Poster Presentations

It’s all in the lean: confirmation of gait deviations at the trunk and pelvis in children with hereditary spastic paraplegia

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Objective: This study aimed to investigate the kinematic gait deficits exhibited by young people with hereditary spastic paraplegia (HSP). In particular, whether children with HSP demonstrated deviations at the trunk, pelvis and hips in all three planes of movement. It was predicted that deficits would be particularly evident in the movements of these segments in the transverse and coronal planes.

Design: Prospective, observational study.

Method: Young people with HSP were recruited through participating hospitals, community providers and online. Eleven youth with a mean age of 12.2 years (SD 3.2) were included in the study (male=7, female=4). Kinematic gait deficits were assessed using three-dimensional gait analysis while the participants walked barefoot without assistive devices. The magnitude of kinematic deviation across the gait cycle was calculated and reported as the Gait Variable Scores for each segment in the three planes of movement. Discrete gait variables were utilised to further describe the timing and direction of specific deviations. For each participant, the gait variables were compared to the gait kinematics collected from a group of typically developing children.

Results: The Gait Variable Scores for the trunk, pelvis and hips in the sagittal and coronal planes were found to be larger than the movements measured for typically developