI and its consequences were stressed by children and caregivers alike. Detailed results of children's focus groups are described in a manuscript by Gorbunova et al., 2017 (in prep.). Results obtained from this study will help to identify differences and similarities between children's and caregivers' views, which are essential to elaborate valid dimensions of the intended questionnaires for children, adolescents and their caregivers after TBI. The questionnaires will be developed simultaneously in an international context for three different age groups.

Bringing About Functional Change by Highlighting Needs, Providing Education and Recommendations

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Background: Effects of paediatric acquired brain injury (ABI) may not become apparent until the impaired area of the brain fully matures due to it occurring on the background of development.¹ Long term consequences remain poorly understood for mild-moderate ABI or those with a 'hidden disability'. They can be life-long and devastating.

Effects may be subtle although can have a substantial impact on a child and young person's (CYP's) learning, the activities they participate in as well the level to which they engage. These sequelae are often being misattributed as 'lazy or 'naughty'.

The Children's Trust is a UK charity, based just outside of London. The reach of the Brain Injury Community Team (BICT) extends to children and families across the UK through a multidisciplinary (MDT) team of Occupational and Speech and Language Therapists who specialise in paediatric ABI.

The Child and Adolescent Scale of Participation (CASP) 2&3 is used an outcome measure by BICT. CASP is a frequently used outcome measure (clinically and academically). Developed primarily for children with acquired neurological disorders, it is used to measure CYP's participation in home, school and community activities.

Methods: Systematic collection of CASP (parent) data before and after BICT intervention (n = 10).

Scores derived from CASP include total score and sub-total scores (home and community activities; home participation and community participation; school participation).

Non-parametric statistical analyses (Wilcoxon Test) to determine if changes post BICT intervention were statistically significant.

Intervention: BICT offers a range of interventions dependent on the needs of the CYP. This includes a comprehensive and holistic initial needs assessment; formal assessment of high level needs; individualised ABI education and a defined programme of clinical support to CYP, families and professionals involved using a consultative model and collaborative and holistic working. Focusing on function they work across home, school and community to increase CYP's participation.

Results: CYP with ABI (n=10): age range: 0-16years; 1 male: 9 females; 3 TBI: 7 ABI.

CASP (parent) statistical analysis: change in total score (0) and school participation (10) were found to be statistically significant ($p < 0.05$). Change was noted in home and community activities (21), home participation (18) and community participation (18) but was not statistically significant.

9 CYP only had an initial needs assessment, ABI education and provision of recommendations.

Conclusion: Specialist community support had a significant impact on a small group of CYP's environment at the level of activity and participation. A clinical MDT and consultative approach has a positive outcome despite some cases requiring only initial assessment, education and recommendation provided. Clinical input for CYP with ABI within the community is beneficial and needed. Greater understanding of long term and high level needs of CYP with ABI within the community is needed.

Health Related Quality of Life (HRQoL) after pediatric Traumatic Brain Injury (TBI): A Focus Group Analysis

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High prevalence and diverse long-term consequences of TBI on a personal and societal level underline the importance of assessment of disease-specific HRQoL after TBI as a measure of self-perceived subjective functioning and well-being. There are established generic instruments validated for pediatric TBI. However, a disease-specific instrument which may be even more sensitive for the TBI condition is still missing. Within the QOLIBRI-Project (Quality of Life after Traumatic Brain Injury) a specific multidimensional instrument with good psychometric properties was developed for adults; the aim of the current study is to fill the gap in this research field for the pediatric population with the QOLIBRI-KIDS/ADOS Project internationally.

In order to obtain a patient driven insight into what matters to the children and adolescents in their everyday life and wellbeing after TBI, focus groups were conducted at several clinics in Germany. Nineteen pediatric participants experienced TBI of different severity and their caregivers were interviewed in separate age groups (5-6y, 7-12y, 13-17y). In half-structured interviews topics as general happiness and satisfaction with everyday life, anger in everyday life, including limitations and disturbances, social life (family, friends), kindergarten and school, life changes after TBI, and care (medical and psychological) were covered.

Preliminary analysis with MAXQDA software revealed that most frequently discussed topics in the pediatric groups were social life, including close contact and support of family members and friends, mental processing, as well school problems. Younger children express deeper demand for family contact including tactile contact whereas for older participant's friendly support tend to play substantial role. Reported school problems and their intensity seem to have relation with degree of TBI experienced.

Results obtained from the study will provide important input in the questionnaire development with three age adapted modules with aim to monitor HRQoL in different care, rehabilitation and daily life contexts.

What Constitutes Legally Admissible Evidence to Support Youth Sports Brain Injuries?

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Introduction: Participation in youth sports is at an all time high, in both organized and recreational settings. Among the more popular organized youth sports are European football (soccer), American football, ice hockey, and rugby. With the increase in youth sports participation comes an increase in youth brain injuries. According to a 2007 CDC study, U.S. hospital emergency departments treat an estimated 135,000 youth sports-and-recreation related traumatic brain injuries (TBIs) annually, including concussions. Public interest in these types of injuries has recently increased, resulting in legislation designed to reduce the overall impact of traumatic brain injuries (TBIs) among young athletes. Additionally, heightened awareness of the risk of TBIs in youth sports has resulted in an increase in lawsuits against sports organizations, including schools and community education outlets, as well as individual coaches. As a result, prolonged litigation and rising legal costs may threaten the continued play of organized youth sports. The purpose of this work is to review the types of evidence legally admissible in court to support the diagnosis, prognosis and long-term consequences of TBIs and/or concussions among injured youth sports participants.

Methods: Drawing from research on a variety of scholarly evidence, medical journals, state statutory law and prevailing jurisprudence found in case law involving youth sports TBIs and concussions, this article discusses types of legally admissible evidence proffered in an action (lawsuit) to support claims for TBI/concussions and legal damages arising from youth sports.

Results: All fifty states, and Washington, DC, have youth sports TBI laws that require a young athlete to be cleared by a third party, usually a doctor, before returning to play. However, currently, there are no legally identified medical tests deemed admissible in court to support the diagnosis of youth TBI or concussion. Rather, courts turn to expert testimony to rule on the facts surrounding such claims. Specifically, courts take into consideration the expert's educational background, training, and experience; the expert's definition of TBI; and studies showing the relationship between the cause of the TBI (i.e. the type of blow to the head), the damaging effects on tissue within the brain, and how damage to the brain sustained in a sports concussion produces the symptoms associated with a TBI.

Discussion: Youth sports TBI legislation and emanating lawsuits is a new and emerging area of law. Methods of testing and diagnosing TBIs and concussions are also emerging; such diagnostic tools include blood tests, neurocognitive assessments and eye tracking. These diagnostic tools provide evidence that may be legally admissible in court as a means for the trier of fact (judge or jury) to assess and rule on the facts of a case that are related to the severity and impact of a youth sports TBI.

Is Traumatic Brain Injury More Likely to Be Associated with Psychological and Cognitive Impairment Than Non-Traumatic Brain Injury?

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Psychological and cognitive impairment are known sequelae of acquired brain injury (ABI) in childhood. Consequences for the patient and their family are often devastating and far-reaching. A greater understanding of the likelihood of psychological and cognitive impairment, following brain injury, would allow more accurate prognosis, and is essential to direct adequate resources to support this vulnerable patient group.

We present a retrospective study, based in a regional paediatric neuro-rehabilitation centre, which evaluated psychological and cognitive outcomes following traumatic and non-traumatic brain injury. Data was obtained using the Health, Functioning and Well-being Summary traffic light tool questionnaire, completed by patients and their families at follow-up appointments. The presence of difficulties was verified by clinician interview with patients and carers.

Data was analysed over an 11 month period, from August 2015 to June 2016, encompassing 81 patients, across 119 clinical encounters. Demographics for both groups mirrored previously published studies. Similar to previously published studies, there was a high incidence of psychological and cognitive difficulties in children post brain injury (53% had a psychological impairment; 41% a cognitive impairment). Contrary to commonly accepted belief, the non-traumatic brain injury group demonstrated a higher incidence of psychological and cognitive needs (71% and 57% respectively). Children with parenchymal involvement on imaging have greater reporting of cognitive impairment (statistically significant), and emotional or behavioural impairment (not statistically significant).

Further evaluation of this data is planned through a prospective study including use of quality of life tools. The data confirms the high frequency of psychological and cognitive needs following acquired brain injuries. We feel this data underpins the importance of recognising the need for psychological support for children with acquired brain injuries, regardless of mechanism. We expect these findings would be reflected in other neuro-rehabilitation units, and could be used to advocate for appropriate resourcing of psychological and cognitive support for children with ABI.

THE FUTURE: Are You Ready for 2020?

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This presentation will discuss the emerging technology with driverless vehicles that will revolutionize accessibility for accident victims. Further, the presenter will explore the impact on the medical, legal, and insurance industries. Other innovations will be discussed as well as their impact on tort law and accident benefits in general. Are you ready for 2020?

Factors for Consideration in Establishing Life Span Service Use for Children with Brain Injuries

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Life care plans (LCP) have emerged as a substantial sub-specialty of the rehabilitation health professions, over the past several decades. Barbara Baptiste and Susan Riddick-Grisham bring considerable clinical and private practice experience from the North American medical-legal perspective, providing expert input on the evolution of care plans since the 1980s for children with brain injuries (BI). Baptiste also brings considerable international experience. In addition, Baptiste as Founder and President of Rehabilitation Management Inc (RMI) and as a rehabilitation science specialist and researcher through the Rehabilitation Sciences Institute (RSI), University of Toronto - and Grisham as co-editor of the "Pediatric Life Care Planning and Case Management" textbook, and numerous other publications, and founder of The Care Planner Network - are both long-standing case managers and Certified Life Care Planners (CLCP). Both have a considerable part of their practice dedicated to children and adolescents with BI.

Life Care Plans (LCP) are developed based on what is medically justifiable and reasonable and supported by evidence. The funds from a LCP would be used to provide the child the support needed to position him/ her in a place that he/ she would most likely have been, within reason, should the injury not have occurred. Inherently, the goal is to enable the child's quality of life, from the stage of injury or trauma to the end of life. Thus, this also becomes a valued resource and support for the child's parents and/or significant others as they plan for their child's future.

An understanding of relevant life span issues is pertinent to the development of a comprehensive LCP. These issues are unique to the individual child and family and take into consideration personal, environmental, and injury related factors that may affect an individual for the remainder of his/ her life. As such, these factors will generally change as a child transitions into adolescence, adulthood, and older adulthood.

The factors discussed in this presentation will be framed according to International Classification of Functioning, Disability and Health (ICF). Developed by the World Health Organization, the ICF is used internationally as a universal language to classify functions, disability, and related factors. Both the US and Canadian experiences will be incorporated, and lessons learned over the past four (4) decades will be shared in an effort to improve access to services and quality of life, and the prediction and planning of life care needs and costs, for children with BI.

Natural Progression of Recovery from Concussion in a Pediatric Population

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Background: Pediatric concussion is an important and rapidly increasing health problem. Despite the high incidence of pediatric concussion, the natural progression of recovery is poorly described. While many studies have focused on the factors predictive of prolonged post-concussive symptoms, the natural progression of recovery remains unknown.

Objective: To investigate the epidemiology of pediatric concussion and to investigate the association between post-concussion symptoms, age, and sex over time.

Methods: This was secondary analysis of a prospective, multicenter cohort study of participants aged 5.00-17.99 years with acute (<48 hours) concussion presenting to 9 Pediatric Emergency Departments in Canada. Post-concussion symptoms were rated using the Post-Concussive Inventory (PCSI) at initial presentation, 1, 2, 4, 8 and 12 weeks. The PCSI is a valid and reliable developmentally specific self-report questionnaire for age groups 5-7 years (0-26 score range), 8-12 years (0-34 score range), and 13-17 years (0-120 score range). Recovery was defined as having no new symptoms compared to the perceived pre-injury score. The association between post-concussion symptoms, age (continuous variable within each PCSI age group), sex, and time was analyzed with 3 mixed-effect models of the total score PCSI measured at the 6-time points. The models included random effects adjusting for site and patient variability across all-time points and fixed effect indicators, including sex, age, time, sex X time, and age X time interactions. Model intercepts were centered at initial presentation.

Results: A total of 2980 participants were included in the analyses. Of these participants, 2250 [n=868 female (39%)] completed the 12-week follow-up, with 1450 [64%(95%CI:62%,66%)] fully recovered by that time [overall recovery: female 54%(95%CI:51%,58%); male 71%(95%CI:68%,73%), $X^2=63.9$, $p<0.001$]. Recovery by age-group: 5-7 [female 64%(95%CI:56%,71%), male 75%(95%CI: 69%,80%), $X^2=4.9$, $p=0.03$]; 8-12 [female 61%(95%CI:56%,67%), male 74%(95%CI:70%,77%), $X^2=15.1$, $p<0.001$]; 13-17 [female 45%(95%CI:40%,50%), male 65%(95%CI:61%,69%), $X^2=38.2$, $p<0.001$]. The mixed-effect models indicated that being female or older was associated with higher initial symptom scores, and that symptoms declined over time; significant main effects were found for female sex [5-7:($\beta=0.55$; 95%CI:0.17,0.93; $p=0.004$); 8-12:($\beta=1.01$; 95%CI:0.61,1.40; $p<0.001$); 13-17:($\beta=6.83$; 95%CI:5.02,8.63; $p<0.001$)]; age [8-12:($\beta=0.48$; 95%CI:0.29,0.66; $p<0.001$); 13-17:($\beta=1.62$; 95%CI:0.92, 2.32; $p<0.001$)] and time [5-7:($\beta=-0.35$; 95%CI:-0.39,-0.31; $p<0.001$); 8-12: ($\beta=-0.32$; 95%CI:-0.54, -0.10; $p<0.005$)]. Being female or older was also associated with a steeper decline in symptoms; both time X sex interactions [13-18:($\beta=-0.23$; 95%CI:-0.42,-0.041;

p=0.02)] and time X age interactions were significant [8-12:($\beta=-0.03$; 95%CI:-0.05, -0.01; p<0.001) and 13-18:($\beta=-0.10$; 95%CI:-0.17,-0.02; p=0.01)].

Conclusion: Most children fully recover from concussion within 3 months. A greater proportion of males and younger children have recovered by 12 weeks. Despite having higher initial symptoms, females and older children show more rapid decreases in symptoms over time. Age- and sex-based recovery curves developed from these findings will improve anticipatory guidance provided by clinicians to patients and families.

Language Outcome Following Childhood Stroke: Effect of Age at Stroke Onset and Stroke Hemispheric Lateralisation

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Background: Studies on language outcome following childhood stroke are rare. Previous investigations of language outcomes in patients with perinatal unilateral brain lesions reported no or only a minor effect of lesion lateralization. In adults, aphasia generally occurs after lesions of the left hemisphere. Little is known about the effect of age at stroke onset and stroke lateralization following post-neonatal unilateral brain lesions during childhood. The effect of stroke lateralization could depend upon age at injury. Therefore the aims of this study were to study language outcomes following childhood stroke, and specifically to examine the effects of age at stroke onset and lesion lateralization on language outcome.

Methods: All children with post-neonatal stroke hospitalized in a single rehabilitation center between 1992 and 2015 were included in this retrospective study: 184 children with hemorrhagic (n=105) or arterial ischemic (n=79) stroke occurring between 1 month and 15 years of age. Comprehensive language assessment, performed using standardized age adapted tests, after a median time since stroke of 3 months, was available for 130 children.

Results: Lesion localization was right hemisphere (n=43), left hemisphere (n=93), bilateral (n=24), or posterior fossa (n=24). Language tests revealed severe impairment. The 4 language skills tested (receptive and expressive, semantic and syntax) were impaired, especially word finding (median SD=-2). Overall, significant impairment was found (scores <-2SD) in 26% of the children for lexical extent, 53% for word finding, 38% for syntactic comprehension and 47% for syntactic expression. Overall, language scores were equivalent and higher (but lower than expected) in right hemisphere and posterior fossa lesions, intermediate in left hemisphere lesions and lowest in bilateral lesions. A positive correlation between age at stroke onset and language scores (i.e. the later the lesion the better the language) was observed in right and marginally bilateral lesions but not in left and posterior fossa lesions. A stroke lateralization effect on language (i.e. better language after right lesion) was absent when stroke occurred before 6 years of age, present but not significant for stroke occurring between 6 and 9 years, and significant for stroke occurring after 9 years of age.

Discussion and Conclusion: These results confirm an interaction between age at stroke onset and lesion lateralization on language outcome, and are discussed in relation to current views on hemispheric lateralization for language.

Longitudinal Changes in Adaptive Functioning Following Preschool Mild Traumatic Brain Injury: Growth Curve Analyses

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Introduction: Paediatric traumatic brain injury (TBI) is associated with acute and persistent impairments in a range of functional domains including cognition, behaviour, and social skills (Beauchamp & Anderson, 2013). TBI is particularly prevalent in children under the age of six years (“preschoolers”) and at such an early age can lead to elevated risk of poor developmental outcomes. Together, the consequences of paediatric TBI can affect how children adapt to their environment in daily activities. Adaptive behaviour impairments, particularly in the social domain, have been reported in children with severe TBI, but are not typically found in children with mild TBI (mTBI, Catroppa et al., 2008; Shultz et al., 2016). However, no studies have addressed temporal trajectory of adaptive abilities following preschool mTBI. We conducted a prospective cohort study conducted in a tertiary care pediatric hospital to explore time course changes in adaptive functioning following mTBI in preschoolers using growth curve modeling.

Method: Parents of 66 children with mTBI (30 girls) and 54 with orthopedic injuries (OI; 29 girls) aged between 1.5 and 5 years at the time of injury, completed the Adaptive Behavior Assessment Scale-II (ABAS-II) at baseline (retrospective assessment of pre-injury functioning) and at 6 and 18 months post-injury. The two groups did not differ significantly on age at injury, sex, race, or parents’ socioeconomic status. For each domain of adaptive functioning (conceptual, practical and social), growth curve analysis was performed in R using the lme4 package to explore group differences at baseline and on the rate of change over 18 months post-injury.

Results: Conceptual and practical domains: There was no effect of group at baseline (conceptual: $\chi^2(1) = 0.14$; $p = .70$; practical: $\chi^2(1) = 0.46$; $p = .49$), nor on the rate of change across time (conceptual: $\chi^2(1) = 0.06$; $p = .80$; practical: $\chi^2(1) = 1.08$; $p = .29$). Social domain. There was no effect of group at baseline ($\chi^2(1) = 0.08$; $p = .77$), but a significant effect of group was found on the rate of change across time ($\chi^2(1) = 4.9$; $p = .02$), with an increase in social abilities over time in the OI group, but no such improvement in the mTBI group.

Conclusions: Findings suggest that mTBI sustained during the preschool period affects the temporal evolution of social adaptive behaviour, but does not appear to affect conceptual and practical domains. This is consistent with the notion that social problems may be among the most debilitating consequences of TBI (Yeates et al., 2007). We observed that social abilities continued to increase over time after OI, whereas they stayed at pre-injury levels after mTBI. Thus, mTBI may disrupt the expected developmental improvement in preschoolers’ social abilities.

A New Comprehensive Tool-box for Assessment of Children's Outcome After Pediatric ICU Admission due to Traumatic Brain Injury (On Behalf of the CREATIVE Consortium)

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Traumatic Brain Injury (TBI) necessitating admission to pediatric ICU (PICU) is a dramatic experience both from physical and emotional perspectives. CREATKids is the pediatric sub-study of the CREATIVE consortium, investigating TBI as part of InTBIR initiative. We aim to study how TBI affects children wellbeing and long term outcome. Expert group (developmental psychologists, pediatric sleep, psychiatric trauma, neurosurgeons, rehabilitation, epidemiologists) led by PICU specialists, developed a comprehensive tool-box assessing impairment and disability in these children.

Methods: Patients are assessed at three time points: Time-0: On admission, parents describe their child's pre-injury sleep, emotional and behavioral characteristic using structured questionnaires; phone call interview 5 months' post injury - assessing use of rehabilitation, child's outcome and quality of life; Time-1: face to face meeting six months post injury, parents fill in same questionnaires as in T0 and also, children are tested with computerized, age-specific, tasks aimed to detect impairments in inhibition, working memory, numerical cognition and attention. The child undergoes a short physical examination.

Questionnaires: All tools are age specific as standard in pediatric research. Temperament: (36/37 items each) IBQ (ages 3months – 14months), ECBQ (ages 14months – three years) and CBQ (3-7 years). Sleep: BISQ (ages 0-3 years), CSHQ (3-12 years) and "school sleep habit survey" (13-18 years). Other: SDQ (2-18 years) behavioral emotional and social problems and their effect on the family. PTSD-RI symptoms of post-traumatic stress disorder (PTSD). PedsQL - measures Physical, emotional, social, and school functioning and quality of life. GOS-E Peds. provide an age-appropriate, measurement of outcome post TBI.

Neuro-Cognitive Tasks: Go/NoGo – assesses inhibition. N-Back - working memory assessment. Corsi - assesses visual (spatial) working memory. Dot Comparison – assess the sensitivity of patients' numerical perception. ANT - providing separate measures for the three different attention networks: Orienting, Alerting and conflict resolution.

Platform: All the assessment tools are computerized and based in a central server (Mario Negri Institute, Milan, Italy). Participating centers access the tools in a secured on-line connection. Computerized tasks are performed with a dedicated touch-screen monitor (Lilliput UM 1010T) in order to create standardization and an intuitive approach to the tasks among participants. Data is saved (anonymously) and analyzed on a centralized server. The Tool-box is currently translated to all participants' native languages (English, Italian, Arabic and Hebrew) and easily can be further translated to others using our online web translator.

Conclusion: The CREATKids tool-box is a novel comprehensive toolbox that uses age specific, state of the art measures to assess sleep, neurocognitive, behavioral, physical and emotional dimensions after TBI. It is distributed using secured internet connection and is centrally analyzed. The tool-box achieves high compliance rates among patients, with each session taking less than one hour to complete.

Outcome of Children after Traumatic Brain Injury - First Results of the CREATKkids Study (On Behalf of the CREATIVE Consortium)

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CREACTIVE multinational project, follow patients with moderate-to-severe traumatic brain injury (TBI), as part of the global InTBIR initiative. Patients outcome are measured in terms of injury-related disability and quality of life at six months post injury. CREATKkids is the pediatric sub study which is led by a team from Ben Gurion University of the Negev in Israel. The Pediatric ICU at Soroka University Medical center is the first to fully implement the study tools and we present our methodology and center's results.

Materials and methods: Common Data Elements endorsed by InTBIR are collected, along with items required to develop a sensitive prognostic model. Clinical data is collected via computerized software built and maintained by the CREATIVE study center situated in the Department of Clinical Epidemiology of Mario Negri institute, Ranica, Italy. Patients outcome are followed-up with separate Tool-box built for CREATKkids study. The tool-box assesses impairment and disability in sleep, behavioral, emotional and neurocognitive dimensions and is distributed via the computerized software using both questionnaires and computer based neurocognitive tasks on designated touch screen. We present the first CREATKkids results from our PICU: Two years descriptive results, Tool-box assessment pilot study and TBI-patients outcome assessment.

Results: Descriptive data: 1280 patients were admitted to our PICU during 2014-2015, 105 (8.2%) due to TBI. Mean age was 5.1 years, 68% were male. 95% came from the emergency room; 94% came from our hospital. Co-morbidity from other diseases was rare. Most head injuries were closed (84%) from low energy falls or traffic accidents; 58% of cases had focal injury, half of them with subarachnoid hemorrhage. 7.5% had diffuse injury. Overall ICU mortality was 2.8% and average length of PICU stay was 2.5 days (median 1 day (1-23)). Tool-box pilot study: the aim was to assess the feasibility of our toolbox to be submitted and complete follow up in diverse PICU patients. 52 PICU patients were approached and 49 consented to participate. 36 (73%) completed phone-call follow-up and 18 arrived to the face to face meeting. We concluded that our Tool-Box is a practical and easy to distribute tool. CREATKkids 6 month follow up outcome preliminary results: Recruitment rate was 50% of TBI parents consenting to participate in the study of them 86% completed the follow-up procedure. Half of the patients that completed the procedure presented symptoms of PTSD in mild to severe manifestation. More than 60% of the patients presented sleep disorder that were not present before the injury. All but three patients completed the computer tasks. All patients passed a short physical examination, physical disability was rare.

Conclusions: We present the first pediatric results of our CREATKkids study which brings important information on Post TBI outcome in children.

Improved Executive Functioning Following Pediatric Goal Management Training in Children with Traumatic Brain Injury: A Pilot Study

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Background: Executive functioning (EF) involves higher-order cognitive processes that control cognitive, emotional and behavioral functions. Executive dysfunction causes significant real-life disability for children with traumatic brain injury (TBI), and efficient interventions aimed at improving EF are needed. Goal Management Training (GMT) is a cognitive rehabilitation intervention for improving EF that has received empirical support in studies of adults with TBI. The purpose of this pilot study was to determine if a newly developed pediatric GMT protocol (pGMT), would lead to improvement in EF in children with TBI, as evidenced by improved executive attention and reduced report of dysexecutive symptoms in daily life six months post-intervention.

Methods: Four children (two girls, two boys) aged 13, 15, 15 and 15 years with TBI, were included, based upon the presence of EF problems as described by parents. The participants received 21 hours of pGMT, using three inpatient intervention periods (two + two + three days) with approximately one week at home in between. This was followed by four hours of pGMT outpatient guidance over a period of eight weeks. Changes related to executive function at baseline and six months follow-up included Conners' Continuous Performance Test II (CPT-II; executive attention), and a questionnaire of everyday manifestations of executive dysfunction (Behavior Rating Inventory of Executive Function (BRIEF) self-report).

Results: Comparisons of pre- and six months post-intervention (Wilcoxon Signed Ranked Test) showed a reduction in CPT-II commission errors (i.e., non-target responses), with mean commissions being reduced from 20 (SD=8) to 13 (SD=8), approaching significance ($p=.07$). A similar trend was found for perseverations ($p=.07$) and detectability ($p=.07$), with subjects showing fewer perseverative responses and improved ability to distinguish and detect X and non-X stimuli. Although a decrease in dysexecutive symptoms (all BRIEF Indexes and overall score) following intervention was detected at six months follow-up, these failed to reach significance. Of note, three of the children reported a clinically significant improvement (i.e., ≥ 1 SD change in overall T-score) on the BRIEF six months post-intervention. Additionally, effect-size estimates indicated large intervention effects ($r >.5$) for the CPT-II variables, and medium ($r >.3$) to large intervention ($r >.5$) effects for the BRIEF variables.

Conclusions: These preliminary results suggest that pGMT may have the potential to improve executive attention and reduce executive difficulties in daily life for children with TBI. Hence, pGMT should be further explored amongst children with acquired brain injury. Studies with a larger sample size and stronger randomized controlled study design are warranted.

Evolution of a Pediatric NeuroRehabilitation Program: Drivers of Change in 28 years of Clinical Practice

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The Milestones' Pediatric NeuroRehabilitation Program (PNR), Michigan Medicine, University of Michigan, was implemented in 1989 to serve as a bridge between inpatient hospitalization and return to school and social/recreational pursuits. Since 1989, over 680 children/teens have participated in the interdisciplinary program, staffed by an experienced team of professionals with expertise in acquired brain injury rehabilitation. In reviewing 28 years of clinical intervention, we have identified several developments that have influenced or changed the treatment model for children with acquired brain injury. This paper will delineate changes implemented in the PNR program and their impact on a comprehensive pediatric rehabilitation model.

In 1989, children discharged from C. S. Mott Children's Hospital with moderate to severe acquired brain injury were enrolled in the PNR outpatient program for comprehensive, daily treatment. The majority of children had been injured in an auto accident, which triggered Michigan's unique auto no-fault law. This law provided wrap-around rehabilitation services, including paid attendant care, home modifications and unlimited rehabilitation therapy. The treatment team provided a combination of individual and group therapies averaging [15-25] hours per week with a graduated return to community and therapeutic activities. Family members were invited to participate at initial and discharge meetings, receiving support from a case manager. Technology included use of AAC devices. A constraint-induced therapy program was implemented to foster use of paretic upper extremities. Average length of stay was 4-5 months of high intensity treatment, with decreasing treatment intensity as a child was guided back to an educational or vocational setting with appropriate accommodations.

Twenty-eight years later, we have identified multiple changes in the treatment model. The presentation will discuss the following trends:

- A changing patient mix with significantly fewer patients with motor vehicle-related TBI and increase in patients with non-traumatic acquired brain injury
- Significant changes in health-care reimbursement models resulting in shorter hospital stays and limits on rehabilitation therapy benefits
- Infusion of a patient-family centered philosophy, with resultant changes in team meetings, treatment provision and communication among clinicians and family members
- Impact of new technologies on rehabilitation intervention for children and teens
- Incorporation of a variety of adapted recreational activities, guided by therapists, to augment individual and group therapies
- Continued positive impact of Michigan's 1973-enacted No-Fault Auto law on rehabilitation and family support for children/teens injured in motor vehicle collisions; we discuss the concept of expanding this model to all individuals who have experienced significant neurologic sequelae
- Impact of the 2004 IDEA TBI classification on return-to-school accommodations along with general changes in special education

The presentation will conclude with a discussion of the challenges and opportunities to maintain and refine comprehensive, interdisciplinary neurorehabilitation programs in the context of medical, educational, and social changes.

Does Medical Diagnosis Determine How We Develop Neuropsychological Rehabilitation Programmes for Children with Demyelinating Conditions Such as Multiple Sclerosis?

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Objective: With an incidence of 9.83 per million children per year, paediatric onset multiple sclerosis (MS) is rare. It does, however, present challenges for differential diagnosis alongside other demyelinating syndromes, such as Acute Disseminated Encephalomyelitis (ADEM) and other acquired demyelinating conditions, making diagnosis complex in this population. Cognitive difficulties, fatigue, and neuropsychiatric disorders are increasingly recognised as significant co-morbidities in this paediatric population. Early diagnosis creates access to appropriate personalised treatments, providing the best opportunity to significantly improve cognitive outcomes, lessen motor disability and reduce long-term healthcare costs. We highlight the different trajectories related to diagnosis and how this may influence our neuropsychological assessment and development of neuro-rehabilitation programmes for the child, incorporating the family and wider healthcare and education systems.

Method: We present the neuropsychological assessment data (Delis-Kaplan Executive Function System; Wechsler Intelligence Scale for Children, Children's Memory Scale, Behavior Rating Inventory of Executive Function) for two children with an initial diagnosis of ADEM; one subsequently diagnosed with MS which is later altered to Myelin Oligodendrocyte Glycoprotein (MOG) antibody mediated encephalitis.

Results: Case 1 presents with average IQ and memory, significant deficits in executive function, including behavioural regulation and hyperactivity. Their diagnostic journey is indicated as recurrent ADEM leading to a diagnosis of MS at 16 years old, later changed to MOG antibody mediated encephalitis. Case 2 presents with deficits in cognition, including memory and executive function, following ADEM diagnosis at a young age.

Conclusions: The onset of MS and related disorders in childhood is rare and lack of awareness frequently results in diagnostic delay. We consider how recent advances in medical investigation have uncovered numerous demyelinating syndromes impacting on the challenge of diagnosis of ADEM, MS and other demyelinating conditions. We question whether we are meeting the neuropsychological needs of these young people due to our limited understanding of the complex and differential diagnoses. We discuss how this influences our assessment and development of neuropsychological rehabilitation programmes for these children.

The Changing Focus of Post-Treatment Neuropsychological Care After Childhood Brain Tumour: A Move Away from the Medical Model

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Background: With improvements in medical treatment, the needs of children post-childhood brain tumour are evolving, and long-term survivorship and quality of life are increasingly on the agenda. As children are surviving with more complex health and rehabilitation needs, neuropsychology services have needed to develop accordingly. It has been important to recognise that previous assessment-based input may not be meeting the broader needs of these young people and the professional teams around them. Increasingly the need for a more proactive stance that accompanies children and young people (CYP) on their journey post-diagnosis has been indicated. We describe the paediatric neuropsychology service within a regional NHS neurosciences centre in the UK. The service has evolved to incorporate this changing picture, and in 2010 set up a new neuropsychological rehabilitation pathway for CYP with a brain tumour. This has focused on ongoing neuro-rehabilitation within a multi-disciplinary (MDT) team.

Discussion: As a result of the long-term needs of CYP in our centre, the services provided through the paediatric neuro-oncology MDT has evolved to consider more effective ways of providing input to children post-brain tumour. The MDT includes professionals from medical, nursing, therapy, charitable, neuropsychology, clinical psychology and education services. Over the last seven years, a number of development ideas have been generated, through both information gathering projects and general clinical practice. These ideas have included awareness days for parents, 'Moving On' sessions for young people who have completed treatment and end of treatment days; each incorporating input from the paediatric neuropsychology service. The service has also delivered parent/carer support and information groups about the cognitive, emotional and behavioural impact of a brain tumour.

We use case examples to outline the role of the neuropsychology service within these developments, detailing the pathway of the child from diagnosis, through treatment, and their post-treatment journey. We also present the positive and constructive feedback provided by patients and professionals from our involvement in these service developments. We discuss how this proactive work with the MDT and education settings has strengthened relationships with our patients, their families and health, social care and education teams surrounding the CYP and family. We also highlight the positive outcomes of proactively providing support which has resulted in less 'fire-fighting' and entrenched problems in the years following diagnosis.

Summary: The changing focus of services for CYP diagnosed with a brain tumour is encouraging. Our service has demonstrated the improvements in care evident in moving away from a primarily medical model towards more holistic support incorporating proactive neuropsychological input. This can both enable more effective reengagement, and enhance participation in education, and the community alike.

The Swedish Version of the Brain Injury Family Intervention for Adolescents (BIFI-A) with Acquired Brain Injuries: A Pilot Study

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Background: Families having a child surviving ABI report high levels of stress, burden and significant levels of anxiety and depression. Given the long-term negative effects on family system functioning and the bidirectional child-family influences on pediatric ABI outcomes, it is critical to look at effective ways of supporting families after ABI.

Aim: To test feasibility of the newly translated Swedish version of the Brain Injury Family Intervention for Adolescents (BIFI-A) and to evaluate whether further modifications and adaptations might be needed before evaluating its efficacy in a larger controlled study.

Method and Procedure: The Brain Injury Family Intervention for Adolescents (BIFI-A) developed in Toronto, Canada is a program based on cognitive behavioral therapy and family therapy principles. The manual contains 11-topics focusing on education, skill building, emotional support and family functioning. Previous studies provide evidence that BIFI-A is a promising family system intervention. The BIFI-A manual was translated into Swedish and adapted to Swedish culture. Four psychologists and one social worker were educated to be treatment therapists. The feasibility of the intervention program was then tested on five families with adolescents suffering from ABI. Descriptive/exploratory self-administered questionnaires and semi-structured interviews with the family members and the therapists were used.

The aspects observed were:

1. Number of family participants; at least parent and patient.
2. Session duration; enough, short of time or too long.
3. Comprehensibility; did the participants understand the session topic?
4. Relevance; was the topic relevant to the invited family?
5. Progress; do they progress from session to session? Do they work between the sessions? Do they need more help or time?

Results: All five families completed the whole intervention program. According to the therapists were the topics comprehensible and relevant for the participating families, but individual adaptations were needed due to age of patient/sibling, language ability and grade of injury. The session duration lasted 1-2 hour/session depending on the subject. After the intervention with BIFI-A, all participating families reported that they would recommend the intervention program to other families having an adolescent surviving ABI. The topics were described as important, comprehensible and relevant for the families, but with individual differences and focus due to the age and injury of the adolescent. Preliminary outcome data from the questionnaires and interviews showed tendencies of reduced parental depression and anxiety as well as higher family functioning.

Conclusion: The study indicates that the Swedish version of BIFI-A is an acceptable and feasible intervention with families having an adolescent surviving ABI. However, the Swedish version still needs modifications and adaptations to Swedish culture before conducting a large scale study on effectiveness.

Heart Rate Variability following Youth Concussion: How do Autonomic Regulation and Concussion Symptoms Differ Over Time Post Injury?

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Background: Concussion is a common injury amongst Canadian youth, with those playing sports nearly six times more likely to sustain a concussion. Beyond the neurometabolic cascade that ensues, concussion is more recently being viewed as a form of autonomic dysregulation whereby homeostasis between the sympathetic and parasympathetic arms of the autonomic nervous system is perturbed. Traditional forms of assessment in youth concussion have relied heavily on the self-report of subjective symptoms. This may be problematic in a population in which concussion-like symptoms are present at baseline, and in those with high incentives to return to sport. Heart rate variability (HRV) has emerged as an objective, non-invasive measure that quantifies the variability between beat-to-beat intervals and has the potential to provide neurophysiological information across the recovery trajectory.

Objective: (1) To explore the effect of concussion on heart rate variability across days post injury in youth athletes; (2) Examine the relationship between subjective post-concussion symptoms (physical, cognitive, emotional, fatigue) and heart rate variability in concussed youth athletes.

Methods: This repeated measure, longitudinal study was comprised of 29 concussed male and female youth athletes between the ages of 10 to 18 years old and 15 age and sex matched controls (total N=44). Participants completed pre-season baseline testing, which included demographic information (age, sex, concussion history), self-reported concussion symptoms (Post Concussion Symptom Inventory [PCSI]), and a 24-hour heart rate recording (via chest strap and watch). Post-concussion symptoms and HRV were collected weekly while the participant was symptomatic and then 1, 3, and 6 months following symptom resolution.

Results: Of the 29 concussed athletes: 8 male/21 female; 15 years old +/- 1.47 years; history of concussion: no history (N=16), 1 prior concussion (N=8), 2 or more prior concussions (N=5). Preliminary results using linear mixed effects modeling indicate changes in heart rate variability across the recovery trajectory, uniquely different from changes in post-concussion symptoms. More rigorous analysis and final results on main effects (while accounting for age and sex) are underway and will be generated for conference presentation. It is expected that sex and concussion symptoms will have an influence on heart rate variability following concussion.

Conclusions: This study explores heart rate variability using a longitudinal design for the first time amongst a pediatric population, while considering demographic influences such as age and sex.

Implications: These preliminary findings enhance the understanding of corroborating subjective (self-reported symptoms) measures with objective (heart rate variability) measures in the context of examining

clinical and physiological recovery trajectories. Clinically, this study can act to extend traditional concussion management protocols in assessing factors beyond subjective self-reporting of symptoms.

Evaluation of an Allied Health Professional Led Clinic in Acquired Brain Injury

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Objective: To establish the child and family experience of attending an allied health professional led clinic in acquired brain injury/stroke at Evelina London Children's Hospital.

Background: Clinical experience suggests children and young people who experience acquired brain injury (ABI) and their families have a wide array of support, information and health care needs that evolve over time. Having established a tertiary-level allied health professional (AHP) led specialist service with regional coverage and working closely with community based services we evaluated the experience of service users. This information will be used to inform future service developments to best meet the needs of our patients and their families.

Methods: Participants were recruited from Evelina London Children's Hospitals ABI recovery clinic. Twelve parents participated in the telephone interviews asking open-ended questions regarding their experience of the service. All participants were parents of children/young people who had been diagnosed with an acquired brain injury. The families had received a range of services from consultation and advice through to partnership intervention with their local community therapists. The interviews were voice recorded, transcribed and themes elicited.

Results: The following themes were identified. i) a tertiary level consultative approach with professionals who cared about the wellbeing of their child and family is valued. ii) Collaboration with local therapists has been identified by families as improving the coordination of care through information signposting and potential intervention iii) access to intensive intervention in partnership with the family and local therapy teams has improved outcomes for the child/young person, iv) through intensive intervention collaboration, parents have identified increased confidence in playing with and understanding their child's needs.

Conclusion: Parents value the opportunity to receive specialist AHP advice delivered in coordination with community based services with a focus on daily life abilities. Practical suggestions for service improvement were offered by parents and aim to be implemented into improving outcomes for families and children seen in the clinic.

Exploring Functional Connectivity Alterations to Varying Cognitive Loads: Developing A Model for Youth Concussion

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Introduction/ Background: Concussion in youth often results in lingering symptoms and executive function deficits that cannot be identified with current clinical imaging methods. More recently, the use of functional connectivity (i.e. communication) between brain regions has shown potential to be used as an objective measure of injury. In addition, complex cognitive dual-task paradigms are more sensitive to underlying disruptions following a concussion⁵. Therefore, the aim of this study is to evaluate executive function connectivity patterns (dorsal lateral prefrontal cortex [DLPFC]), during single and dual task completion in healthy youth in order to create a model of comparison for youth with concussions.

Methods: Six healthy youth (mean age 15.1±1.9 years; 5 females, 1 male) completed 5-minute resting state, single (Stroop Interference and postural sway) and dual tasks (single tasks simultaneously). Brain activation was measured with the Hitachi ETG-4000 fNIRS system (Hitachi Medical Co, Japan). A seed based approach was used to evaluate the left DLPFC via localization by 10-20 EEG coordinate estimation and verified with maximal hemodynamic activity during the Stroop task. Pearson R correlation coefficients were used to evaluate intra- and inter- functional connectivity. Pairwise T-test were used to evaluate connectivity changes between each state. Additionally, correlation analysis between connectivity results and performance (accuracy and reaction time) were completed.

Results: While participants completed the Stroop task, intra-hemispheric connectivity increased in comparison to connectivity at resting state (M=0.23, SD=0.06, N=6, P<0.01), balance ((M=0.24, SD=0.18, p<0.01), and dual task (M=.23, SD=0.21, p<0.05). Whereas interhemispheric connectivity was only significantly greater than resting state (M=0.18, SD=.18, p>0.05), and balance connectivity (M=0.16, SD=.14, p>0.05). When evaluating connectivity in left DLPFC during rest, balance and dual-task conditions, there were no significant changes to intra- and inter-connectivity measures. Increased accuracy during Stroop task was significantly correlated with increased inter- and intra- hemispheric connectivity during single (R=.87, p=0.04) and dual-task (R=.89, p=0.02), respectively.

Conclusion: Inter- and intra-hemispheric connectivity values are altered in specific brain regions during different cognitive or physically demanding tasks. Functional connectivity during dual-task was not significantly different from resting state, which could be due to altered communication between other brain regions, or possibly due to the increased cognitive demands on the brain. By establishing connectivity patterns in healthy youth, a framework for evaluating youth who have sustained a concussion may be valuable.

What Are We Doing in the Acute Phase of Paediatric Speech and Language Therapy Brain Injury Rehabilitation?

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The role of the speech and language therapist (SLT) within the acute phase of rehabilitation following childhood brain injury is acknowledged in the Royal College of SLT's Resource Manual for Commissioning Speech, Language and Communication Needs (RCSLT 2010) and Royal College of Physicians Stroke in childhood: clinical guideline for diagnosis, management and rehabilitation (RCPCH 2017). The International Classification of Functioning SLT Brain Injury management framework (ICF BI SLT 2010) outlines the types of therapeutic interventions which may be indicated for acquired speech, language, swallowing and cognitive-communication difficulties. Within the acute phase early SLT assessment, diagnostics and tailored programmes of intervention are equally highlighted alongside promotion of wellbeing, training and education of both staff and significant others as being key to rehabilitative success. Despite this recognition of the SLT role, the RCSLT highlights that due to the complexity of this group capturing the specific role and value of the SLT and its impact on clinical outcomes remains difficult.

This retrospective study of 21 children with brain injury (mean age= 9:0yrs range 0:2mths: 15:8yrs), profiles the SLT interventions delivered over an average admission time of 50 days (range 4-272 days) at a tertiary trauma hospital in London, UK. 9 children had suffered a traumatic brain injury (SAH = 2, DAI = 4, skull # = 5, SDH = 2) and 12 children had an acquired brain injury (ischaemic stroke = 4, NMDA = 1, encephalitis = 1, MELAS = 1, ICH = 2, ADEM = 2, Empyema = 1, post fossa tumour = 1). It profiles the type of therapy delivered compared to the ICF BI SLT management framework (including qualitative description of therapy given) and time and frequency (avg time/session/day, hrs /week) of interventions. Initial and final clinical outcomes are reported (11: Dysphagia), (4: Dysarthria), (14: Aphasia), (2: Dysphonia), (8: Cognition) using Enderby (2016) Therapy Outcome Measures (TOM's).

This study provides a localised review of therapeutic interventions compared to the ICF BI SLT evidence based framework and how this correlates with clinical outcomes. Data collected may also outline the proportion and pattern of interventions used for different aetiologies and presentations of acquired speech, language and swallowing difficulties and how this may impact on increasing clinical outcomes for children. It is hoped that this study will serve to promote the role of the acute SLT for children and families after brain injury to guide and support development of local pathways, standards of care and specific commissioning.

Association Between BDNF Val66Met Polymorphism and Internalizing Behavioral Problems After Mild Traumatic Brain Injury in Preschool Children

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Background: Behavioral impairments are among the most widespread consequences of pediatric traumatic brain injury (TBI). However, the emergence of such impairments is difficult to predict as they depend on a complex interaction between injury characteristics, child-related variables and environmental factors. In addition, recent studies suggest that certain genes may be involved in post-TBI outcome through their contribution to neuroplasticity mechanisms. For example, the BDNF gene plays an essential role in synapse formation, learning and development and protein concentrations of BDNF increase in the acute phase post-injury. Of note, the Val66Met polymorphism of the BDNF gene (frequency of 20-30% in Caucasian populations) is associated with decreased regulated secretion of BDNF.

Objective: The aim of this study was to investigate the association between the presence of the BDNF Val66Met polymorphism and internalizing behavior problems (e.g., anxiety and depression) after preschool (i.e., 18-60 months old) mild TBI. We hypothesized that internalizing problems would be more prevalent in the mild TBI group compared with control groups, especially for carriers of the Val66Met polymorphism.

Methodology: This work is part of a prospective, longitudinal cohort study of preschool TBI. Participants (N=121) were recruited to one of three groups: children with mild TBI, typically developing children (TDC) and children with orthopedic injuries (OI). After DNA extraction from saliva, genotype profiling of BDNFval66met was performed with PCR followed by pyrosequencing. Mothers of children in all three groups completed the Child Behavior Checklist as a measure of behavioral outcome six- and twelve-months post-injury.

Results: At six months post-TBI, there is a significant group x genotype interaction, such that children with mild TBI exhibit more internalizing behaviors than those with orthopedic injuries and controls, but only for non-carriers of the Val66Met polymorphism. These results are counter to our initial hypothesis and suggest that during this particular developmental window (18-60 months old), the lower protein secretion conferred by the BDNFval66met may consist of a protective factor for the development of behavior problems. At twelve-month post-injury, however, reports of internalizing behavior were equivalent for the carriers and the non-carriers.

Conclusion: These results will be discussed in light of the developmental approach proposed by Casey & colleagues (2009) to interpret the effects of gene-related alterations on neuroanatomic and behavioral phenotypes.

Longitudinal Assessment of Cortical Excitability in Paediatric Traumatic Brain Injury

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Introduction: Recovery from mild traumatic brain injury (mTBI) is variable, with symptoms persisting past 3 months in 10-15% of children. Mechanisms of neurotransmission in mTBI recovery are poorly understood, however prior evidence suggests neurotransmission mechanisms are altered after an mTBI. The role of altered neurotransmission in post-concussive symptom persistence in children is unknown. Transcranial Magnetic Stimulation is a non-invasive brain stimulation technique that can be used to investigate neurotransmission post-injury by measuring alterations in cortical excitability in the superficial layers of the cortex.

Objective: The aim of this study was to determine if cortical excitability is altered following mTBI in children, and compare its relation to symptomatology at one and two months post injury.

Methods: This was a prospective controlled cohort study of children (aged 8 to 18 years) with mTBI. The Post-Concussion Symptom Inventory (PCSI) was used to determine recovery status (symptomatic vs. asymptomatic).

Control group: Healthy children without a history of neurotrauma and of similar age, sex and socioeconomic circumstance.

Procedure: Cortical excitability was measured using single and paired pulse TMS paradigms at one and two months post injury.

Outcome measures: The primary outcome was long interval cortical inhibition (LICI), a measure of GABA mediated cortical inhibition. Secondary outcomes included alternate TMS paradigms.

Results: Ninety-five children with mTBI (62 symptomatic, 59% female, mean age 14.07, SD=2.51, 33 asymptomatic, 45% female, mean age 13.71, SD = 2.57) and twenty-nine healthy controls (48% female, mean age 14.25, SD=2.97) were enrolled. Long interval cortical inhibition (LICI) values decreased (showing greater inhibition) between session one (40 days post injury) ($F(1, 59) = 5.70, p = 0.020$) than at session two (70 days post injury).

Conclusions: TMS measures of cortical excitability are altered at two months post injury. Long interval cortical inhibition is reduced in children with persistent symptoms after two months.

Grip Strength Performance in Youth Ice Hockey Players: A Normative Study to Inform Concussion Management

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Background: Concussion is a common injury in youth ice hockey, accounting for approximately 18% of all injuries. Strength has been shown to be impaired following a concussion, thus may be used in concussion assessment and evaluation. However, to date there is a paucity of up-to-date and developmentally sensitive grip strength norms for youth athletes. Furthermore, little is known about how age, sex, body mass index (BMI), and other concussion factors influence grip strength performance.

Objectives: The aims of this study are to 1) Describe normative grip strength values in youth ice hockey players at baseline; and, 2) Explore the relationship between age, sex, BMI, and presence of concussion-like symptoms (headache, fatigue) on grip strength.

Methods: A convenience sample of 695 male and female youth ice hockey players between the ages of 10 and 16 years were included in this study. Participants completed pre-injury/baseline assessments of grip strength (Smedley dynamometer), self-report of concussion-like symptoms (PCSI-C & PCSI-Y), as well as demographic information (age, sex, concussion history). Multiple regression analyses were performed to explore the effects of age, sex, BMI, concussion history, and the presence of concussion-like symptoms on grip strength performance.

Results: Regression analyses revealed significant effects for age and sex ($p < 0.01$), whereby grip strength increased with age, and males had greater grip strength than females after the age of 12. Body mass index also showed a significant effect ($p < 0.01$), participants with a higher BMI showed greater performance. Finally, those who reported a headache at baseline had significantly lower grip strength ($p < 0.01$).

Conclusions: This study addresses the need for grip strength normative data specific to youth ice hockey players. Further, results from this study provide insight into factors that influence grip strength, which may facilitate post-concussion evaluation and guide safe return-to-play decision making for this population. In collaboration with further validation (test-retest reliability, sensitivity/specificity), these findings contribute towards positioning grip strength as a clinical measure that can be used during the concussion management of children and youth.

Re-Emergence of Head Control on the Physical Abilities and Mobility Scale is Associated with Resolution of Disorder of Consciousness during Inpatient Rehabilitation in a Larger Sample of Children with Brain Injury

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Objective: During inpatient rehabilitation, identifying markers of recovery in children admitted with Disorders of Consciousness (DOC) can be challenging. The Physical Abilities and Mobility Scale (PAMS) is a 20-item measure that was developed to quantify progress towards physical therapy goals. Each item is scored 1-5 (1 indicating limited capability and 5 indicating independence within parameters of each measure). We previously demonstrated, in a preliminary sample (n=10 children with TBI), that PAMS Head Control (HC) score within 2-3 weeks of admission to inpatient rehabilitation was associated with emergence to the conscious state. The objective of this study is to expand upon our prior work to determine, in a larger sample size inclusive of children with varying etiologies of acquired brain injury (ABI) resulting in DOC, whether the return of head control, as measured by the PAMS, is associated with emergence to a conscious state (CS) during inpatient rehabilitation.

Methods: 57 children (ages 2-21 years) who sustained an ABI and presented with a DOC at admission to inpatient rehabilitation were included. As part of clinical care, the PAMS was administered upon admission and approximately every 2 weeks until discharge. Emergence to CS by discharge was determined based on medical record review. Three ratings, on admission and then approximately 2 and 4 weeks following admission, were utilized. Qualitative analysis and independent samples t-tests were conducted.

Results: Twenty-six children (46%) emerged to a CS by discharge. All children who did emerge by discharge exhibited a change in HC scores by Time 2 or 3 (or were at the ceiling of the item scale). Of the 31 children who did not emerge, 7 remained at the basement of the scale at all time points, while others showed some change. Of the children who did emerge to a CS, 85% had a HC score of 5 (maintained head up for at least 1 minute) by time 3. Of the 31 children who did not emerge to a CS, 81% had HC scores of less than or equal to 3 (maintained head up for less than 30 seconds) by Time 3. The group that emerged had statistically higher scores at all three time points ($p=.028$ at time 1, $p<.001$ at times 2 and 3).

Conclusions: These data confirm, in a larger sample size, that return of HC as rated on the PAMS is associated with emergence to CS by discharge. Head control appears to be an important marker of recovery in children with DOC. Although there were individuals who did not progress out of a DOC by discharge, several of them who scored well on the PAMS head control item went on to emerge from a DOC following discharge; future studies should include longer follow-up assessments.

Communication Skills in Children Aroused from Traumatic Coma

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Background: The aim of the study was to analyze the communication reactions of children in minimal consciousness stage after moderate and severe traumatic brain injury (TBI) and to determine the profile of non-verbal behavior characteristic of the state of reduced awareness and the indication of those areas of communication with the person after severe brain injury which should be specifically taken into account during therapy aimed at restoring the ability to communicate and thus to improve the quality of life of people with reduced levels of awareness as their families.

Material and method: 15 subjects from Children Memorial Hospital in Warsaw were enrolled after severe traumatic brain injury followed by coma and their communication was monitored during the year. The GCS Scale was used as well as Lowenstein Communication Scale for the Minimally Responsive Patient (LCS) (Borer-Alafi et al., 2002) and Individual Communication Skills Sheet (in polish: A. Nowak, K. Kobylacka-Sikorska, 2013).

Results: The analysis of the results showed that at some stage of consciousness recovery certain characteristics of communication may be identified. In Stage I, the predominantly preverbal (pre-linguistic) communication elements were observed most frequently in primary screening. In Stadium II, it showed a significant increase in the level of communication in two areas of preverbal communication: primary and sensory. There were also messages from the organization of behavior, so more informed use of communication and audio communication. Intra-psychotic communication has also increased somewhat. III Stadium - non-verbal communication is specialized, there are socially accepted gestures such as "ok" or hand gesture to greet. At this stage verbal communication is also developing.

Conclusions: By analyzing the stages of reconstruction, attention is drawn to the similarity of the sequence of phases to the ontogenetic development of speech. As in the development of the child, the first uncoordinated, non-specific reactions to deprivation appear, which gradually submerge in the specification, along with the development of further brain structures. The first messages are rather vegetative, with the development of further brain structures developing specific social gestures.

The Quality of Life of Children After Mild and Moderate Traumatic Brain Injury

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Background: The aim of the study was to evaluate the quality of life of children after mild and moderate traumatic brain injury (TBI) and an analysis of the specific assessment of individual areas of functioning in these children's perception. This subject is important both in terms of the further education of the children but also in terms of their adapting to life after brain injury.

Material and methods: We tested 30 children after traumatic brain injury treated at the Neurotherapeutic Centre in Bydgoszcz and Children Memorial Hospital in Warsaw in the period of 2014-2016. Eighteen of these children had experienced mild brain injury and twelve moderate brain injury, and had returned to school education. An analysis of the documentation (interviews and medical records), neuropsychological assessments: RAVLT, D2, physiological assessments: ADL as well as the Scale for Quality of Life KIDSCREEN-27 was used in the examination of the children.

Results: We found that the quality of life of children after mild to moderate traumatic brain injury is significantly reduced in the areas of assessment of physical functioning, general mood and school life. The quality of life of the examined children did not differ from the normative group in the area of family functioning and the assessment of received support and peer relations. The results substantiated the validity of including within research children after mild and moderate traumatic brain injury through the assisting of specialist interactions in three key environments.

Next-Generation Interactive Devices in Neurorehabilitation of Social Skills in Children with Acquired Brain Injury

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Background: Neurological disorders affect children's social development and social skills. Impairment in communication can lead to social rejection. Creating modern and attractive rehabilitation methods, such as multiuser and multitouch tabletop technology is important in pediatric social skills remediation.

Aim: Developing social skills neurorehabilitation design for children with acquired brain injury using multitouch tabletop technology.

Methods: 15 children with acquired brain injury (ABI) - epilepsy, sTBI, tics, stroke - aged 8-13 participated: 7 in training group, 8 in waiting-list and 9 healthy controls. Social perception skills were evaluated using Social perception domain in NEPSY-II and Theory of Mind stories. Friendship Observation Scale (FOS) was used for assessing social communication skills and cooperational behaviours. Children's parents completed questionnaires: executive functioning behaviour (BRIEF-P), Social Cognition Questionnaire and Social Skills Rating System. Children were trained with two interactive computer-based applications. "NoProblem!" application, that complies with principles of Cognitive Behavioral Therapy, was used on Multi-user Diamond Touch tabletop (DTT) to train social perception. Snowflake"on Suite Multi-Teach platform was used for collaboration skills. Altogether, 10 paired sessions were conducted in two parts: social skills and cooperation skills training guided by two therapists. For social skills, children were presented with social scenarios (pictures and videos), where they found correct solutions and thereafter, role-play was conducted. Also, video processing and discussions about real-life experiences were included for developing metacognitive skills. For cooperation, children were presented with tasks requiring compromises, mutual decision-making etc.

Results: We found pre-training problems in patients compared to healthy peers: weaker executive functions, deficit in social perception and skills. Individual assessments revealed below average performance in emotion recognition and Theory of Mind. Low frequency of entry and ending skills for conversations and cooperational behaviours (accepting rules, wait for turn) were observed using FOS scoring during social situations and role-plays. Patients scored ratings 2-3: approximately 25-50% of skills were observed during assessments. We found that patients used less non-verbal communication, had more inadequate social responses and remarkable problems with understanding social scenarios. They interrupted conversations frequently and had lower perception of communication norms. After training, intervention group performed better in Theory of Mind skills. Also, noticeable increase in cooperational behaviours and empathy skills compared to baseline performance were observed.

Conclusions: Children with ABI have deficits in social communication and collaboration skills. They make fewer or excessive attempts towards collaborating with each other. After paired collaborative neurorehabilitation, we found noticeable increase in Theory of Mind, communication skills and cooperational behaviours in patients. Improving social skills is crucial for children for feeling competent in everyday social interactions and better quality of life. Children are easily motivated and their everyday

social skills benefit from using next-generation devices (MTT) in playful atmosphere (estimated by standardized assessment and parents' reports).

Implementation of a Neuroscience Center of Excellence and Measuring Increase in Utilization of Specialty Services

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Objective: Medical facilities worldwide have begun to form Neuroscience Centers of Excellence which have been shown to improve patient care outcomes in patients with traumatic brain injury (TBI). In October 2015, our medical facility developed a multi-disciplinary Neuroscience Center of Excellence with the goal to improve our patient care outcomes. Our hypothesis was that implementation of this Neuroscience Center, which included development of clinical guidelines along with a daily pediatric intensive care unit (PICU) huddle, would increase utilization of specialty services and decrease time to initial consultation for children with mild, moderate, or severe traumatic brain injury.

Methods: Data was collected as part of the implementation of the multi-disciplinary Neuroscience Center of Excellence. We performed a retrospective study of all patients (age 0-17 years) who had serious TBI (AIS \geq 3 in head region) and were admitted to the hospital between November 2013 to October 2016 at a level 1 pediatric trauma center. Variables that we looked at included demographics, clinical diagnoses (GCS, AIS, ISS), and clinical features associated with additional support services. We excluded patients who did not survive acute hospitalization. Pre-program was defined as the period before the daily multidisciplinary team meetings initiation (11/2013-10/2015), and post-program was defined as the period after the initiation of the meetings (11/2015-10/2016). We used statistical significance testing to compare pre- and post-program percentages of patients who received consults and mean times to orders of consultations.

Results: Overall, we showed that implementation of an organized Neuroscience Center of Excellence with clinical guidelines and a daily PICU huddle significantly increased utilization of specialty services ($p < .001$) and significantly decreased the time to initial consultation ($p < .001$).

Patients consulted

11/2013 -10/2014: 28

11/2014 - 10/2015: 46

11/2015 - 10/2016: 68

Patients not consulted

11/2013 -10/2014: 129

11/2014 - 10/2015: 96

11/2015 - 10/2016: 34

Percentage patients consulted

11/2013 -10/2014: 17.8%

11/2014 - 10/2015: 32.4%

11/2015 - 10/2016: 66.7%

p-value: $< .001$

Time to consult order, median

11/2013 -10/2014: 80.4

11/2014 - 10/2015: 34.0

11/2015 - 10/2016: 26.1

p-value: <.001

Conclusion: Implementation of an organized Neuroscience Center of Excellence with development of clinical guidelines and improved communication improves access to specialty services and decreases time to initial consultation. In the future, we would like to evaluate long-term outcomes in relation to early access to specialty services.

Treatment of Adolescents with Persistent Post-Concussion Headaches Using Botulinum Toxin A: A Case Series

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Objective: To present safety and tolerability of treating persistent post-concussive headaches with botulinum toxin A (Botox) in adolescents.

Design: Retrospective case series

Setting: A tertiary rehabilitation hospital interdisciplinary outpatient concussion clinic for adolescents aged 12-18 years.

Participants: seven patients ages 15-18 with persistent post-concussion headaches.

Interventions: 1. Comprehensive assessment by an interdisciplinary rehab team. 2. Establishing the diagnosis of chronic daily headache disorder with 15 headaches per month, 8 of them meeting pediatric migraine criteria. Headache treatment included neck exercises, physiotherapy, CBT, mindfulness, oral prophylactic and abortive migraine medications as well as Botox. Patients selected had prolonged debilitating headaches, had failed other treatment options, and/or had specific circumstances precluding use of other treatment options, were unable to attend school, tolerate daily activities. 3. Discussion of potential side effects of Botox, complications of injection, review of current literature evidence. Verbal consent obtained.

Outcome measures: Clinical monitoring of adverse events of injection, side effects of Botox, effect on daily activities and headaches.

Main Results: There were no adverse events related to the injection of Botox. Some patients experienced a transient flare up of headaches after injection. All patients reported that injections and post-injection side effects were tolerable. Reduction in headaches was variable.

Conclusions: Based on this small clinical sample of adolescents with severe persistent post-concussion headaches, Botox appears to be a well-tolerated and safe treatment option. Prospective, RCT studies are required to confirm this preliminary clinical impression.

From Paper to Practice - Developing and Implementing Sports Injury Prevention Interventions That Make a Difference - A Citywide Concussion Program for Youth Sport Athletes

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There has been much written in the last five years, in science publications and in the press, on the importance of reducing the number of youth sport concussions and finding ways to manage concussion recovery better in children. And for all the clamor to create or change school and youth sport concussion policies, there are very few examples of how to take theory laid out in these scientific papers and implement low-cost programs in children's day to day lives across an entire city.

This presentation will highlight an on-going three year project in Norwalk, Connecticut, USA, where RE-AIM Sports Setting Matrix (RE-AIM SSM), a health promotion planning and evaluation framework, was used to develop and implement a city-wide concussion education and management policy targeted at the 11,000 children in all schools and all city youth recreation sports programs. In 2014, researchers were concerned the newly updated CT State Concussion Law only applied to 1,145 high school students participating on official high school teams. The project launched in the 2014-2015 school year to investigate how many of the 9,855 non-children not covered by the state law were having concussions and how many student-athletes were having concussions.

For the last three years, all concussions reported to the school nurses and athletic trainers in all the Norwalk Public School were recorded by age, sex, mechanism of injury, and where injury occurred. All children, aged kindergarten to 12th grade, could be considered involved in sports if sports are considered in a range from peer organized games at recess, school gym class, official sports teams and also solo sports outside of school. Specific data was also captured on the ratio of sports to non-sports injuries, and if concussions happened at school or home.

Researchers then used the RE-AIM Sports Setting Matrix (RE-AIM SSM) to guide the development, implementation and evaluation of sports injury prevention interventions across this entire city by involving the schools, the city hospital, city government, youth sports organizations and the city parks and recreation department.

The proposed presentation on this project will discuss how to use RE-AIM SSM to develop interventions and accompanying implementation plans targeted at a multi-layered implementation context to maximize the adoption and overall impact of sports injury prevention interventions. The presentation will also provide a unique opportunity for participants to share the challenges they face and explore practical solutions in planning and implementing sports injury prevention interventions in complex settings.

NOTE: While the RE-AIM SSM was used in this case was modified to be specific to the community sports setting context, this framework could be used to optimize the impact of future sports safety, and other health promotion, interventions in complex real-world settings.

Test-Retest Reliability of the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) in Youth Athletes

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Background: The Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) is the most commonly used computerized neurocognitive test used in concussion assessment. However, previous research examining the test-retest reliability of this assessment tool in the pediatric population is variable and requires further investigation. In addition, the comparison between short, medium and long-term test-retest intervals on the stability of ImPACT performance over time has yet to be explored.

Objectives: This study aims to explore the test-retest reliability of ImPACT in youth athletes (9-18 years), and to further investigate the influence of time between reassessments on test-retest reliability.

Methods: A total of 66 athletes completed two baseline ImPACT assessments at variable time points (0 - 34 months). The sample was grouped into 3 time intervals: 0-6 months (N=20), 6-12 months (N=24), and 12+ months (N=22). At the group level, test-retest reliability was assessed using intraclass correlation coefficients (ICCs). At the individual level, the percentage of athletes showing meaningful clinical change between reassessments was assessed using reliable change indices (RCIs).

Results: ICCs for ImPACT composite scores ranged from .36 to .77 (single)/.53 to .87 (average). For the shortest time interval, ICCs for composite scores varied from .45 to .90, with visual speed (.90) and reaction time (.83) showing the strongest stability. For the medium time interval, ICCs for composite scores ranged from .40 to .77, with visual speed (.77) showing the strongest stability. For the longest time interval, ICCs for composite scores ranged from .10 to .60. The RCIs at 95% CI showed that 20% of the total sample improved meaningfully between baseline and reassessment, while 2% demonstrated meaningful decline. The total percentage of participants showing meaningful change increased with time, with the longest time interval showing the highest percentage of individuals with meaningful improvement or decline.

Conclusions: This study contributes to the current literature examining the test-retest reliability of ImPACT in youth athletes and provides new insight into the measure's stability across various test-retest time intervals. The results highlight the importance of considering time between testing intervals when interpreting changes in ImPACT performance post-injury and the need to explore test-retest reliability in the context of clinical use.

Sensitivity and Specificity of a Multimodal Approach for Concussion Management in Youth Athletes

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Background: Current medical and expert supported consensus endorses a multimodal approach to concussion management. However, the psychometric properties of individual clinical measures that make up concussion assessment batteries have yet to be adequately examined in the pediatric population.

Objectives: To explore the sensitivity and specificity of a multimodal approach compared to individual clinical measures for the assessment of concussion in youth athletes at symptomatic and asymptomatic time points following concussion.

Methods: A prospective longitudinal case-control design was used for this study. A sample of 935 youth athletes ages 9-18 years, completed baseline assessments using clinical measures of cognition (ImPACT), balance (BioSway), upper and lower body strength (hand dynamometer, standing long jump), and post-concussion symptoms (Post-Concussion Symptom Inventory). To date, 36 youth athletes sustained a concussion and were retested at two time points: symptomatic (only balance and upper body strength; did not complete clinical measures that could exacerbate post-concussion symptoms) and asymptomatic (cognition, balance, upper and lower body strength; no longer experiencing post-concussion symptoms). Thirty six age- and sex-matched control participants from the baseline sample were re-tested on the same clinical measures at these same time points. Sensitivity and specificity were calculated using reliable change indices (RCIs). One-sided 70%, 80%, 90%, and 95% confidence intervals were used to detect meaningful clinical decline in scores between time points and determine highest sensitivity and specificity.

Results: At the symptomatic assessment, using a one-sided 80% CI, the balance measure was able to correctly identify 10 of the 36 concussed athletes (28% sensitivity), while incorrectly identifying 6 of the 36 control athletes (83% specificity). Grip strength showed a higher sensitivity (42%) and specificity (92%) than balance. Combining balance and grip strength improves the sensitivity (56%), but did not improve the overall sensitivity/specificity in comparison to grip strength alone. At the asymptomatic assessment, the sensitivity of each clinical measure ranged from 25-33%, whereas the specificity varied from 81-94%. Combining the entire battery (ImPACT, balance, upper and lower body strength), improved the sensitivity (58%), but lowered the specificity (58%). The combination of upper and lower body strength assessments yielded the highest overall sensitivity/specificity for distinguishing between youth athletes with and without a concussion upon post-concussion symptom resolution.

Conclusions: This study presents, for the first time, the individual and combined sensitivity/specificity values of a multimodal (cognition, balance and strength) clinical assessment battery within the youth athlete population. The findings provide insight into the value of a multimodal approach for concussion management in youth athletes. For optimal clinical utility, consideration of the sensitivity and specificity of individual and combined clinical measures at both symptomatic and asymptomatic time points is suggested.

Measurement of the Tentorium Cerebelli and Sleep Problems in Pediatric Mild Traumatic Brain Injury

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Objectives: Children with mild traumatic brain injury (mTBI) may experience sleep problems due to changes in secretion of melatonin from pineal gland. Structural anatomical variations of the posterior fossa have previously been hypothesized to increase the risk of the injury to the pineal gland. In this study, we evaluated the anatomy of the posterior fossa, specifically the tentorium length and angle, in children with mTBI and its relationship with sleep problems, one month following the injury.

Methods: This is a cross sectional cohort study on a sample of children 8-18 years old, one month following mTBI (n=25 Asymptomatic and n=32 Symptomatic) with healthy controls of similar age and gender (n=22). Exclusion criteria included: significant medical or neurodevelopmental disorder, previous mTBI within the last 3 months, and contraindication to MRI.

Outcome measures: The Post-Concussion Syndrome Inventory (PSCI) was used to measure post-concussive symptoms (PCS). A subscore of five questions related to sleep problems (difficulty falling sleep, sleeping less or more than usual, drowsiness and fatigue) was calculated. Sleep behavior (sleep efficiency, sleep onset and total sleep time) were assessed using the actiwatch and sleep diary. T1-weighted magnetic resonance imaging (MRI) scans were used to measure tentorium length and angle.

Process: Assessors were blinded to group. Two assessors evaluated each scan. If there was disagreement of tentorium length or angle, then the scan was reevaluated and a consensus was reached. Statistical analysis: Data was analysed with SPSS software using ANOVA (for measuring tentorium length and angle difference between the symptomatic, asymptomatic and control groups) and Spearman correlation (for measuring the correlation between the tentorium length and angle and sleep problem scorers). Linear regression model analysis was used to assess the effect of tentorium length and angle on sleep problems whilst controlling for pre-injury sleep problems, age and gender. Posterior fossa volumetric studies are ongoing.

Results: Inter-observer reliability before the consensus showed a good correlation for tentorium length ($r=0.7$) and an excellent correlation for tentorium angle ($r=0.9$). One-way ANOVA analysis between three symptomatic, asymptomatic and control group showed no significant effect of group for tentorium length ($F=0.105$, $p=0.9$) and angle ($F=0.135$, $p=0.8$). Also, there was no correlation between sleep problems and tentorium length and angle. Only pre-injury sleep problems were associated with sleep problems post-injury (overall model: $F=2.73$, $p<0.05$; $\text{Beta}= 0.44$, $p<0.01$). Posterior volumetric data will also be presented.

Conclusions: Contrary to previous research, the anatomy of the posterior fossa is similar in children with mTBI compared to healthy controls. Objective and subjective indicators of post-injury sleep problems were not related to posterior fossa anatomy following mTBI. Further volumetric studies of pineal gland might be helpful in identifying children who are at the risk of persistent symptoms or sleep dysfunction following mTBI.

An Investigation into Social Functioning Following Mild TBI In Early Childhood: The Quality of Parent-Child Interactions

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Objectives: The young brain is vulnerable to injury due to inherent physiological and developmental factors (Huelke, 1998), and even mild forms of traumatic brain injury (mTBI) can result in cognitive and behavioral changes (McKinlay et al., 2002; Bellerose et al., 2015). Despite the high prevalence of mTBI before the age of six years (“preschool”), little is known of its impact on children’s social functioning. Parent–child relationships represent the center of young children’s social environments and are therefore ideal contexts for studying the potential effects of mTBI on their social functioning. The aim of this study was to assess the quality of parent–child interactions after preschool mTBI using observational methods.

Methods: The sample included 130 children (18–60 months old at recruitment) divided into three groups: children with uncomplicated mTBI (n = 47), children with orthopedic injury (OI, n = 27), and non-injured children (NI, n = 56). The quality of parent–child interactions was assessed 6 months post-injury using the Mutually Responsive Orientation (MRO) scale (Aksan et al., 2006), an observational measure of the quality and dyadic nature of parent–child exchanges, which includes three subscales: Harmonious Communication, Mutual Cooperation, and Emotional Ambiance.

Results: MANOVA including the three MRO subscales yielded a significant multivariate main effect for group, $F(6,250) = 2.14$, $p = .049$, Wilks’ Lambda = .91. At the univariate level, all three MRO subscales showed significant differences between groups; Harmonious Communication, $F(2,127) = 6.03$, $p = .003$, Mutual Cooperation, $F(2,127) = 5.88$, $p = .004$, and Emotional Ambiance, $F(2,127) = 4.52$, $p = .013$. Fisher’s LSD indicated significant differences between the NI group and the mTBI group on all three subscales (p ’s = .001–.004). Medium effect sizes were found for these comparisons. There were no significant differences between the OI group and the other two groups, although visual inspection of the data suggests that OI dyads tended to have scores that were qualitatively higher than the mTBI group and lower than the NI group on all three MRO subscales.

Conclusions: Both injured groups (mTBI, OI) displayed altered parent-child interaction, but only those with mTBI and their parents differed significantly from the normative parent–child dyads. The results suggest that sustaining a minor traumatic injury during the preschool years could affect parent-child interactions, but to observe significant changes, the injury must involve the head (mTBI). Globally, parents and children with mTBI exhibited interactions that were less characterized by mutually responsive orientation, described as a positive, mutually binding, and cooperative relationship. The current findings have implications for monitoring social development after early mTBI because the quality of parent-child interactions in early childhood is one of the strongest predictors of child socialization in subsequent years (Kochanska, 1997, 2002; Kochanska & Murray, 2000).

EEG and Cortical P300 ERP Fast Technique to Evaluate TBI Brain Physiology Pre and Post Intervention. Event Related Potentials are Easily Quantified with Modern Computer Processing

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EEG P300 cortical evoked related potentials (ERPs) are easily quantified with modern computer processing. Headsets are becoming fast and easy to apply and precision is quite good.

We have used the cortical evoked auditory P300 protocol for the past 5 years having tested over 500 youth and college age athletes. The sports include football at the University of Colorado as well as Texas high school. Also, junior hockey and youth soccer players. The players are tested pre-season and 24 hours after concussion, then before return to play and at the end of the season.

Statistical analysis shows a variance of 12% but after concussion the decrease in P300 amplitude is greater than 45%. Most athletes show a return to baseline within one week, however about 30% are slow to return and agree not showing significant improvement until 3 weeks. Some, about 10% take about 3 months or more to return to baseline. Post concussive syndrome brain state can be monitored.

Furthermore, this system can be used for analysis of brain function in patients with acquired brain injury, that is moderate to severe TBI, minimally conscious state as well as stroke and cerebral palsy.

EEG based auditory cortical ERP P300 using 19 active electrodes applied with the standard 10/20 montage is well tolerated and easily applied. Pre treatment quantification of P300 amplitudes as well as cortical region coherence power is detected and used as a baseline prior to instituting a therapeutic intervention. Brain function can be tracked easily as the patient's brain responds to therapy.

In many cases, there is a cortically detected change before there is a functional improvement. This helps clinicians analysis of the benefit of medication changes and therapies.

Application technique and case series will be presented.

Reactivity of Stress Response Systems and Post-Traumatic Stress after Pediatric Injury: Impact of Age and Type of Injury

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Traumatic injury is a major source of acute and chronic stress that may place children at high risk for developing alterations in stress response systems and compromise long-term physical and psychological health. Between 25-57% of injured children develop significant subclinical post-traumatic stress symptoms (PTSS). In a prospective, observational cohort study, we examined stress-reactivity of the hypothalamic-pituitary-adrenal axis (HPA; salivary cortisol) and autonomic nervous system (ANS; salivary alpha amylase, sAA) following pediatric injury. The primary aim was to characterize salivary cortisol and sAA stress-related reactivity in children and adolescents sustaining traumatic injury in comparison to a healthy control group. A secondary aim examined the degree to which, within the injury groups, individual differences in salivary cortisol and sAA correlated with self-reported PTSS.

Methods: Participants were 8-15 years of age and hospitalized for traumatic brain injury (TBI; n=55; M age =13.9 yrs; 40 males) or extracranial injury (EI; n=29; M age 12.3 yrs, 20 males) following vehicular accidents and a healthy non-injured comparison group (n=33; M age =12.5 yrs, 16 males). Six months post-injury, saliva was collected before and after the Trier Social Stress Test –Child Version (TSST-C), a validated stress induction procedure that elicits time-linked changes in cortisol and sAA that index stress reactivity and recovery. Samples were assayed at Salimetrics, Inc. using commercially available enzyme immunoassay assay for cortisol and enzyme reaction kit for sAA.

Generalized linear models with a negative binomial distribution and log link function examined the effects of group, saliva collection time during the TSST-C, age, and their interactions on salivary analyte levels. Planned comparisons examined cortisol and sAA values for 1) both injury groups versus the healthy group and 2) the TBI versus the EI group. Spearman partial correlation coefficients controlling for age examined the relation of the cortisol and sAA area under the curve values with Child PTSD Scale scores.

Results: Relative to the healthy group, injured children (ages 8 to 12 years), but not adolescents (ages 13 to 15 yrs), had higher cortisol levels; regardless of age, injured participants showed dampened cortisol reactivity to social evaluative threat. Compared to participants with EI, children with TBI had elevated cortisol and adolescents had elevated sAA. With respect to PTSS, individual differences in sAA were negatively correlated with avoidance in the TBI group and positively correlated with emotional numbing within the EI group.

Conclusions: Both the HPA and ANS stress systems were dysregulated during the chronic stage of recovery from pediatric injury. Age at injury and type of injury were major determinants of HPA and ANS dysregulation. Given the high incidence and public health burden of pediatric injury, it is critically important to understand links between neurobiological changes and long-term physical and psychological health outcomes following TBI.

A Novel Rehabilitation Approach for a Child with Acquired Brain and Spinal Cord Injury: A Case Report

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Background: Incidence for a Chiari malformation is estimated to be less than one in 1000 people with characteristic abnormalities noted with downward displacement of cerebellum tonsils. When asymptotic, a Chiari is often left untreated or may not be discovered. However, when cerebral spinal fluid (CSF) is compromised by an infection, bacterial meningitis, the benign symptoms can become life threatening. The infected CSF can cause increased pressure, leading to distension of the cerebellar tonsils, compressing the brainstem tissue and artery systems. While rare in the pediatric population, cerebral vascular accident (CVA) and spinal cord injury (SCI) may occur. Physical and occupational therapy during the acute phase of a CVA and SCI is vital to promoting optimal outcomes.

Case Description: Patient initially presented to her pediatrician with headaches, body aches, and neck stiffness, accompanied by fever. Patient continued to medically decline and was intubated. Patient was transferred to JHH Children's Center with concerns for septic shock from bacterial meningitis. Patient hypotensive and required chest compressions and was stabilized. A CT and MRI showed edema and acute infarcts involving bilateral inferior cerebellar hemispheres, vermis, caudal aspect of the medulla, as well as the upper cervical spinal cord at the craniocervical junction, as well as pre-existing Chiari malformation. Due to increases in ICP, she then underwent suboccipital craniectomy on Day 1 of admission with resection of necrotic areas (bilateral tonsils) of the cerebellum. She remained ventilator-dependent in the pediatric intensive care unit (PICU) for 16 days until PEG placement and tracheostomy for ongoing feeding difficulty and respiratory failure. She was dependent for all cares and mobility with quadriplegia. Cognition intact for the entirety of admission. Patient was admitted in the PICU for a total of 29 days. PT saw patient for a total of 21 sessions and OT for 17 sessions.

Interventions: Nontraditional intensive care interventions were used to promote patient and family centered care. Family provided patient's interests and motivators. Therapy incorporated patient preferences into interventions. Examples include: baking at the edge of bed, in lieu of traditional range of motion exercises, using the Letto Ergometer for cycling with lower extremities while supine in bed, and "dancing" with head turn and trunk rotation to promote vestibular integration.

Discussion: There is limited literature related to the treatment of children with Chiari malformations and meningitis with subsequent bilateral CVAs and brainstem tissue compression in the PICU. As a result, treatment interventions should be based on clinical presentations focusing on their functional limitations and overall goals, but also should be family and patient-centered. Further research is needed to determine the most effective rehabilitation interventions in the PICU to promote patient and family centered care.

Keywords: acquired brain injury, occupational therapy, physical therapy, rehabilitation

Validating the Reliability of the KOSCHI on a Prospective Basis in Inpatient Rehabilitation Program

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Objective: To validate the inter-rater and intra-rater properties of The King's Outcome Scale for Childhood Head Injury (KOSCHI) in youths who participate in a rehabilitation program for their acquired brain injuries (ABI).

Method: We recruited children and youth youths between the ages of 4 to 18, with acquired brain injuries of traumatic and non traumatic etiologies involved in the Brain Injury Rehabilitation program at the time either as an inpatient or outpatient. We excluded youths who had fluctuating or deteriorating neurologic conditions as a result of autoimmune encephalitis, multiple sclerosis and intractable seizures requiring neurosurgical intervention. We created a structured clinical interview form for the KOSCHI relevant data and a scoring algorithm. The KOSCHI form was completed and scored by one of three pediatricians during an in-person clinical interview with the youth and parent(s)/guardian(s). To assess the inter-rater reliability of the KOSCHI score, the form was re-viewed and scored by another pediatrician 24 to 72 hours later. The first completed KOSCHI form was independently scored by a community psychiatrist to also assess inter-rater reliability. For youths in the outpatient program, the KOSCHI form was administered and scored in-person by a pediatrician and second pediatrician independently scored the completed KOSCHI form. We administered two measures of overall health status at the time of the first clinical interview. Six months later, the KOSCHI form and the two overall health status measures were re-administered.

Results: We enrolled 200 youths who experienced an ABI, sixty-four who had a direct admission to the brain injury rehab. program as an inpatient and 136 through the outpatient and follow up clinic.

Gender n (%)

Male 115(64) Female 65(36)

Age at Initial Assessment (years)

Mean SD; range 12.87 SD 3.95 (4.15 - 18.93)

Time of Injury to Assessment (years)

Mean SD; range 4.13 SD 4.73 (0.02- 17.084)

Glasgow Coma Scale n=57

Mean SD; range 7.74 SD 3.70 (3-15)

Weighted Kappa scores

Weighted Kappa (95% CI)

Interpretation of Kappa

Pediatrician to Pediatrician

In-person Assessment to Chart Review

Inpatient/Day patient Baseline 0.54 (0.4-0.67)

In-person Assessment to Form Derived

Outpatient Baseline 0.63 (0.53-0.73)

Outpatient Follow-Up 0.71 (0.51-0.91)

Inpatient/Day patient Follow-Up 0.68 (0.51- 0.86)

Psychiatrist to Psychiatrist

Outpatient Baseline 0.69 (0.59-0.79)

Outpatient Follow-Up 0.64 (0.48-0.80)

The relationship between the KOSCHI scores and mean scores on the PedsQL and MPAI were examined. The distribution is displayed in Figure 3. Examination of baseline KOSCHI scores in relation to PedsQL and MPAI scores reveals spearman correlations of 0.68 and -0.87 respectively.

Conclusions: The KOSCHI is a tool with inter-rater and intra-rater reliability that show convergent validity with the Mayo Portland Adaptability Inventory and the Peds QL scores. It can be reliably administered by rehabilitation paediatricians and adult physiatrists, in a diverse ABI youth rehabilitation population.

Addressing Similarities and Differences in the Pediatric TBI and CNS Brain Tumor Population in the Educational Setting

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Children with central nervous system brain tumors have many similarities to those who have sustained a traumatic brain injury from an external physical force. In both cases, most were on a path of typical development when the diagnosis or injury occurred. While there are many parallels between the two populations regarding acquired deficits, those with brain tumors often present with a greater impact on functioning. There are also fundamental differences in treatment approaches. Specifically, children with CNS tumors require long-term, on-going treatment and follow-up scans, have the potential for tumor re-growth or secondary malignancies, as well as late effects of treatment from chemotherapy and/or cranial radiation unique to the brain tumor population. While students with traumatic brain injury are typically on an upward trajectory with regard to recovery of function given appropriate interventions, those with brain tumors continue to be impacted by the very treatment that may have saved their lives, and close to 30% will succumb to the diagnosis despite aggressive treatment.

Educators who specialize in assessment and school integration/reintegration for students with CNS tumors must rely on the pediatric literature with regard to appropriate practices and evidenced based interventions due to the paucity of literature for students with CNS tumors. In doing so, it is imperative they are acutely aware of the unique characteristics that sets this population apart from those children with TBI. A review of the similarities and differences in treatment and deficits as well as appropriate strategies for school integration/reintegration and appropriate implementation of interventions will be discussed, as well as how to address the needs of the student and staff when a student is terminal.

Real Live Escape the Room Tasks in the Rehabilitation Hospital to Teach Executive Function Skills

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Social interaction, friendship and independence are key quality of life measures during adolescence. Therefore, circumstances which promote these situations, even with a limited number of people, are usually motivating. Real live Escape the Room Activities and Scavenger Hunts are very popular in society today. The purpose is for an individual or a group to work together for one common goal (ie. to get the key to open a door or to be the first to collect the pieces). To be successful you are called to process information quickly, attend to task, solve problems, utilize critical thinking skills, and to practice proper social pragmatic skills. In essence, you need to have competent executive function skills (EFS). That is a set of multiple cognitive capacities that act in a coordinated way to allow you to engage in purposeful, organized, strategies, self-regulated, goal directed behavior.

EFS are difficult to capture during standardized testing, which is usually structured and rarely mimics everyday life. Additionally in the pediatric population research validates that as they mature changes occur in the Prefrontal Cortex and its connections along with the development of important cognitive skills, particularly EFS. Hence when an Acquired Brain Injury (ABI) occurs in this population it makes it harder to quantify skills and progress. Nor is it easy to identify if EFS yet to be developed will occur on time or not at all.

As part of the rehabilitation program for pediatric patients with an ABI, individual Speech Language Pathology therapy frequently targets cognitive communication skills. Therapy often focuses on meta-cognitive strategies, external compensatory strategies, critical thinking skills, and bridging strategies. One patient's rehabilitation program included development of a real live hospital based "Escape the Room" task. This presentation will highlight McCloskey's four arenas in which EFS are used – intrapersonal, interpersonal, environmental, and symbol system in the context of a real live Escape the Room task during inpatient rehabilitation.

Objectives:

1. Review one rehabilitation hospital's development and use of a live "Escape the Room" Speech Task to solidify executive function skills.
2. Compare results of standardized tests with completion of the "Escape the Room" Speech Task
3. Review case study highlighting the therapeutic benefits of using the Escape the Room Speech Task.

Methods: Retrospective case study

Results/Conclusions:

1. Generalization of the metacognitive approach to completing the task increased with repetition.
2. The patient was able to review the effectiveness of different strategies and treatment approaches when completing functional tasks.
3. It provided tangible results to compare with results of standardized test and use when devising a school re-entry plan.

Treatment and Identification of Intracranial Hypertension (Pseudotumor Cerebri) in Pediatric Patients with Predominant Headache Subtype Post Concussion Syndrome Improves Outcomes and Reduces Disability

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Background: Dysregulation of the osmotic gradient between the interstitial fluid, blood vessels and the brain parenchyma results in increased fluid accumulation in the brain causing increases in intracranial pressure (ICP). Cerebral edema can be a clinical manifestation of traumatic brain injury (TBI) that peaks at 36-72 hours post-injury and patients are carefully monitored for this complication. Intracranial hypertension (IH) is characterized by increased ICP in the absence of a tumor or other diseases and can result from cerebral edema, which is common after MTBI but is not considered as a consequence of mild TBI (mTBI). Intracranial hypertension secondary to a specific condition is called pseudotumor cerebri (PTC), typically associated with normal imaging findings, although subtle abnormal findings may exist in some patients. Pseudotumor cerebri is diagnosed by a lumbar puncture (LP) with a cerebral spinal fluid (CSF) opening pressure of >25 cm/H₂O in children or >20 cm/H₂O in adults. Post traumatic headache (PTH) commonly presents immediately after injury but in a subset of patients can occur 2-3 days after injury. This “secondary peak” may reflect post-traumatic cerebral edema in a select group of patients. Here we discuss a specific IH, or post traumatic pseudotumor cerebri headache (PTPTC) phenotype, found in 5 cases of mTBI and review the clinical implications.

Case series: We conducted a retrospective case series report of 5 patients diagnosed with PTPTC in a pediatric population (5-16 years old). Patients were assessed at 2-5 days post primary injury. Symptoms that prompted hospital or clinic visits included new or changes in headache pattern (positional, intensity, “early morning”), new or change in vision (blurry, positional, diplopia), new or change in auditory function (pulsatile tinnitus, “popping”), and worsening of balance and cognition. Significant clinical findings included increases in body temperature, neck/head pain, papilledema or cranial nerve deficit (6th), and lack of coordination. We found that neuroimaging could be normal but in one case, magnetic resonance (MR) imaging showed decreased intracranial space ratio, “empty Sella”, optic nerve sheath/head enlargement, displaced cerebellar tonsils, and reduced basilar cistern space. MR venography showed diminished size of transverse or sigmoid sinus in certain patients. In every case, elevated CSF pressure was documented by LP, documented normal CSF laboratory testing and all cases improved with treatment specific to PTPTC such as acetazolamide.

Conclusions: The importance of recognizing of this specific post traumatic headache type, PTPTC, in mTBI includes: being able to tailor specific treatment with use of LP for diagnosis and relief of symptoms and treatment with carbonic anhydrase inhibitors that lower ICP, such as topiramate or acetazolamide. It is postulated that the condition of PTPTC may predispose certain athletes to a condition called second impact syndrome.

Brain Deformation of Youth Athletes During Subconcussive Head Impact

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Introduction: To better understand and prevent concussive injuries, biomechanical factors of head impact, such as impact location and direction, relating to injury need to be well characterized. Directional dependence in brain response has been reported throughout the literature by researchers using animal models as well as finite element (FE) models.

Materials and Methods: On-field head impact data has been collected during practices and games for three youth teams over four football seasons using the Head Impact Telemetry (HIT) System. Each impact has an associated azimuth (θ) and elevation (α) angle which was used to identify impacts near ($\pm 15^\circ$) six locations of interest. The elevation angle is measured from the nose ($\alpha=0^\circ$) to the top of the head ($\alpha=90^\circ$), and the azimuth angle is measured from the back ($\theta=0^\circ$) of the head about the z-axis to the front of the head ($\theta=180^\circ$). The six impact locations (Figure 1) were adapted from previously published impact locations [3, 4]. At each impact location, 5%, 50%, and 95% percentile linear and rotational acceleration impacts were used to scale normalized load curves that were obtained from previously measured six degree of freedom (6DOF) data. These scaled curves were used as boundary conditions for finite element simulation using an anatomically accurate finite element model, the atlas-based brain model (ABM) (Figure 1) [5]. The strain response of the brain was analyzed by computing the maximum principal strain (MPS) in each brain element. The peak values were sorted in order of decreasing MPS value and plotted against the percentage of total brain volume corresponding to each MPS value.

Results and Discussion: A total of 40,538 impacts from 119 individual athletes were recorded. Strain results for the 50th percentile impacts for each location are displayed in Figure 1. The 50th percentile linear acceleration values were 31.2 g's, 17.3 g's, 14.8 g's, 18.4 g's, 17.0 g's, and 18.1 g's and the 50th percentile rotational acceleration values were 1,269 rad/s², 1,009 rad/s², 765 rad/s², 1,116 rad/s², 1,050 rad/s², and 1,078 rad/s², for location A, B, C, D, E, and F, respectively. Strain response in the brain represented as volume fraction of brain experiencing displayed levels of MPS for the 50th percentile impact.

Conclusions: This study demonstrates that MPS varies by impact location. The location that resulted in the largest strains was location B, a frontal impact through the facemask. The locations that resulted in lower strains were location A, a frontal impact towards the top of the head, and F, a rear impact. Quantifying the relationship between impact location, magnitude and brain deformation will aid researchers, clinicians, and equipment manufacturers in head injury prevention.

Evaluation of Cognitive Recovery after Sports-Related Concussion in High School Athletes Using fMRI of Working Memory

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Objectives: The literature has shown equivocal findings regarding the nature and persistence of cognitive and neuroimaging sequelae after sports-related concussion (SRC). Few longitudinal studies have been conducted to examine the time course of these effects, particularly in younger athletes. We previously reported greater working memory-related fMRI activation in high school athletes relative to controls one month after concussion, which was positively correlated with parent-reported post-concussive symptoms and accompanied by impaired cognitive performance. The purpose of this study was to examine the same cohort six weeks after the first assessment, to evaluate changes in brain activation and cognitive functioning over time.

Methods: Twenty-two high school athletes (mean age: 15.6 ± 1.3 years; 14 male) were studied one month (29.0 ± 12.3 days) after SRC (visit 1, V1) and again six weeks (43.6 ± 5.4 days) later (visit 2, V2). Concussed athletes were compared to 21 demographically matched healthy non-contact sport athlete control participants (age: 16.1 ± 1.1 ; 13 male) evaluated at the same interval (42.0 ± 1.8 days between assessments). Participants completed a visual-verbal N-back working memory fMRI task at 3T (task conditions 0-, 1-, 2-, and 3-back) and neuropsychological testing. Image preprocessing and group comparisons (full factorial model) were conducted using SPM8. N-back task performance, cognitive performance, and demographic data were compared in SPSS using appropriate statistical tests (e.g., chi square, ANOVA).

Results: At V1 the SRC group showed significantly poorer performance than controls across N-back task conditions, as well as for neuropsychological domains of attentional accuracy and overall cognition. This was accompanied by significantly greater bilateral dorsolateral prefrontal cortex activation in the SRC group than controls for the 2-back greater than 0-back contrast. At V2, significant improvement was apparent in N-back performance, with the only significant difference noted on the 0-back condition. For neuropsychological testing significant differences were apparent at V2 for processing speed and attentional accuracy, the latter markedly attenuated relative to V1. Concomitant with these functional improvements, within-group comparisons showed significant reductions in bilateral frontal activation in the SRC group. Interaction analyses confirmed reductions in the SRC group relative to controls in left claustrum and inferior frontal gyrus and right superior and medial frontal and superior temporal gyri.

Conclusions: We previously reported significantly lower cognitive performance and greater brain activation in the SRC group relative to controls one month post-injury. The current longitudinal assessment demonstrates improved cognition over time, though areas of significant weakness remain, potentially indicating incomplete recovery from injury in a subgroup of individuals 2-3 months after concussion. The apparent normalization of brain activation in brain regions within typical working memory circuitry suggests that fMRI may be a useful tool to monitor recovery from SRC and examine factors contributing to effective recovery.

Transcranial Doppler Should Be the Gold Standard for Diagnosing Concussion and Tracking Recovery: A Prospective TCD Young Collegiate Athlete Study Showing Impairment of Cerebrovascular Reactivity After Stated Resolution of Concussion Symptoms

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Background: Transcranial Doppler (TCD) is a tool that provides reliable and objective measurements of the cerebrovascular system, which is altered in several ways after mild TBI. Clinical outcomes after mTBI are often studied based on subjective patient reporting scales or doing modified components of a Neurological Exam. We report our findings of collegiate athletes who despite reporting “no symptoms” after concussion but showed impaired Cerebrovascular Reactivity (CVR) using TCD. **Technology Overview:** TCD is an ideal but underutilized diagnostic portable tool to adjunct other “TBI markers” such as blood biomarkers and Neuroimaging. It is a relatively inexpensive system and provides measurements such as the Pulsatility index, large vessel velocities and cerebrovascular reactivity (CVR) which are objective quantifiable measures.

Clinical Study: TCD was used as an evaluation in an ongoing prospective cohort of collegiate athletes during acute (day-3) and sub-acute (day-21) phases following concussion and compare them with non-injured athletes.

Materials and Methods: Sixteen male and female collegiate athletes (21±1 years) diagnosed with sports-related concussion were enrolled. Sixteen sports matched non-injured controls (21±1 years) were also enrolled. For the injured athletes, data was collected during the acute (day-3) and sub-acute (day-21) phase following concussion and for the controls data was collected at one time point. Sports Concussion Assessment Tool-3, along with other instruments were used to evaluate symptom severity, cognition and balance. Continuous middle cerebral artery blood flow velocity (MCAV) was obtained by TCD and End-tidal CO₂ was measured. Beat-to-beat MCAV was evaluated in response to changes in end-tidal CO₂ (PetCo₂) for 2-minutes each during normal breathing (Normal-PetCo₂), inspiring a gas mixture containing 8% CO₂, 21% oxygen (High-PetCo₂) and, hyperventilating (Low-PetCo₂).

CVR was analyzed as the slope of the linear relationship between end-tidal CO₂ and MCAV, which was expressed as the change in CBF velocity per mmHg change in end-tidal CO₂. Independent and paired t-tests were used to compare CVR between acute and sub-acute phase following concussion with the controls.

Results: Concussed athletes exhibited higher symptom severity (26.3±0.5 versus 5±7 P= 0.0007) and lower cognition (26.5±1.6 versus 28.3±2.4 P=0.03) during acute phase compared to the controls. Symptoms and cognition were resolved in the sub-acute phase. CVR was attenuated in the acute phase compared to the control (1.7±0.5U versus 2.3±0.3U, P=0.0006) and it continued to be blunted in the sub-acute phase following concussion (1.9±0.5U P=0.04).

Conclusions: Despite symptom and cognitive improvement, CVR appears to be impaired in the sub-acute phase following concussion. If only standard evaluation tools were used to evaluate the athletes, cerebrovascular physiological impairment would not have been identified. Impaired CVR may put athletes at risk for deleterious “second impact” injuries. TCD is a useful vascular biomarker for physiological recovery and aid in accurate diagnosis and return-to play decision-making for concussion.

Bridging the Gap for School Re-Entry Following Rehabilitation for Brain and Spinal Cord Injury and Disease

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Background: Timely intervention and responsiveness of rehabilitation is critical in the first year following a child or young person's acquired brain injury, spinal cord injury or severe illness given their highly variable sequelae in this period. Schools are a key contact point and are thus ideally placed to recognise problems, alert parents/carers and work with rehabilitation staff to maximise the timeliness and appropriateness of interventions. It is essential that families remain at the centre of this collaboration, as they and their child are the recipients of any decision that is made and action that occurs. This research investigates families' experiences of school re-entry after a period of inpatient rehabilitation, including the contribution of hospital rehabilitation outpatients' departments, school and home to a successful transition. Results will inform the development of new policies and procedures for paediatric rehabilitation departments and NSW schools to communicate more effectively and work collaboratively for children in their return to school.

Methods: Parents/carers of twenty school-aged participants were recruited purposively from rehabilitation outpatients' departments in three NSW paediatric hospitals. Parents/carers were video-interviewed using in-depth, open-ended methods. Data were organised in NVivo 11 and analysed using the constant comparative method.

Results: Preliminary results from initial interviews demonstrate the range of family needs in the transition back to school, particularly regarding children and young people's participation. This includes: planning for school re-entry; supports provided and adaptations made for classroom, physical education, excursion and extracurricular activities; adequate, timely communication between all involved; participants' suggestions for improvements and messages they have for other families experiencing similar transitions. Families were generally supportive of direct school-to-hospital communication about their child's progress and needs, but nonetheless wanted to be regularly informed of this communication and preferably via one hospital and/or school staff member, similar to a case worker model. The most positive school experiences resulted from strong support of teachers at the level of school Principal/Vice Principal and regular, multidisciplinary meetings that included representation from school, home (including parents/carers and children) and hospital.

Conclusion: Organisational cross-collaboration is most effective when family experiences are taken into account at the earliest stage of communications change and on an ongoing basis. Considering patient and family experiences early in the process of organisational change is an efficient use of organisations' time and resources and has the greatest impact for children, young people and their families.

Age-at-Injury Effects on Socialization and Emotion Regulation

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Many studies have demonstrated that the recovery process after head injuries sustained early in life is substantively different compared to those experienced in adulthood (Taylor & Alden, 1997). Indeed, earlier age head injuries have been associated with greater impairments in reading and written language skills (Shaffer, Bijur, Oliver, & Rutter, 1980), and mild head injuries (MHI) in high school have been shown to produce more severe and persistent cognitive impairments compared to those sustained in college (Field et al., 2003). In addition to academic and cognitive impairments, MHIs have also been implicated in emotional and behavioural dysfunction, given the orbitofrontal cortex's increased vulnerability to disruption in any closed-head injury (Morales et al., 2007). When sympathetic nervous system feedback to and from the orbitofrontal cortex is disrupted, those with a history of MHI may be unable to effectively make use of emotion-generated 'somatic markers' (i.e., 'gut feelings') to guide their behaviour and decision-making processes (e.g., Damasio, Everitt, & Bishop, 1996). Consequently, a lack of visceral cues and emotional dysregulation may have a more profound influence on normal developmental capabilities when head injuries are sustained at an earlier age.

The current research sought to examine the effect of age at injury on long-term adjustment and psychosocial well-being. We hypothesized that those who sustained their injuries at a younger age would experience more socioemotional challenges in university compared to those who sustained their injuries at a later age. Using a cross-sectional design, university students completed a series of self-report questionnaires in the Jack and Nora Walker Lifespan Development Centre testing facilities at Brock University in St. Catharines, Ontario, Canada. Age at injury accounted for 21.1% of the variance in daily stress in university, such that those who sustained their injuries in childhood experienced greater self-reported stress. Age at injury was also a significant predictor of sociability, whereby those with earlier injuries showed less preference for social interactions, $b = -.235$, 95% CI [.023, .446]. Moreover, age at injury significantly predicted emotion-based decision-making, such that those with earlier injuries reported a tendency to make important life decisions based on logic, rather than emotion, $b = .278$, 95% CI [.083, .476]. Lastly, age at injury was found to be a marginally significant predictor of negative problem orientation, such that those with earlier injuries reported a tendency to adopt a dysfunctional or inhibitive cognitive-emotional set when solving problems, $b = -.199$, 95% CI [-.849, .001]. Although the effects of MHI persist regardless of age, this research demonstrates that injuries occurring earlier in life may compromise an individual's capacity to cope emotionally, leading to greater social challenges later in life compared to those who sustain their injuries in adulthood.

Comparing Postural Stability After Sport-Related and Non Sport-Related Concussion: Do We Need to Make a Distinction?

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Context: Although postural impairments have long been reported following a concussion in the pediatric population, we still know very little about who is more at risk of presenting those balance problems and about how mechanism of injury (sport vs non-sport) could influence the type and duration of balance problems after concussions.

Objective: To compare balance function in children having sustained a sport-related (SRC) or non sport-related (NSRC) concussion, to that of children with an orthopedic injury (OI) and to healthy controls (HC), over a one-year period.

Design: Prospective cohort study.

Participants: A total of 112 children and adolescents participated in this study. Among them, 38 were concussed, with 27 having sustained a SRC; and 11 a NSRC, as well as 38 HC, and 36 OI.

Intervention: Balance function was evaluated at 2 weeks, 3 months, 6 months and 12 months after concussion, and at the same time intervals for the control groups.

Main Outcome Measure: The balance subtest of the Bruininks-Oseretsky Test of Motor Proficiency (BOT2) which comprises eight items, was used to evaluate both static and dynamic balance. For the purpose of this study, the two most difficult items, tandem stance and single leg stance with eyes closed on a balance beam, were also analyzed individually. Moreover, a Timed Foam Test consisting of standing on a foam surface in 3 foot positions: feet together, single leg stance and tandem stance, was used to measure static balance on an unstable surface. Finally, the Post Concussion Symptom Scale (PCSS) was used as a patient-reported outcome to specifically with the balance-related items.

Results: There was an improvement over the one-year follow-up period in tandem standing on balance beam in BOT2 ($p=0.020$) and in single leg standing on foam surface ($p=0.027$) for all groups. Group differences were found with the BOT2 between the NSRC and NI groups at the 2-week assessment, where the NSRC group had more postural instability during tandem standing on the balance beam ($p=0.013$). Moreover, at the second week, the NSRC group performed significantly worse than the SRC ($p=0.018$) and NI ($p=0.016$) groups during single leg standing on foam surface, and reported more symptoms than the SRC group on the PCSS ($p<0.001$). At the third month, group differences were only found between NSRC and SRC groups in single leg standing on foam surface where the NSRC group had lower performance than the SRC group ($p=0.018$).

Conclusion: Concussed children and adolescents improved balance over a year post injury in some challenging activities. Moreover, children sustaining a concussion outside of a sports activity seem to have higher levels of postural instability up to 3 months post injury when compared to those injured in sport.

Keywords: concussion, balance

Active Rehabilitation for Concussion Management. What Kind of Aerobic Exercise Do Symptomatic Youth Perform as Part of a Home Program?

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Background: Despite a growing trend of using exercise to promote recovery following concussion, there is limited data available describing what type of exercise patients do when prescribed a home program. As part of a recent pilot randomized clinical trial aiming to determine if early Active Rehabilitation (AR) (starting 2 weeks post-concussion) was a safe and acceptable management strategy for concussion management, we also wished to monitor post-concussion symptoms and adherence to prescribed aerobic exercise parameters (frequency, duration, intensity, and mode).

Objective: To describe home-exercise parameters reported by participants in an AR study as a means to estimate adherence to prescribed intervention.

Design: Participants received a daily e-mail with a link to an online survey. Two groups (early, usual care) received the same intervention (AR) but the start times differed. The early group started 2 weeks post-concussion whereas the usual care group started 4 weeks post-concussion. Participants received daily e-mails until one of the following criteria were met; 1) asymptomatic for five consecutive days, 2) discharged from physical therapy, or 3) the end of the study period (8 weeks).

Participants: Seventeen youth (9-17 years old) with post-concussion symptoms for at least two-weeks.

Outcome Measure: Online survey. The online survey measured 7 specific post-concussion symptoms before and after exercise, as well as exercise mode, duration (minutes), and intensity using the Pictorial Children's Effort Rating Table (PCERT). The exercise parameters from the online survey for the first week of AR were compared with the medical record, where exercise prescription by the clinician had been logged, to estimate adherence.

Results: 24 surveys were completed by 9 participants in their first week of AR. Clinicians prescribed aerobic exercise 7 days/week to both the early AR and usual AR groups. The early group reported performing exercise 3.7 days/week compared to 4.2 days/week in usual care. Participants were prescribed a mean 16.1 and 16.7 minutes of aerobic exercise in the early and usual care groups respectively. Participants reported exercise durations of an average 13.2 minutes (early AR group) and 17.7 minutes (usual AR group). The intensity was prescribed at 2.7/10 for the early group and 3.1/10 in usual care on the PCERT. Participants in the early group reported exercise intensity of 2.1/10 on the PCERT compared to 3/10 in the usual care group. Walking and stationary cycling were the most frequently reported modes of exercise.

Conclusion: Children and teens receiving early or usual care AR for their persistent post-concussion symptoms adhered closely to the prescribed intensity and duration of their home-exercise program but failed to meet the frequency expectation. It may be overly optimistic to expect youth to perform daily exercises at home while managing return to school and other activities.

The Challenges of Self-Report Among Adolescents and Young Adults with Prolonged Recovery from Concussion

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Concussion related concerns among children and adolescents initiate over 400,000 hospital visits each year in the US. Assessment of concussion recovery relies heavily on patient self-report of physical, cognitive, and emotional symptoms. Health care providers use symptom self-ratings to make return to learn and return to play decisions. The most common assessment strategy has been to track the intensity, severity, and duration of symptoms following injury via a Post Concussive Symptom (PCS) inventory. PCS ratings are lengthy, subjective, and often provide little guidance for targeted interventions to decrease symptoms or improve recovery outcomes. There is also emerging concern regarding the possible iatrogenic effects of such continued focus on symptomatology. There is evidence that concussion recovery can be complicated by previously existing psychological conditions, and that patients undergoing concussion recovery are at an elevated risk for developing anxiety and depression. This presentation will discuss how patients and their parents describe their emotional/behavioral symptoms in the context of a prolonged recovery from concussion.

The presentation will review clinical data is from over 50 youth and young adults who participated in a specialty Pediatric Concussion Psychology Clinic. Patients were referred from a primary care team concerned for prolonged elevations in PCS. At the initial visit, all participants and parents rate emotional and behavioral functioning as well as perception of recovery. Patients complete a brief neurocognitive battery of tests sensitive to cognitive changes most likely after concussion, such as difficulties with cognitive processing speed and memory. Patients and parents also receive brief psychological intervention focused on building resilience and coping skills while encouraging increased participation in various life activities. Symptom ratings and perception of recovery are re-administered at the follow-up visit.

Preliminary findings indicate that reports of historical emotional and behavioral functioning are not consistently correlated with reports of emotional/behavioral concerns specifically in the context of concussion. Forms that ask specifically about overall concussion symptoms are more likely to indicate current emotional distress, and in that context emotional symptoms are highly correlated with overall symptom reporting. Finally, PCS scores are more likely to change after the psychological intervention than ratings of perceived recovery.

Findings promote discussion useful to treatment providers who wish to assess their patient's current emotional functioning during concussion recovery. More standard psychological surveys and general medical history forms may not reveal even significant overall symptom distress in this population, including psychological distress. This line of inquiry may also be helpful in the pursuit to identify more efficient strategies for patients to rate concussion symptoms as they return to typical life activities, allowing an increased focus on function and recovery with reduced attention toward cataloging symptoms.

Structured Assessment Protocol for Pediatric Patients with Acquired Brain Injuries in An Inpatient Rehabilitation Hospital

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A standard protocol for assessment of pediatric patients with acquired brain injury enables the rehabilitation team to monitor progress in different functional domains and to tailor interventions to optimize recovery from coma and disorders of consciousness to confusional states to later stages of recovery. Incorporation of data into the EMR facilitates tracking and assessing the effects of interventions.

Methods: We developed a structured assessment protocol for pediatric patients undergoing rehabilitation using standardized, quantitative instruments. We chose assessments for each of the 3 designated stages of recovery: (1) disorders of consciousness; (2) confusional states; and (3) impaired cognition state. Frequency of administration and criteria for change to the next stage and/or assessment were determined with careful consideration of clinical care needs. Assessments involved domains assessed by physical, occupational, and speech-language pathology; pediatrics; psychology; neuropsychology; pediatric neurology; and functional outcome measures. These included Coma Recovery Scale – revised (CRS-R); Rappaport Coma Near Coma Scale (CNC), Agitated Behavioral Scale (ABS), Children's Orientation and Amnesia Test (COAT), Orientation Log (OLOG), Cognitive and linguistic Scales (CALs), Physical and Mobility Scale (PAMS)chi / Rank, PEDI, Glasgow Outcome – Extended Scale (GOES), and WeeFIM.

Results: To implement the protocol, we trained staff in administration and interpretation of all measures, established inter-rater reliability, designated super-users, incorporated assessments into the electronic medical records in unique, retrievable fields for data tracking, and planned analysis of outcome data. Data collected through this protocol have been successfully incorporated into individualized clinical treatment plans.

Conclusions: A standard protocol for assessment of children through the brain injury trajectory enables the rehabilitation team to monitor progress and inform interventions more appropriately. In addition to informing clinical practice, the structure data will support research to understand alteration of consciousness and to improve cognitive function.

Clival Fractures in Children: Diagnostic Option Within the Emergency Room Setting

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Introduction: Clival fractures are a rare but severe result of blunt head trauma in all ages of life. There is only a small number of case reports about pediatric clival fractures published until today and therefore it has been difficult to determine a specific pediatric emergency room algorithm. The aim of this study is to present clinical features, radiological findings and to take a look at the outcome of pediatric patients with clival fractures.

Methods: Two patients were evaluated in a pediatric trauma room setting within the primary survey with our Munich modified ATLS (Advanced Trauma Life Support) Algorithm, including extended FAST Sonography (Focused Assessment with Sonography in Trauma).

Results: From 2014 to 2015 an 8- and a 9-year old boy were admitted to our hospital with isolated blunt head trauma. Clinically, both patients presented with signs and symptoms of basal skull fracture. Initial native cCT delineated trapped air in basal cisterns and therefore contrast enhanced CT was performed. Both patients suffered from a clival fracture in concert with additional cranial fractures. Neither CT nor MRI depicted vascular damage.

Conclusion: A single CT-Angiography with application of intravenous contrast in a prolonged bolus for visualization of the arterial and venous vessels of the head and cervical spine is highly recommended in the acute setting if:

First: The initial cCT-Scan showing entrapped air w/o diastasis of the spheno-occipital suture after pediatric head trauma and second: due to the morphology of a cervical spine fracture or the trauma mechanism a vascular damage seems possible.

Keywords: Clival fractures, children, traumatic brain injury, angiography

Post Concussion Symptoms in Female Athlete - A Review of Literature and Case Report

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Evidence supports that female athletes suffer concussion and suffer from post-concussion symptoms at a higher rate than male athletes. (1,2). The growing literature support and personal case experience demonstrates that female athletes may report concussion symptoms less often than their male counterparts yet have greater social and cognitive impact. This presentation contributes to the growing evidence that there is a sex and gender difference in occurrence and TBI symptom reporting. Using case report methodology, provider presents clinical data to support a multi-disciplinary approach to post-concussion care for athletes.

A fourteen year old female athlete suffered head to head contact while playing basketball. She complained initially of headache and neck pain but denied further symptoms. She was returned to play. Three days later she had continuing headache symptoms and felt "dizzy". She presented to her primary care provider and was diagnosed with a concussion. She was placed on rest and given NSAIDS for her headache symptoms. She presented to the emergency room on post-concussion day seven with worsening headache, nausea, photophobia and cognitive complaints. Neurologic exam and CT head were normal. She was diagnosed with migraine headache and post-concussive symptoms and told to follow up with her PCM. Fast forward twenty four months and the patient was being home schooled, had little social interactions and had been evaluated by multiple neurologists and psychologists and diagnosed with depression and migraine headaches. She was prescribed topamax and NSAIDS and psychotherapy. Patient and parents were then seen and evaluated in a comprehensive interdisciplinary TBI treatment program. Results indicate that multi-disciplinary TBI care provided following appropriate evidence based treatment and education improved quality of life; patient returned to school that following year without TBI or psychological symptom endorsement. Follow up reports indicate patient continues to function well psycho-socially and has resumed full engagement in sports activity.

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Long-Term Participation and Family Impact After Acquired Brain Injury (ABI) in Children and Youth: Design and First Results of a Dutch Multi-Center Study

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Introduction: Research on outcomes in ABI in children and youth has long been mainly focused on physical and cognitive functioning, whereas few studies were concerned with societal participation and the impact on the family.

Therefore the aim of this study was to prospectively describe the course of participation and impact on family after ABI in children and youth.

Patients/Method: Design: multicenter, prospective, observational study, embedded in usual care in rehabilitation centers.

Patients: 150 consecutive children, adolescents and young adults (4-25 years) with a diagnosis ABI, their families and a significant other person (like a friend or teacher), admitted to a rehabilitation center. Exclusion criteria were physical or mental consequences affecting study participation.

Assessments: The administration of a set of electronic questionnaires at admission, 12 and 24 months is introduced in every center. It includes the following instruments: Child and Family Follow-up Survey (CFFS), Child and Adolescent Scale of Participation (CASP-Y), Paediatric Quality of Life Inventory Family Impact Module (PedsQLTMFIM), Pediatric Health Related Quality of Life (PedsQLTMHRQoL) and Fatigue (PedsQLTM Fatigue). Injury and rehabilitation treatment characteristics are collected from the patient files by the researcher.

Results: Sixteen of the 18 rehabilitation centers in the Netherlands were approached, of which 13 agreed to participate, with inclusion starting from October 1st, 2015. By April, 2017 135 patients were included in 11 centers.

Conclusion: A multicenter study started to prospectively describe the course of participation and impact on family in a large cohort of children and adolescents who are referred for ABI at a rehabilitation center in the Netherlands appeared to be feasible.

Association Between Metoclopramide Treatment in the ED and Post-Concussion Headache

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Background: There is limited pediatric literature examining effective treatments to prevent persistent headaches in children presenting with acute concussion symptoms. Metoclopramide is a commonly used treatment for acute headaches within the emergency department but its use has not been studied in concussion.

Objective: To determine if metoclopramide administration in the emergency department is associated with a reduction in headache symptoms in children at 1- and 4-week post-concussion.

Methods: Children aged 8.00-17.99 years with an acute concussion (<48 hours) presenting to 9 emergency departments of the Pediatric Emergency Research Canada network were enrolled in a prospective cohort study, from August 2013 to June 2015. Primary outcome was the change in headache symptoms at 4 weeks post-injury relative to pre-injury status, and the secondary outcome was headache change at 1-week post injury. The exposure of interest for this study was metoclopramide administration in the index visit. Treatments administered in the ED were collected using standardized forms. Self-report symptom questionnaires were rated at initial presentation, 1 and 4 weeks using the Post-Concussion Symptom Inventory. Presence of headache, a dichotomous variable, was based on the 4-week headache score minus the recalled pre-injury score. Propensity scores were developed using multivariate logistic regression to reflect the probability of a participant receiving metoclopramide, given patient characteristics. The association between metoclopramide administration and headache persistence was examined with a risk ratio using both an unadjusted analysis and 1:4 propensity score matching.

Results: Baseline assessments were completed in 2095 participants of which 65 received metoclopramide within 48 hours of acute concussion. At 1 and 4 weeks, 54% (963/1808) and 26% (456/1780) of participants had ongoing headache relative to baseline respectively. In unadjusted analysis, no association between metoclopramide and headache persistence at 4-weeks was found [treated group 27.3% vs untreated group 25.6%; relative risk (RR): 1.02 (95% CI: 0.87-1.21)]. Metoclopramide was not associated with a lower headache persistence risk at 4-weeks on the propensity score matching [n=225 (27.1% treated group vs 32.8% untreated group); RR: 0.92 (95%CI: 0.75, 1.13)]. The unadjusted analysis [treated group 53.4% vs untreated group 53.2%; relative risk (RR): 1.00 (95% CI: 0.76-1.33)] and the matched propensity score analysis [treated group 52% vs untreated group 59.4%; RR: 0.84 (95% CI: 0.60-1.19)] for the one-week outcome demonstrated no association between metoclopramide and headache persistency.

Conclusions: Metoclopramide administration was not associated with a reduced risk of ongoing headache compared to pre-injury baseline at 1- and 4-weeks. Further research is necessary to determine which pharmacotherapies may be effective in acute post-traumatic headache treatment and prevention of persistent headaches following pediatric concussion.

The Clinical Course of Children Younger than 3 Years of Age with anti-N-methyl-D-aspartate Receptor Encephalitis

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Objective: To describe the presentation, clinical course, and outcomes in children younger than 3 years of age with anti-N-methyl-D-aspartate Receptor (anti-NMDAR) encephalitis, specifically highlighting unique features within this specific age group, as little is known about anti-NMDAR encephalitis in very young children.

Methods: Retrospective chart review of children younger than 3 years of age who were diagnosed with anti-NMDAR encephalitis at a single pediatric tertiary referral hospital during a 2 year period (2015-2016). Data collected included demographics, presentation at admission, diagnostic evaluation, clinical course, immune suppression and other treatments, and exam at discharge and last follow-up appointment.

Results: Three children aged 18 – 23 months were admitted with anti-NMDAR encephalitis. All presented with predominantly motor (not walking) and language (talking less) complaints with initially mild abnormal movements and irritability. CSF and other studies were consistent with the diagnosis, though one child had concomitant positive PCR for Epstein Bar Virus in CSF. Choreiform and other movement disorders markedly worsened in all 3 children early during acute hospitalization, requiring intubation, ICU admission, and continuous medication for control of movements in 2 children. All 3 received IV Methylprednisolone, IVIG, and Rituximab within the first 2 weeks of admission; the 2 children requiring critical care also underwent plasmapheresis, during which one child developed a left inferior cerebellar stroke. One child received a dose of cyclophosphamide after all other treatments due to lack of clinical improvement. One child required tracheostomy and two required gastrostomy tube placement. None had clinical or electrographic seizures; 2 of the 3 developed autonomic instability. Clonazepam was started and continued at discharge in all 3 children; Tetrabenazine was prescribed for 2 of the 3. All 3 children were significantly functionally impaired (non-verbal, non-ambulatory) at acute hospitalization discharge. Only 1 of the 2 children made notable functional gains during subsequent inpatient rehabilitation; however, at last follow-up evaluation, all 3 demonstrated ongoing neurodevelopmental gains with gross motor skills while language skills remain significantly impaired for age. None had ongoing movement disorder at follow-up evaluation.

Discussion: As highlighted in this case series, the initial presentation and clinical course of children younger than 3 years of age is different than older children and adults with anti-NMDAR encephalitis. Follow-up is ongoing for the children yet it appears that even with early and aggressive immune suppressive therapies, all 3 children have ongoing developmental delays, especially language impairment, within the first year of insult. Considering the underlying neurodevelopmental pathophysiology, young children may be uniquely vulnerable to deleterious effects following anti-NMDAR encephalitis.

Acquired Brain Injury: The Introduction of Outcome Measures in Paediatric Settings

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The use of outcome measures in the adult working age population has been used to demonstrate both the functional improvement of individuals and the cost effectiveness of specialist rehabilitation [1]. The outcome measures employed can be difficult to apply directly to the childhood population and therefore proving value of specialist services can be problematic. In the current study professionals in paediatric settings in the UK were asked to complete a questionnaire regarding their experiences introducing outcome measures to children with acquired brain injury. The findings are discussed in the context of the current UK healthcare climate and indications for future research and investigation are offered.

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The Role of Graded Exercise Testing and Heart Rate Variability Training in Pediatric and Adolescent Concussion Rehabilitation

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Concussion (mild traumatic brain injury-TBI) remains a challenging injury to treat because there are no clearly defined predispositions, biomarkers, imaging criteria, or prognostic criteria for a definitive diagnosis. Overlapping symptoms include headaches (> 90%); dizziness (79%); cervical spine pain (61%); insomnia (42%); exercise intolerance; difficulties with executive function, memory and attention; slowed reaction times; visual processing; anxiety; and irritability. Concussive injury results in a neurometabolic cascade and energy crisis, including alterations in cerebral blood flow (CBF) for 10-21 days post-injury. This autonomic dysregulation, due to uncoupling between CBF and oxygen consumption, results in decreased heart rate variability (HRV), an increased heart rate (HR), and increased diastolic blood pressure response during exercise.

HRV is a measure of the balance between sympathetic and parasympathetic drive. Reduced HRV predicts mortality after myocardial infarction, depression, susceptibility to sudden infant death syndrome, poor survival in premature infants, academic performance, stress, and emotional self-regulation. HRV reflects an athlete's readiness to tolerate training load, recovery, optimal training times, and immune status. Metabolic and central nervous system readiness and HRV are easily measured during sport and yield objective data to design and modify the concussion rehabilitation prescription.

Asymptomatic concussed adolescent athletes present with increased sympathetic nervous system activity, decreased cerebral blood flow autoregulation, lower HRV, and increased HR compared to control subjects for up to four weeks post injury. Increased sympathetic tone is also associated with up to 70% of patients with chronic dizziness. Recognition of autonomic dysfunction and its effects on co-occurring conditions such as vestibulocular symptoms, balance, reaction time, and dual-task deficits is key in designing rehabilitation programs. Graded exercise testing (GXT) has been advocated as a means to determine the highest submaximal, subsymptom exercise threshold to facilitate cerebral blood flow, determine the target metabolic system, training intensity and exercise type to return to sport. HRV training with an exercise prescription based on cardiac response (blood pressure, HR vs. intensity), is a valuable tool to improve academic and athletic performance following concussion.

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Establishing Autonomous Behavior to Improve Social Behavior in a Boy with Self-Injurious Behavior After Acquired Brain Injury

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Objective : We sought to improve the social behavior of a boy attending a regular elementary school who developed self-injurious behavior years after a traumatic brain injury, by modifying his environment and helping him establish autonomous behavior.

Case : A boy aged 7 years 4 months visited us for initial consultation about problematic behavior consisting of constant non-suicidal self-injury and strange behavior at home, but quiet at school. He had a traumatic brain injury in a road traffic accident 2.5 years earlier. Hospital medical records noted diffuse axonal injury and MRI findings of scattered lesions across the commissural fibers in the left hemisphere, right thalamus, and left parietal lobe. Disturbance of consciousness lasted 3 weeks, and hospital stay was 29 days.

Methods and Outcome: (1) **Assessment :** Interview with his mother and class teacher about his daily activities. Behavioral observation of him playing with his younger brother and sister during the interview to verify self-injurious behaviors. Clinical data provided by the hospital, including scores on the Wechsler Intelligence Scale for Children (3rd edition; verbal IQ 108, performance IQ 75, full scale IQ 91, verbal comprehension index 117, perceptual organization 80, freedom from distractibility 76, and processing speed 78) and moderate memory loss according to the Rivermead Behavioural Memory Test. Additional assessment using the Profile of Mood States revealed strong negative emotions. The School Function Assessment revealed difficulties engaging in functional communication and active social interaction, which teachers had not noticed during behavioral observation.

(2) **Overall findings:** He had repeated mistakes from his vulnerability in auditory short-term memory of disorders. He could not stop engaging in stress-coping behaviors at home because of stress resulting from mistakes he was making at school. Once started, stress-coping behavior escalated because of his inability to control impulse, making him regret and repeat self-injurious behavior. Residual abilities, like high verbal comprehension suggesting strong language conceptualization and relatively good attentional function, appeared to help him.

(3) **Hypothesis and treatment approach:** A stepwise strategy was applied according to Mayahara and Nakashima (2007). First, to complement attention deficit, we improved his perception of visual cues from his surroundings. Second, we improved the relationship between the boy and his mother and how his mother acted as a supporter and advisor. In this case, we used the PDCA approach to synthesize the needs of children and the therapists' advices. Then, in corporation with his mother, we established and worked through stepped behavioral goals to help him behave autonomously.

Through this approach: Together with his mother, we established and worked through stepped behavioral goals to help him regulate his behavior autonomously. Through this approach, the self-injurious behaviors are reduced and he is more relaxed at home, playing with friends.

Discussion : In our study, an elementary school student developed self-injurious behavior years after TBI likely because, due to a neurodevelopmental delay, he could not manage challenges of a new developmental stage as described by Chapman et al. (2007).

Our patient's WISC-III scores revealed high Verbal Comprehension but extremely low Perceptual Organization, Freedom from Distractibility, and Processing Speed, suggesting a decline in intellectual performance due to TBI. WISC-III also showed vulnerability in auditory short-term memory, and RBMT indicated moderate memory loss. We thought that he became unable to manage new challenges at elementary school as a result of decreased cognitive function.

Mistakes attributable to vulnerability in auditory short-term memory were reduced by using visual information and then utilizing support. Because mistakes were reduced, our patient was able to attend classes and join in play, gradually establishing autonomous behavior.

Residual abilities, like high verbal comprehension suggesting strong language conceptualization and relatively good attentional function, appeared to help him acquire high levels of verbal understanding for emotional suppression and improve cognition.

To decide on interventions appropriate for this boy with TBI, it was necessary for us to establish support based on the results of assessing cognitive vulnerability. It has been shown that children who have reintegrated into elementary school have high needs for a support system for problematic emotional behaviors attributable to cognitive vulnerability. In our patient, our decision to intervene in his surrounding environments, in addition to providing direct support, was found to be effective.

Regarding environmental factors, we educated his mother to act as supporter and adviser and, more importantly, as collaborator to help him stay calm and behave autonomously. Our approach of providing such education to the boy's mother was an effective measure for stabilizing his emotions.

Pediatric Concussion Outcome Priorities from Patient, Parent and Educator Perspectives: A Qualitative Study

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Background: One-third of youth experience post-concussive symptoms beyond one month, with potential loss of social activities, prolonged absenteeism from school, and neuropsychiatric problems. Our objective was to examine the impact of pediatric concussion at home, school and play, and evaluate outcome priorities from a patient, parent and educator perspective.

Participants and Methods: We conducted a qualitative study from May 2015-February 2016. Eligible patients were aged 5-18 years with acute concussion treated at Children's Hospital of Eastern Ontario (CHEO) emergency department (ED), or with chronic concussion followed in rehabilitation studies at McMaster University. Eligible parents had a child with concussion presenting to one of the two participating sites. Eligible educators were academic and/or athletic staff employed at one of three secondary schools in Ontario.

Participation included a one-time, 30-minute semi-structured individual telephone interview, using the Dillman Tailored Design Method. Sample size depended on thematic saturation balanced per target audience.

Interview topics included: concussion awareness, experience with concussion, support and resources, and outcome priorities. Interviews were audio-recorded and transcribed verbatim for analysis. NVivo software was used to organize, analyze and code data; a constant comparative method was applied to identify themes.

Results: Nine patients (acute concussion n=1, chronic concussion n=8; mean age 13.1 years, range 5-17 years), 17 parents (13 with a concussed and 4 with a non-concussed child), and 14 educators (academic staff n=9, athletic staff n=9, and/or special needs assistance staff n=2) were enrolled.

Concussion was recognized as serious health concern in school-aged youth. Both media attention and implementation of concussion protocols in schools and sports were perceived as contributors to a changing personal and public opinion. While most interpreted this increased awareness as positive, some feared student manipulation of the school system. Parents expressed the need for more consistent information and resources from reliable sources including health care professionals. Educators indicated that resource needs and availability varied across schools and educator roles.

Concussion impact on daily activities ranged from missing a few days to prolonged absence from school, sports and social activities with gradual return necessitating classroom and sports accommodations. Patients worried about short-term problems including decreased peer contact, whereas parents and educators expressed growing concern for long-term complications including prolonged absence from school and decreased academic achievements, and limited peer contact leading to psychological stress. Parents and educators indicated timely return to school as a primary goal during concussion recovery.

Conclusion: Recent media attention and introduction of concussion protocols have contributed to increased concern for both short- and long-term consequences of pediatric concussion. Initial concussion recovery in school-aged youth should be focussed on timely return to academic activities and ensuring peer contact during recovery.

Age-at-Injury Effects on Long-term Cognitive Outcomes: Examining the Moderating Role of Early Medical Intervention

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Research demonstrates that the outcomes observed after head injury vary as a function of the age at which the injury was sustained; in particular, head injuries sustained at a younger age are associated with poorer outcomes as they adversely affect developmental processes (Taylor & Alden, 1997). Indeed, earlier age head injuries have been associated with significant cognitive deficits (e.g., lower intellectual capacity, lower academic ability, and impaired executive function) when compared to normative expectations (Anderson et al., 2009), and mild head injuries (MHIs) sustained in high school have been linked to prolonged acute cognitive recovery compared to injuries sustained in college (Field et al., 2003). Importantly, however, there is evidence that these adverse injury outcomes can be mitigated by early medical intervention in children (Ponsford et al., 2001). The current study sought to investigate whether earlier age injuries are associated with poorer long-term cognitive outcomes in university and whether early medical treatment influences this relationship. In particular, differences in cognitive functioning were compared between those who sustained a MHI in childhood/early adolescence (≤ 15 years of age) and those who sustained a MHI in late adolescence or adulthood (>15 years of age); medical treatment was examined as a potential moderator of this relationship. Using a cross-sectional design, university students completed a series of self-report questionnaires and performance-based cognitive measures in the Jack and Nora Walker Lifespan Development Centre testing facilities at Brock University in St. Catharines, Ontario, Canada. Results indicated a main effect of age, such that those who sustained their injury at or prior to age 15 made significantly more errors on the switching condition of the Trail Making Test (TMT; Delis & Kaplan, 2002) compared to those who sustained their injury at 15 years of age or older, $F(1, 27) = 9.686, p < .05$. Interestingly, there was a significant interaction between age at injury and whether participants received medical attention for their injuries, $F(1, 27) = 4.422, p < .05$, whereby performance differences between earlier and later age injuries were eliminated if medical treatment was received, $p = .419$. In contrast, those who sustained their injury in childhood or adolescence and had no medical treatment made significantly more errors than those who sustained their injury at a later age and also did not receive treatment, $F(1, 27) = 10.92, p = .003$. Similar results were observed for performance on the Spelling subtest of the Wide Range Achievement Test (WRAT-4; Wilkinson & Robertson, 2006); of those who did not receive medical attention, an earlier age at injury was associated with worse performance. Taken together, these findings imply that medical attention may help to lessen long-term cognitive challenges in those experiencing pediatric brain injury.

A New Submaximal Graded Cycle Ergometer Test for Assessing Recovery from Concussion in Children and Adolescents

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Objective: To evaluate a submaximal graded cycle ergometer test for retest reliability (RTR) in the evaluation of the effects of symptom exacerbation from concussion in children and adolescents.

Setting: Concussion Clinic.

Participants: A sample composed of 111 children and adolescents (age range: 10-18 years) with concussion gave informed consent and participated in this study. Participants were screened for and excluded based on the following: cardiovascular and pulmonary disease, hypertension, orthopedic limitations to exercise.

Intervention: On their arrival at the clinic, participants' height, weight and resting heart rate were recorded. A modified Astrand-Saltin (Astrand & Rhyming, 1954) protocol was used for the maximal CE tests. Seat height was adjusted using a method suggested by Nordeen-Snyder (1977) and remained constant for all tests. The test required participants to cycle at a fixed cadence determined by the participant during the pre-test phase, with power output being increased every 3 min until the participant could not maintain the cadence or when any concussion symptom would be exacerbated. Children and adolescents began the test at a pre-set power. Each stage of the ergometer test lasted 3 min. The test was designed to have four stages: one warm-up stage, and three additional submaximal stages. Blood pressure, Borg Scale of Perceived Exertion and post-concussion symptom scale was taken at every stages of the test.

Main Outcome Measures: Maximal heart rate (HR), systolic blood pressure, diastolic blood pressure, rating of perceived exertion and presence or absence of symptom exacerbation. The symptom exacerbation HR was also recorded.

Results: The submaximal cycle ergometer showed good properties for identifying children and adolescents with symptom exacerbation from concussion.

Recovery of Functional Walking Capacity in Children After Brain Injury

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Background: Post-BI children present long lasting limitations in functional walking capacity.

Objectives: To evaluate changes and factors related to improvements in functional walking capacity post pediatric BI.

Methods: Youth with BI admitted to the inpatient/outpatient Pediatric Rehabilitation Department were recruited. At admission (T0) and discharge (T1) functional walking capacity [six minutes-walk test (6MWT)], 6MWT heart rate (HR), and gait impairment [10-meters walk test (10MWT)] were evaluated. Changes in 6MWT from T0-to-T1 were compared via paired t-test and effect sizes. Standard deviation (SD) gap from expected walking distance (in typically-developing children) was calculated. Factors related to improvement in 6MWT (etiology, sex, use of assistive devices) were evaluated using correlations. Following that, the minimal detectable change (MDC) was calculated. The group was divided into two based on 6MWT improvement status (children who did or did not present improvement greater than the MDC). Differences between groups were examined using independent t-tests, chi squared test, and receiving operating characteristic curves (ROC).

Results: A total of 60 children participated in this study (mean age=12.34±3.34; average time post injury=3.79±5.22 months; non-TBI, n=27; TBI, n=33). At T0, mean walking distance was 303.94±28.40 meters, 6.02±2.86 SD below the expected walking distance. The MDC was 45.86 meters. At T1, 66% of the sample presented meaningful improvement in 6MWT distance (improvement >45.86 meters). However, most children still presented walking performance over 2SD below the expected walking distance. Effect sizes were large for both TBI (effect size=1.18) and non-TBI (effect size= 0.88) groups and the prevalence of significant improvement was similar for both groups. Mean percentage from maximal HR at the end of the test was 71% at both T0 and T1 (vigorous exercise intensity). Change in 6MWT distance was significantly correlated with injury chronicity ($r=-0.299$), SD gap ($r=0.566$), and 10MWT at T0 ($r=0.544$). More boys presented significant improvements in 6MWT than girls. Children who used assistive devices also presented greater improvement in 6MWT in comparison to children who did not use assistive devices. SD gap identified correctly children in the improvement and non-improvement groups (sensitivity and specificity >80%; area under the curve= 0.80; critical value=4.65 SD gap).

Conclusion: Despite large improvements seen during rehabilitation, children with BI presented severe limitations in walking capacity at discharge. The reduced walking capacity may be related to cardiovascular fitness (high percentage of maximal HR at the end of the test) and gait impairment (significant associations between 6MWT and 10MWT). Several factors are related to greater improvements in 6MWT. This information is important in order to tailor appropriate intervention strategies.

Effect of Contextual Interference in Motor Learning in the Diparesis by Cerebral Palsy

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Background: Individuals with Cerebral Palsy (CP) diparesis showed sensorimotor impairments, which may damage the performance of motor skills, and consequently, their learning. Thus, it is necessary the knowledge of the motor learning and the factors that could interfere in this process. **Objective:** Verify the effect of contextual interference using a maze task, in participants with diparesis CP.

Method: In this study 32 participants were evaluated (mean age: 15.87±5.94 years, 18 males and 14 females), 16 with CP diparesis and 16 participants with typical development paired by sex and age with CPD. The maze task was performed in a computer using a constant practice (same maze- CoP) or random practice (different maze-RaP), in three phases: in the acquisition the participants who performed the CoP executed 30 times the same maze (maze 1) and the participants that performed the RaP executed 30 times (alternating between five different maze). After five minutes, all participants executed 5 times the maze 1 (Retention), and more 5 attempts from another maze (Transfer). Data were organized in blocks and performed the Kruskal Wallis test and Dunn's post-test (significance of $p < .05$).

Results: The Cerebral Palsy group showed longer task execution time compared to Typical development Group for all phases ($p < .0001$). The participants from both groups who performed CoP decreased the movement time from the first acquisition block (A1) to the last (A6) (Cerebral palsy: A1=24.33±15.87s and A6=15.22±8.56s; Typical development: A1=4.52±1.39s and A6=3.37±0.74s), with decrease from A6 to retention and increased for transfer. In the RaP, both groups showed decreased in task execution time from A1 to A6 (Cerebral Palsy: A1=21.46±9.78s and A6=11.5±5.95s; Typical development: A1=7.05±2.7s and A6:5.62±2.47s), with decrease from A6 to retention and increased for transfer. However, there was no significant difference between the types of practice in both groups.

Conclusion: All participants presented improve in performance, but there was no effect of contextual interference (constant versus random practice) on the motor learning of participants with diparesis and typical development.

The Effect of the 35 Hours Robotic Assisted Gait Training on the Quality of Life of a Young Adult with CP: One Case Study

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Introduction: Cerebral Palsy (CP) is a chronic disorder of movement control and posture. The ambulation ability depends on the level of spasticity in the specific muscle groups (adductors, hamstrings) and equinovarus deformity of the foot. In many cases normal walking pattern is not a realistic goal for the CP patients. The main goal of robotic assisted gait training is retraining a walking ability, but there are also other positive effects on the functional as well activity and participation level.

Purpose: Using the International Classification of Functioning, Disability and Health (ICF) to describe the problems of functioning and participation by the structured way and to analyze the results of the robotic-assisted gait training on the level of functioning and participation in one case study example.

Objective: A 31 years old man had a 35 hours of the robotic-assisted gait training in the time period from 15.02.2016 to 27.03.2017. His main problems before the therapy were sweating (b830) due the extra energy expenditure of spastic gait (b770), pain in the back (b28013) due the low power of the muscles of the trunk (b7305). He had low exercise tolerance (b455) what had negative influence on his participation in all major life areas.(d850, d920).

During the robotic assisted gait training program he walked totally 32.284 km. 922 m per session.

Conclusions: In this one case study we found positive influence of the intensive locomotion training on spastic gait (b770), pain in the back (b28013), power of the muscles of the trunk (b7305), tone of muscles of lower half of body (b7353), exercise tolerance (b455) and on the sweating (b830), what let him to be more active in the social life (d850, d920) and had a great positive influence on his quality of life.

The Assessment of Oculomotor and Visual Task-Related Brain Activity After Concussion Using Functional Near Infrared Spectroscopy (fNIRS)

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Objective: Functional near-infrared spectroscopy (fNIRS) is a noninvasive and portable neuroimaging modality that detects changes in blood oxygenation related to human brain function. It is a promising objective biomarker for identifying pathophysiologic changes associated with concussion. The objective of this study was to determine the utility of fNIRS to detect and differentiate cortical brain activity between concussed and healthy subjects when performing oculomotor and visual tasks which has not been previously described.

Methods: A prospective study of 38 concussed subjects and 9 healthy controls was undertaken where all participants completed standard oculomotor and visual tasks, including the King-Devick test (K-D), while wearing an fNIRS headband that recorded anterior prefrontal cortex oxygenation changes with 4 optodes and 12 channels at 4Hz sampling rate. Linear mixed model analysis was performed to compare oxygenation changes in the two cohorts.

Results: Among this pilot cohort, healthy controls showed significantly greater oxygenation changes upon initiation of the King-Devick test compared to concussed subjects, but had decreased oxygenation changes over each successive test card ($F_{1,172} = 4.06$, $p < 0.05$) compared to injured subjects, indicating a habituation to the task over time in healthy controls that did not occur in concussed subjects. There were also significant differences in spatial patterns of oxygenation changes between the left and right prefrontal cortex between concussion subjects and healthy controls with monocular accommodation assessment ($F_{1,66} = 12.05$, $p < 0.001$) indicating recruitment of different cortical areas for the task in concussed subjects versus healthy controls.

Conclusions: Our preliminary experimental results suggest that fNIRS has utility in detecting differences in cerebral blood oxygenation change between concussed and healthy subjects with excellent temporal and spatial resolution based on the given oculomotor or visual task. Further investigation into this neuroimaging modality for quantifying changes in cognitive workload after injury and over the course of recovery is warranted. fNIRS may be useful as an objective measure of injury and recovery, supplementing the clinical assessment and management of concussion.

Abnormal Accommodative Amplitude is Associated with Prolonged Concussion Recovery in Children

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Objective: Vision and vestibular deficits are common following concussion. It is unknown, however, which of these findings, may be associated with prolonged recovery. The objective of this study was to determine which vision or vestibular deficits are associated with prolonged recovery in children and to identify interrelationships between such deficits.

Methods: A retrospective cohort study of pediatric patients with concussion was conducted in subspecialty concussion program within a large pediatric care network. 432 random patient records were abstracted for data. The presence of vision or vestibular deficits upon initial presentation for clinical care at a subspecialty concussion program was determined and the main outcome measure of interest was time to functional clinical recovery.

Results: Study subjects ranged from 5-18 years (median=14). 378 of 432 (88%) patients presented with one of the following vision or vestibular deficits: saccades (82%), balance (68%), smooth pursuits (66%), vestibulo-oculomotor reflex (VOR) (66%), near point of convergence (35%) or accommodative amplitude (22%). A prior history of motion sickness was associated with vision and vestibular dysfunction. Physical examination deficits associated within distinct vision and vestibular clusters. Abnormal balance, VOR, smooth pursuits and accommodative amplitude predicted prolonged recovery time.

Conclusions: Abnormal accommodative amplitude is associated with prolonged concussion recovery in children, as are deficits in balance, VOR and smooth pursuit function. Vision and vestibular deficits associate within specific clusters. A prior history of motion sickness was associated with vision and vestibular deficits following concussion. Vision assessments in concussion must move beyond visual acuity.

Use of Mental Health Services by Adolescents After Traumatic Brain Injury: Findings From a Randomized Controlled Trial

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Background: Mental health problems are common following pediatric TBI. Studies have suggested that many in need of mental health services do not receive them, but these studies have not consistently used prospective and objective methods, or followed this population longer than 1 year.

Objective: To examine adolescents' use of mental health care services after traumatic brain injury (TBI).

Design: Multicenter prospective randomized controlled trial.

Setting: Five major level 1 US trauma centers.

Participants: Adolescents (aged 12-17 years) with moderate to severe TBI were recruited for a randomized clinical trial (132 participants at baseline, 124 at 6 months, 113 at 12 months, and 101 at 18 months).

Methods: Participants were randomly assigned to a counselor-assisted problem-solving (CAPS) group or an Internet resource comparison (IRC) group. Follow-up assessments were completed at 6, 12, and 18 months after baseline. Generalized estimating equations with a logit link and random intercept were used to examine use of mental health care services. Treatment group and participant impairment were examined as predictors of use.

Main Outcome Measurements: Mental health care use was measured with the Service Assessment for Children and Adolescents. Daily functioning and clinical outcome were assessed with the Child and Adolescent Functional Assessment Scale. Behavioral and emotional functioning was measured with the Child Behavior Checklist; executive dysfunction was measured with the Behavior Rating Inventory of Executive Function.

Results: Use of mental health services ranged from 22% to 35% in the 2 years after TBI. The proportion of impaired adolescents ranged from 28% to 66%. The proportion of patients impaired was significantly lower in the CAPS group than in the IRC group at 18 months after baseline (28% and 56%, respectively; $z=2.78$; $P=.005$). Patient age at TBI was a significant predictor: Older adolescents (aged 14-17 years) sought services more frequently than younger adolescents (aged 12-13 years) ($P=.003$).

Conclusions: Only half of the adolescents with evidence of behavioral health needs after TBI received mental health services. Future studies should examine barriers associated with seeking services after TBI and investigate the role of psychoeducation as preventive care in this population.

Supporting Early Discharge from a UK Paediatric Major Trauma Unit Following Acquired Brain Injury - The SORT Model

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Sheffield Children's Hospital NHS Foundation Trust (SCHFT) is one of the 5 stand alone Children's Major Trauma Centres within the UK. Their multi-disciplinary Acquired Brain Injury (ABI) rehabilitation team have developed inpatient services for both traumatic and non traumatic ABI over the years but recognised the need for families to be discharged to their own environment for community rehabilitation at the earliest possible point. However, early discharge had not been able to be supported consistently within the community team services. Input in community was not intensive; often only once per week and limited to a number of weeks of input. Families report to feel unsupported and left to "fend for themselves" once discharged from hospital.

The WHO ICF considers the impact of environmental factors on functioning when a person has a health condition. Families reported that need to be home was in conflict with the need for ongoing intensive rehabilitation. In the UK there are very few options for intensive rehabilitation for children and young people with ABI when out of the hospital setting. An acute hospital is recognised as not the most appropriate facility for ABI rehab.

With this in mind SCHFT has developed a Specialist Outreach Rehabilitation Team (SORT) to facilitate early discharge from the acute hospital ward to home following ABI. The team comprises of a physiotherapist, an occupational therapist, a therapy assistant, rehabilitation outreach co-ordinator and an acquired brain injury specialist.

The presentation will describe the input that the team offers, including methods of input across the service, the environments and goals. Issues and options for supporting local community services are discussed.

Members of the SORT team are able to support to the child and their family through to transition to adult services:

- The rehabilitation outreach co-ordinator assists families to negotiate their way through the services, sign post to charities and aid general adjustment to life out of hospital.
- The brain injury specialist is able to assist family with strategies to manage ongoing issues following ABI such as sleep, pacing, fatigue management, organisational skills, behaviour management etc as well as giving brain injury education to family / schools. This post is funded by The Children's Trust Charity www.thechildrenstrust.org.uk.

The presentation will include:

- Service user feedback
- Outcome measurements – benefits and barriers
- Limitations of current service
- Areas for future development
- Economic benefits of early discharge

It is recognised that the SORT team is in its infancy and its evaluation is critical is looking at the long term impact of this model of service.

Acquired Brain Injury Multi-Disciplinary Clinic Follow Up - Are We Filling the Gaps? The Story So Far

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Sheffield Children's Hospital (SCH) neuro rehabilitation team have developed a multidisciplinary (MDT) monthly follow up clinic for children and young people (CYP) with Acquired Brain Injuries (ABI). The MDT clinic consists of a Consultant in Paediatric Neurodisability, Speech and Language therapist, Physiotherapist, Occupational therapist, Psychologist, Rehabilitation Co-ordinator and Brain Injury Specialist (The Children's Trust Charity post).

Alongside this clinic the team have developed an additional clinic for those with ongoing problems following mild ABI. This clinic is also monthly and run by the Consultant in Paediatric Neurodisability and the Brain Injury Specialist.

The development of these clinics has allowed for longitudinal follow up from initial injury through to transition to adult services for children and young people with ABI.

The presentation will include the following information regarding the clinics Dec 2015 – Dec 2016:

- Referral criteria and process
- Demographics
 - o Number of attendees
 - o Method of injury (traumatic / non traumatic)
 - o Presenting issues
- Outcomes
 - o Assessment and clinic actions/recommendations
 - o Service user feedback
 - o Benefits to MDT

CYP are reviewed on an individual basis dependent on need, this may be 3 monthly or just at times of transition such as starting school, moving to secondary education etc. The CYP are seen by the same team who provided rehabilitation whilst an inpatient, allowing for familiarity, reassurance and consistency of service.

The provision of these MDT clinics has enhanced the follow on support for CYP with ABI. However, this retrospective review of the years clinic highlights the ongoing gaps and inconsistencies of local service provision across a NHS region and accentuates the need to develop further support for the whole family as well as the CYP with ABI from time of injury and throughout their lifetime.

New Platforms for Social Skills Rehabilitation in Children with Acquired Brain Injury

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Background: Acquired brain injury (ABI) often affects children's social development and social communication skills. Impairment in social communication can lead to social rejection - lack of friends, unpopularity, inadequate social responses. Using modern and attractive neurorehabilitation methods, such as multiuser and multitouch tabletop technology, is important in pediatric social skills remediation.

Aim: The aim of our project is to develop a social communication and cooperation skills rehabilitation program for children with ABI using multitouch tabletop technology. The aim of the current case-study was to assess children with ABI for the need for intervention.

Methods: Two patients with severe traumatic brain injury (sTBI) participated in the pilot-project: 12 yrs old boy and 10 yrs old girl; 4 months post-injury. In addition, two healthy controls (matched age and sex) participated in the assessments. Social perception skills were evaluated with the Social perception domain of the NEPSY-II test battery and Theory of Mind stories. Children's parents completed questionnaires: attention, executive functioning behaviour (BRIEF-P), Social Cognition Questionnaire and Social Skills Rating System: Children were trained with two interactive computer-based applications. The multi-user multi-touch Diamond Touch tabletop (DT) was used to train social perception and social communication skills with NoProblem! application. The Snowflake application on the Suite Multi-Teach software platform was used for training children's collaboration skills.

Results: We found pre-trauma problems in female patient compared to healthy peer: lower attention (score 35 compared to 52), executive functions (177/95), social perception (171/207) and social skills (102/115). No noticeable difference existed between boys pre-injury.

Post-injury, both children with sTBI had lower scores in each function compared to pre-injury performance. Attention was 5 points lower post-injury for girl and 13 for boy. Both had increased difficulties with executive behaviour: problem scores higher by 30 points for girl and 48 for boy (207/177 and 158/110, respectively). Social perception worsened 28 points for girl (143/171) and 46 for boy (148/194). Also, performance in social skills lowered 81 points for girl (30/111) and 76 for boy (36/112).

Conclusions: Children with sTBI may have pre-existing problems with executive function and social communication. In addition, they make fewer attempts towards collaborating with each other. Still, we found noticeably increased problems with executive behaviour, social perception and social skills 4 months post-injury. The girl had lower functions already pre-injury, but the boy had more severe post-injury impairment. Children with sTBI need neurorehabilitation for social communication and cooperation skills.

Structured Model of Neurorehabilitation of Social Skills Deficit Using Modern Multi-User Technology

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Background: Social competence is a multidimensional concept reflecting the capacity to integrate behavioural, cognitive and affective skills to social contexts. Social development and cooperation skills are often impaired in children with acquired brain injury (ABI). Assessment and treatment of social neuropsychological impairments has received comparably less development than other domains of cognition (Yeates, 2014). Modern multitouch-multiuser tabletop technology (MMT) introduces effective learning environment for pediatric social skills remediation.

Aim: Creating a theoretical model of main components of social cognition with intervention and evaluation tools for social skills neurorehabilitation for children with acquired brain injury using MMT.

Methods: 15 children with ABI - epilepsy, sTBI, tics, stroke - aged 8-13 have participated in our pilot-study: 7 in training group, 8 in waiting-list and 9 healthy controls. Children have attended social skills neurorehabilitation and performed individual and paired assessments.

Results: We created a theoretical social cognition neurorehabilitation model as a basis for practical MTT intervention for children with ABI and social difficulties. The evaluation and rehabilitation tools for abilities under social cognition domain are depicted: social communication skills, cooperation skills, Theory of Mind (ToM), emotion recognition, social attention, social anxiety, executive functions.

Individual and paired evaluation tools for social cognition are used before and after the intervention period and in follow-up assessment 1 year after. Emotion perception and social attention are evaluated using Social perception domain in NEPSY-II test battery. Theory of Mind skills are evaluated with ToM stories. Children's parents complete questionnaires: executive functioning behaviour (BRIEF-P), Social Cognition Questionnaire and Social Skills Rating System.

For paired evaluation the Friendship Observation Scale (FOS) is used for assessing social communication skills and cooperational behaviours based on children's direct interaction.

For intervention tools, children are trained with interactive computer-based applications, video processing and virtual reality methods. "NoProblem!" application, that complies with principles of Cognitive Behavioral Therapy, is used on Multi-user Diamond Touch tabletop (DTT) to train social communication skills. Children are presented with situations at school, after school and at home environments for which role-plays are conducted. Children are also presented with social scenarios through video processing. Discussions about real-life experiences are included for developing metacognitive skills. For cooperation skills training, „Snowflake“ on Suite Multi-Teach platform is used: educational games (eg. "Einstein") and cooperational games (eg. "Bridge-Building"). Virtual Reality (VR) applications are used for social anxiety and emotion perception training.

Conclusions: Children with ABI have impairments in social cognition, which lead to deficits in social communication and cooperation skills. We have created a theoretical model of the main components of social cognition with intervention and evaluation tools. Based on this model, a practical neurorehabilitation design for social skills is created for children using next-generation devices (MTT, VR).

Family-Centered, Interdisciplinary Acute Inpatient Rehabilitation at a Pediatric Specialty Hospital: Fostering Continuous Quality Improvement Through Collaboration

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We present a description of our inpatient rehabilitation program, highlighting interdisciplinary collaboration. Preparation begins before admission and may involve pre-admission conferences, discussion around room assignment and primary therapist assignment, and projected special needs (for example for the patient who is ventilator-dependent). Admission includes an interdisciplinary arena evaluation with PT, OT and SLP. Weekly interdisciplinary rounds include the full team: physicians, OT, PT, SLP, therapeutic recreation specialists, social work, care coordinators, music therapy, psychology, child life, rehab nursing, chaplaincy, school-teacher, and ethics. Priorities and goals are discussed, and any challenges to goal attainment are addressed as a team. Daily rounding also occurs on a smaller scale, with two-way communication facilitated. Representatives share information widely on a daily basis with the entire team. Family conferences take place every two to three weeks, and include the treating team, as well as any supports the family identifies (for instance, school personnel). Throughout the admission, there is close contact with the child's school, and discharge planning is focused on smoothing the transition. In addition to family conferences and rounds, team meetings may be warranted, to help ensure that the treating team speaks with one voice. When needed, the team gathers to ensure careful communication and treatment planning in unison. Discharge planning begins early during an admission and concludes with targeted teaching sessions provided by nursing and therapies. Efforts are continuous to improve communication with outpatient therapists, school and medical support. Debriefings are used as a tool to identify moral distress, need for expanded resources, and educational needs.

An interdisciplinary best practices work group meets monthly, to help identify and address issues that arise, and reports directly to rehab leadership. This group develops educational materials, clarifies or develops protocols, and develops and implements clinical practice guidelines, to facilitate quality improvement. Any member of the team can raise concerns for this group to address. Personnel involved in treatment are directly involved in preparing for accrediting visits. A high degree of accountability and involvement is expected and achieved through this model. Through continuous quality improvement initiatives, our program morphs over time to best meet the needs of our patients and their families.

Outcome Following Traumatic Brain Injury in Children and Adolescents in a Specialized Ambulant Consultation of The Social Pediatric Center

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Traumatic brain injury (TBI) is one of the most common causes of functional deficits or disabilities in childhood (1). Long-term consequences of TBI include various neurological problems or handicaps and psychosocial problems for these children and their families. In Germany, about 75.000 children under the age of 16 sustain head injury each year (2) with 94% being classified as mild TBI. Only few publications about the medical and psychosocial outcome after pediatric TBI exist in Germany compared to anglo- american papers (3). Our own clinical experience and the perspective of Kirkwood and Yeates (4) determine the importance of a multidimensional approach for TBI considering a bio-psycho-social model of diseases or health related problems. Here we report in retrospective study clinical neurological and psychosocial findings of 160 patients with TBI that presented to our center from 2007 to 2016 (median age at TBI: 3;5 years, median age at first contact 5;5 years). In our cohort 29% experienced a TBI below the age of 12 months, and 54 patients are still being treated at our specialized clinic. For all patients, we estimate the outcome with the Glasgow Outcome Scale (GOS-E Peds) according to the clinical patient documentation. Approximately 11% of patients with mild TBI showing a negative outcome, in line with (4). Our patients with mild TBI have more perinatal risk factors. Patients with medium severe and severe TBI show a worse outcome and a higher need of professional-medical and social support as expected. Children with battered child syndrome (n=23) display a poor outcome with a higher percentage of social risk factors, as expected. We conclude the need of a valid estimation of premorbid status directly after the injury, the use of more differentiated tools to picture the outcome of these patients in a better way. Open questions remain including the indicators for the need of ambulant socialpediatric case management, in-patient rehabilitation, school and occupational reintegration programs, psychoeducational programs, and the contribution of neuropsychology for the rehabilitation process. Ongoing monitoring with consistent consultation in sensitive developmental stages (preschool, adolescence, transition) is urgently warranted.

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Neurobehavioral and Cognitive Behavioral Therapy for Children with Neurodevelopmental Disorders: Case Series

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Children with neurodevelopmental disorders often demonstrate executive dysfunction that interferes with their participation and functioning across school, home, peer and community settings. However, many therapists or counselors are not trained to provide neurobehavioral therapies to target these issues. This study will present findings regarding effectiveness of neurobehavioral and cognitive behavioral therapy (CBT) in improving aspects of executive functioning, emphasizing aspects related to behavioral regulation and emotional regulation. Specifically, this case series will review the results from six case studies, with ages ranging from 7 to 10 years old. Each client was provided CBT 10-14 sessions utilizing an evidence-based manualized structured curriculum. Each intervention utilized single subject design. Assessment data was collected at baseline, during intervention to monitor progress, and after treatment to determine outcome. Prior to intervention, the children were diagnosed with one or more of the following neurodevelopmental disorders: Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder, and/or Tourette's Disorder. Two of the six were also diagnosed with comorbid generalized anxiety disorders. Single subject design analysis and case series data analyses revealed statistically significant and clinically meaningful results. This presentation will include recommendations for data collection across methods, measures, settings/sources and for interpretation of data to determine reliable change. Implications for intervention implementation across diagnostic groups, across clinic and school settings, and length of therapy will be discussed. Recommendations regarding best practice with teaching graduate students these skills and in providing clinical supervision with graduate student clinicians will be included.

Cortical Thickness, Brain Volume Changes and Neurocognitive Function in Children with Diffuse Axonal Lesions

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Traumatic brain injury (TBI) in children and adolescents frequently involves the frontal and temporal lobes, and is correlated with specific structural and behavioral changes. Children show an increased vulnerability to injury due to intrinsic developmental differences in the immature brain compared to the adult. As a consequence, impaired or delayed development of isolated brain regions and differences in brain anatomy and connectivity at the systems level are expected. Little is known about the impact of diffuse axonal injury (DAI) in childhood on the cortical thickness, where there is an expected interference between maturation cortical thinning and traumatic cortical atrophy as a result of transneuronal and Wallerian degeneration. In this study, we assessed cortical changes and brain volumes in a well-characterized cohort of 19 children approximately two years after a moderate-to-severe TBI, with nearly exclusive DAI. All participants were scanned in the Ghent University Hospital. Following MRI sequences were administered: 3D Fluid Attenuation Inversion Recovery, Susceptibility weighted imaging, 3D T1-weighted Magnetization Prepared Rapid Gradient Echo, high resolution coronal T2-weighted image. We compared these magnetic resonance image (MRI) results with 19 age and gender matched typically developing children. Cortical reconstruction and volumetric segmentation was performed with FreeSurfer image analysis. As structural abnormalities in the brain could reflect functional cognitive decline, all the participants (DAI and controls) underwent a comprehensive neuropsychological test battery, including: the Digit and Spatial Span forwards and backwards (verbal and spatial working memory), the Digit Symbol Substitution Test (information processing speed), the Stockings of Cambridge (planning and executive functioning), the Intra-Extra dimensional set shift (cognitive flexibility), the Flanker task (inhibition and selective attention) and Continuous Performance Test (sustained and selective attention).

Furthermore, we obtained child- and parent-reported symptoms of the Behavior Rating Inventory of Executive Function (BRIEF). A selection of comparisons between DAI pubers and their matched controls, was undertaken in the SPSS software.

The strength of this study is the powerful homogeneity of the TBI candidates, concerning the age, injury mechanism, type of brain lesion, and recovery. We only included pubers between the age of 11 and 17 years old; in whom developmental maturation of the frontal and temporal cortical mantle is specifically vulnerable. Our participants with a traumatic brain injury had nearly exclusive widespread DAI on MRI. They recuperated quite well after a long period of multidisciplinary rehabilitation, went to regular schools, but still experienced impaired adaptive functioning in daily living.

Developmental Staging After Brain injury in the First Six Months of Life

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The case study of an infant who sustained a severe brain injury at three months of age and followed for six years is presented. The infant was ejected onto a roadside from the lap of her mother with whom she was commuting, on impact. Initial examination revealed the infant to be awake and displaying appropriate motor tone and eye-following, but later examination revealed a loss of smiling responses in the presence of her primary caregiver. Patient's ability to show discrimination of strangers was lost leaving her with social confusion in the first year of life. A CT brain scan done at six months of age revealed a large area of contusion extending bilaterally over the fronto-parietal area. Although patient developed preverbal and motor behaviours at a mildly later chronological age, a persisting loss of appropriate affective response, particularly in the presence of strangers, left the mother-child dyad with a significantly reduced emotional bond. Follow-up studies of patient at six years of age revealed significant disturbances in her social relationships although cognitive development was in the age-appropriate age. These changes in social-affective responses, thought to be related to the area of direct brain damage identified on CT brain scan, will disturb the future affective functioning of patient placing her at significant risk for personal violation. The implications of this case for further research into the impact of brain injury on social-affective behaviours, in particular relation to gender, is discussed.

Dissociated Alterations of Self-Body Schema and Others' Body Holistic Perception in Children with Supratentorial and Infratentorial Tumor

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Alterations of cognitive and social functioning are common long-term consequences of pediatric brain tumors. However, the specificity of the pattern of neuropsychological deficits according to the site of tumor is not still clear, nor has it been clarified the impact of pediatric brain tumors on the development of self-body representation and social perception abilities. Here, we addressed these issues by comparing the abilities of 15 patients with a supratentorial tumor (ST; 6 females, aged 8-16 years), 15 patients with an infratentorial tumor (IT; 6 females, aged 8-13 years), and 30 gender and age-matched children with typical development (TD) in two different tasks of body representation. In a first task, we tested children's ability to perform egocentric and object-based mental spatial transformations by requiring left-right judgments, respectively, on a visually presented human figure or on an external object (namely, the letter F). In a second task, we tested children's ability to make use of configural and holistic processing of the body by using, respectively, the inversion effect and composite illusion paradigms. The body inversion effect refers to the striking disruption of recognition abilities when social stimuli (i.e., faces and bodies), but not other objects, are presented upside-down; the composite illusion refers to the difficulty in perceiving the match between two identical top halves of a body (or of a face) when they are combined with different bottom halves. These two effects reflect, respectively, the perception of the spatial relation between the different body parts in the context of the whole body space (i.e., configural processing) and the representation of a body as a unique entity as opposed to the combination of its single parts (i.e., holistic processing) and have been related to the activity of category-selective areas in the fusiform gyrus. The results showed that, independently from tumor site, ST and IT patients were impaired, as compared to TD children, in both egocentric and object-based mental spatial transformations as well as in the holistic perception of others bodies; configural body processing was instead spared. Importantly, however, when comparing performance of the two patient groups, ST children had specific impairments in egocentric mental spatial transformations. Conversely, IT children showed specific alterations in the holistic processing of others' bodies. These results may reflect damage to temporo-parietal areas, involved in self-body schema, in ST tumor and neurofunctional alterations of basal temporal areas in IT tumor, which may be due to either proximity to tumor site or craniospinal radiotherapy. The dissociation between different aspects of body representation in ST and IT pediatric brain tumor survivors may help not only the neuropsychological evaluation of self representations and social perception abilities, but also the implementation of different sensorimotor and cognitive intervention strategies.

Educational Level and Vocational Situation of Pediatric TBI Patients 18–25 Years After Severe Trauma and Inpatient Rehabilitation – Data from a Two-Stage Follow-Up Study

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Objectives: To follow the course of development of a group of pediatric TBI patients into adulthood and identify predictors for quality of life and vocational situation. To evaluate the predictive validity of a comprehensive neurological and neuropsychological follow-up evaluation at the end of adolescence.

Methods: In this very long term follow-up study, Study I* (T3) had provided a detailed neuropsychological evaluation of 140 patients between age 16 and 23, after at least 3 years (mean interval 9;10 years) post trauma. Data from the start and the end of each participant's inpatient treatment were included (T1 and T2).

For Study II* (T4), 102 former patients from the original sample could be recruited so far. The study examines vocational outcome, partnership status and quality of life in adulthood, and their relation to the data from Study I (predictive validity of a comprehensive neuropsychological examination at age 16-23 (T3)).

Results: Study I: Severity of trauma (moderate and severe vs. very severe (GCS = 8, PTA ≥ 7 days) and age at trauma had been the most relevant predictors of neuropsychological and educational group outcome at the age interval between 16 and 23 years. Neuropsychological data collected after a long time interval demonstrated a positive developmental trajectory for the total group, the difference to normally developing peers getting smaller with time.

The subgroup with acquired posttraumatic seizure disorders (10.7 % of the total sample) had experienced a distinctly different developmental course: while there had been no significant difference at the end of rehabilitation (mainly due to the enormous spread of scores within groups), neuropsychological scores of PTE patients had deteriorated after the end of rehabilitation treatment, in accordance with the "growing into deficit" hypothesis. A significant difference between groups was found to have emerged over time.

Study II: Follow-up measures include socio-economic status, quality of life and partnership information, assessed through a structured telephone interview and several questionnaires, as for instance the Glasgow Outcome-Scale Extended (GOSE), WHOQOL-BREF, and Quality Of Life after Brain Injury (QOLIBRI). Neuropsychological level at T3 was expected to have a further long term effect on vocational situation in adulthood.

Informations about vocational situation were collected during informal telephone and E-Mail contacts in the course of recruitment. Preliminary analyses yielded statistically significant effects of neuropsychological level at T3 on later vocational level and independent living status at T4.

Conclusions: After pediatric TBI, a thorough neurological and neuropsychological examination in late adolescence, as suggested by many experts in the field, can effectively increase the chances for adequate vocational placement. At a crucial transition point in each individual's life, such an evaluation could help pediatric TBI patients find their way into an individually satisfying vocational situation.

Theory of Mind and Parental Nurturance as Predictors of Peer Relationships after Childhood Traumatic Brain Injury

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Objectives: Traumatic brain injury (TBI) sustained in childhood is associated with poor social outcomes. Children with TBI are more likely to be victimized or rejected by their peers and less likely to have mutual friends compared to children with an orthopedic injury (OI). Theory of mind (ToM), a key social cognitive skill, has been identified as a mediator of the association between injury severity and social adjustment for children with TBI. Furthermore, parenting factors, such as nurturance, have been identified as moderators of social outcome in children with TBI. The current study examined how these factors jointly predict peer relations. Specifically, the study investigated the role of ToM as a mediator of the relationship between TBI and peer victimization/rejection and friendship, as well as the moderating effect of parental nurturance on these relationships.

Participants & Methods: Participants were children ages 8 to 13 years ($M = 10.42$, $SD = 1.47$) with severe TBI ($n = 15$), complicated mild/moderate TBI ($n = 40$), or OI ($n = 32$). They were part of a multi-site study investigating social outcomes in children with TBI. All children were 12 to 63 months old at the time of injury ($M = 7.84$, $SD = 1.94$). Data on peer victimization/rejection and friendship were collected in school classrooms. Peer rejection/victimization was measured using the Extended Class Play, and reciprocal friendship was measured by asking children to name their three best friends in the classroom. Parental nurturance was measured using the Child-Rearing Practices Report Questionnaire. Finally, ToM was measured based on average performance across three tasks measuring different aspects of ToM: the Jack and Jill task, the Emotional and Emotive Faces task, and the Irony and Empathy task.

Results: A single path model for each peer outcome was testing using PROCESS. The overall model accounted for a significant proportion of variance (18.6%) in peer victimization/rejection ($p = .006$). ToM mediated the effects of injury on peer victimization/rejection (poorer ToM predicted greater victimization/rejection), but only for children in the severe TBI group. Parental nurturance significantly moderated this relationship, such that the mediation effect of ToM was significant only at low and average levels of parental nurturance. The overall model was not significant in predicting friendship, although severe TBI was associated with fewer mutual friendships; ToM did not mediate the effects of TBI on friendship and parental nurturance did not moderate the association of ToM with friendship.

Conclusion: The results suggest that high parental nurturance may act as an important buffer of the negative effects of severe TBI on ToM and subsequent risk of peer rejection/victimization. Interventions designed to increase parental nurturance or ToM may thus be beneficial for children with severe TBI.

Corpus Callosum Abnormalities on Diffusion Tensor Imaging One Month after Sports-Related Concussion in High School Athletes and Relation to Brain Function

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Objectives: A limited literature has examined structural and functional brain changes after sports-related concussion (SRC) using advanced neuroimaging techniques such as diffusion tensor imaging (DTI) and functional magnetic resonance imaging (fMRI). We previously reported greater working memory-related fMRI activation in high school athletes relative to controls one month after concussion, which was positively correlated with parent-reported post-concussive symptoms and accompanied by impaired cognitive performance. Here we report on brain white matter integrity using DTI in the same cohort and its relationships to fMRI brain activation, cognition, and post-concussive symptoms.

Methods: Twenty-two high school athletes (mean age: 15.6 ± 1.3 years; 14 male) were studied one month (29.0 ± 12.3 days) after SRC and compared to 21 demographically matched healthy non-contact sport athlete control participants (mean age: 16.1 ± 1.1 years; 13 male). Participants completed a comprehensive evaluation including structural and functional MRI on a Siemens Skyra 3T magnet and assessment of cognition and post-concussive symptoms. DTI images were corrected for eddy currents and motion using FSL. A fractional anisotropy (FA) threshold of 0.2 was used for tract-based spatial statistics (TBSS). Results were examined using threshold-free cluster enhancement with family-wise error (FWE) correction for multiple comparisons set at 0.05. FA values from the significant cluster detected from between-group comparison were correlated with fMRI activation, cognitive performance, and post-concussive symptoms using SPSS.

Results: The SRC group showed significantly lower FA than the control group in a cluster in the body of the corpus callosum in the left hemisphere. Across the whole cohort significant ($p < 0.05$) positive correlations were seen between FA in this cluster and attentional accuracy and working memory performance, which were previously shown to be impaired in SRC relative to controls. Significant ($p < 0.05$) negative correlations were seen between FA in this cluster and fMRI activation during a working memory task in the left cingulate, claustrum, and insular regions. Greater activation in these regions was previously shown to correlate with greater parent-reported post-concussive symptoms.

Conclusions: In the current analysis we demonstrated reduced white matter integrity in the corpus callosum one month after SRC relative to matched controls. Greater white matter abnormality correlated with poorer cognitive performance and greater fMRI activation in left cingulate, claustrum, and insular regions in which greater activation was previously shown to be related to worse post-concussive symptoms per parent report. These findings demonstrate the complementary information gained by multimodality imaging approaches, and offer additional evidence of demonstrable brain abnormalities after SRC, consistent with prior work showing reduced white matter integrity in the corpus callosum after concussion in college athletes. Longitudinal analyses are underway to monitor evolution of these abnormalities over time.

A Fatal Case of Neuroinvasive West Nile Virus Passively Transplanted to a Post-Hematopoietic Stem Cell Transplant Pediatric Patient with Acute Myeloid Leukemia

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Objective: To present a case of an immunocompromised child with neuroinvasive West Nile Virus (WNV) infection which was passively transplanted from a haploidentical related donor who had been unknowingly infected after pre-transplant screening.

Methods: This case study presents an eight year old boy with high-risk AML who developed fever followed by progressive lethargy, dysarthria, and generalized weakness 22 days after haploidentical hematopoietic stem cell transplant (HSCT). MRI brain revealed increased T2/FLAIR signal with restricted diffusion & enlargement of bilateral thalami and superior cerebellum. CSF studies showed 12 WBCs, 0 RBCs, glucose 72mg/dL, protein 48mg/dL. Extensive infectious disease including bacterial, viral, and fungal work-up was negative. His symptoms rapidly progressed to flaccid paralysis, loss of reflexes, and respiratory failure. MRI spine showed enhancement of ventral nerve roots suggesting both central and peripheral nerve involvement. He received IV methylprednisolone 30mg/kg therapy x 5 days, IVIG (2g/kg total) x5 days, 5 rounds of plasmapheresis, followed by an additional 5 day course of IVIG (2g/kg total). Despite aggressive treatment, he continued to clinically decline and repeat MRI brain showed new areas of involvement including the brainstem. At this time, CSF WNV PCR came back positive. Though pre-transplant screening was negative for WNV, repeat donor testing revealed the donor had seroconverted with high titers of IgM and IgG antibodies against WNV.

Results: In a last attempt to help control the WNV infection, a decision was made to request the FDA for compassionate use of convalescent donor plasma. Unfortunately, he showed no improvement in his clinical status and passed away 55 days after his transplant.

Conclusion: Neuroinvasive WNV is more common in an immunocompromised host. In our patient, his immune impairment preventing production of appropriate immunoglobulins contributed to both the difficulty with diagnosis and the inability to fight the infection. Even though donors are routinely screened for infections such as WNV within 30 days of HSCT, it is still possible to contract infection during the pre-transplant period leading to potentially fatal infection in the immunocompromised HSCT recipient.

Making Sense of Adolescents: Cognitive and Behavioural Functions in Adolescents after TBI

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Traumatic brain injury (TBI) constitutes a significant burden on health care resources in India. It leads temporary or permanent impairments of physical, cognitive, emotional and psychosocial functions with associated diminishes or altered state of consciousness. TBI prevalence is more on teenager and early adulthood age. Adolescence is the period of transition between childhood to adulthood. It is a period when rapid physiological changes and demands for new social roles take place. The adolescents, due to these changes often face a number of crises and dilemmas. Aim of the study was to find out the effects of TBI on cognitive and behavioral functions in adolescent with Traumatic Brain Injury. A total sample of 30 adolescents: 15 mild to moderate TBI with GCS score of 9-15 and 15 normal adolescents. In the age range of 12 to 16 years, both genders, right handed with normal or corrected hearing and vision were selected. Both groups after obtaining ethical clearance and informed consent were assessed Neuropsychological tests using NIMHANS Neuropsychology Battery, Visual Analogy Scale and Developmental Psychopathology check list. The result showed that there was a significant difference between two groups on cognitive and behavioral functions. Adolescent with TBI showed more cognitive deficits and increased behavioral problems as compared to normal adolescents. The details will be presented.

The Relationships Among Intracranial Pressure, Cerebrospinal Fluid Space and Head Circumference in Young Children

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Object: The purpose of this study was to retrospectively evaluate and analyze the relationships between intracranial pressure (ICP), cerebrospinal fluid space (CSF) and head circumference (HC).

Methods: The medical records at single institution were reviewed to identify 780 patients under 6-year-old who underwent a lumbar puncture for measuring the ICP. Exclusion criteria were as follows; 1) unrecorded HC or ICP on chart; 2) diagnosed craniosynostosis or intracranial tumor; and 3) performed shunt or cranial vault operation. The enrolled patients were divided into three age-groups (group 1: up to 12 months; group 2: over 12 to 36 months; group 3: over 36 to 72 months).

Results: Eighty eight of total 780 patients were enrolled. The study group was composed of 62 boys and 26 girls, with a mean age of 20.6 ± 17.9 months. First aged group (group 1, n=38) was composed of 23 boys and 15 girls, with a mean age of 6.6 ± 2.7 months. In this group, a mean HC was 43.7 ± 4.8 cm (56.6 \pm 38.4 percentile) and a mean ICP was 24.1 ± 5.8 cmH₂O. An average Evans ratio was 0.27 ± 0.06 . The significant subdural hygroma (SDHG) was detected in 25 patients and the average thickness of it was 3.4 ± 2.7 mm. There was a significant positive correlation between the ICP and the HC ($r=.474$, $p=.003$). Second aged group (group 2, n=31) was composed of 23 boys and 8 girls, with a mean age of 19.5 ± 6.7 months. In this group, a mean HC was 48.9 ± 3.4 cm (68.6 \pm 35.6 percentile) and a mean ICP was 27.6 ± 7.7 cmH₂O. An average Evans ratio was 0.29 ± 0.10 . The SDHG was detected in 11 patients and the average thickness of it was 1.9 ± 2.5 mm. There was a significant positive correlation between the ICP and the HC percentile ($r=.408$, $p=.023$). The ICP and the thickness of SDHG were also significantly correlated ($r=.429$, $p=.016$). In third aged group (group 3, n=19), a mean HC was 50.1 ± 3.2 cm (54.1 \pm 36.9 percentile) and a mean ICP was 25.9 ± 6.6 cmH₂O. An average Evans ratio was 0.25 ± 0.05 . The SDHG was detected in two cases.

Conclusion: With closure of cranial suture, the ICP related to the HC especially in infant with non- or less closed sutures, and the SDHG related to the ICP in toddler with partial closed cranial sutures. In these results, the HC may be reflected in the ICP at early period with rapidly growing HC, and thickness of the SDHG could be expected from the ICP at period with cranial suture closure to some degree.

Post Traumatic Mutism (PTM) in Childhood: Clinical Characteristics and Neurocognitive Consequences

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Introduction: Post traumatic mutism (PTM) is characterized by short term dysfunction of speech after brain injury with no significant decrease of comprehension. The incidence of PTM in patients with severe Traumatic Brain Injury (TBI) was estimated around 3% (Levin et al., 1983), and was slightly higher in children (Jian et al., 2009). PTM may result from diffuse cerebral trauma. There is very little research regarding the neurological basis of PTM and the sequelae of the condition, and even less pediatric studies. The aims of this study were to identify clinical characteristics of the PTM period and to characterize long-term cognitive profile of children with PTM.

Method: A retrospective study of 20 children hospitalized with PTM after TBI with age ranged between 3-16 years at the time of injury. Comprehensive neuropsychological assessment was performed between one to three years after the accident.

Results: Duration of PTM ranged between 10-162 days and was highly positively related to the duration of coma ($r = 0.899$, $p < 0.001$) and to the duration of aphagia (inability to swallow) ($r = 0.936$, $p < 0.001$). The duration of PTM was invertly predicted abilities of visual-motor integration ($r = -0.750$, $p < 0.5$) and coding ($r = -0.742$, $p < 0.05$) 1-3 years after the injury.

Discussion: The high correlation between speech and swallowing durations may be due to temporary disconnection of a shared brain mechanism. The duration of PTM predicts visual-motor integration abilities. PTM is more common in patients with diffuse brain injury, particularly in DAI. This may be an expression of the severity of their disconnection phenomena.

Computational Simulation of Impact - Induced Traumatic Brain Injury In Adults and Children

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Mild traumatic brain injury (mTBI) may happen due to the impact of sport balls on human heads. Tragic impacts have been observed by flying golf balls or clubs in golf. Children are often more vulnerable to such incidents. Computation of the head and brain response to an impact by a ball at different speeds and the measure of the deformation and stresses due to such impacts will lead to a better understanding of sub-concussive head injuries. In this study, a biomechanical computational simulation is focused on the analysis of the impact of a golf ball on two human head models. Using a finite-element method (FEM), an adult and an 8-year old child head responses are examined under an impact by a ball in sagittal and lateral directions. The results are shown for head acceleration, brain intracranial pressure (ICP) and shear strains under impact speeds of 10 and 15 m/s. The results indicate that an identical impact condition which may cause mTBI in adults can lead to severe brain injury in children.

Improvement Rate of Patients with Severe Brain Injury During Post-Acute Intensive Rehabilitation: A Comparison Between Pediatric (Under 18 Years) and Adult Population

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Introduction: Patients with a severe brain injury, i.e. with Glasgow Coma scale ≤ 8 in the acute phase (Jennett 1986) need specific and multidisciplinary holistic treatment in post-acute rehabilitation wards.

Methods: We analyzed 2058 patients with severe brain injury admitted in the Post-Coma unit of Santa Lucia Foundation in Rome, consecutively transferred from intensive care units, neurosurgical or cardiosurgery wards. The population of patients were divided in 3 groups: 50 patients under 18 years (mean age 16.5 ± 1.1 yrs.), 70 older than 65 years (mean age 70.6 ± 4.8 yrs.) and the remaining 900 cases with an age range from 18 to 65 years (mean age 39.8 ± 13.6 yrs.).

The data were analyzed by means of Kruskal Wallis test and post-hoc Mann-Whitney u-test with Bonferroni correction.

Results: Statistically significant differences were found between patients younger than 18 years and adults, respectively for time interval from the acute event ($p < 0.001$) and DRS at discharge time of the rehabilitation ward. A forwards binary regression analysis showed that, using discharge GOS as principal outcome measure, the outcome is influenced by age (Odds Ratio $OR=1.761$, $p < 0.001$), length of stay in rehabilitation ($OR=0.591$, $p=0.001$) and finally by the GOS at discharge ($OR=0.396$, $p < 0.001$).

Conclusions: Our data confirm that younger patients with severe brain injury have a better prognosis than older patients, are (able to be) admitted earlier to post-acute rehabilitation units and need shorter lengths of stay in rehabilitation to reach a favorable outcome.

Quality of Life and Mood of Youth Who Are Slow to Recover After Concussion and Participating in An Exercise-Based Active Rehabilitation Intervention

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Background: There is a great focus in current concussion management in asking children to report on individual symptoms, with less concern on the impact of these symptoms on their overall function. Our group has developed an active rehabilitation intervention (ARI) for children, which had a hypothesized effect on functional recovery. Indeed, this study aimed to determine the impact of providing participants aged 8 to 17 years who are slow to recover following a concussion, with a well-developed ARI, compared to receiving standard care alone, on quality of life (QoL) and mood 6 weeks post-initiation of ARI.

Material and methods: A multicenter prospective quasi-experimental control group design was used. 49 youth were enrolled (experimental n=36; control n=13). Participants were assessed on 2 different occasions: (i) initial visit (baseline); and (ii) 6 weeks post-enrolment. Primary outcomes included: (i) Child-reported QoL obtained by the Pediatric Quality of Life Inventory Version 4.0 (PedsQL-4.0), and Child-reported mood obtained by the Beck Youth Inventory for children and adolescents Second edition (BYI-2nd). A two-sample Wilcoxon rank-sum Man-Whitney Test (t-test) was used to investigate the changes in mean QoL and mood scores between 2 study groups over 2 time points.

Results: The experimental group showed an increase in QoL ($p=0.04$), while those of children in the control group remained stable over time. In addition, children who received the ARI reported lower levels on the anger scale ($p=0.02$) of the BYI-2nd than children in the control group, while presenting with similar levels for the other scales.

Conclusion: Quality of life is a patient-reported outcome, which is comprehensive and represents the children's overall status. In parallel, anger or irritability is commonly reported in individuals with concussion. Our results support the use of exercise-based interventions for children who are slow to recover following a concussion, to improve youth's functioning.

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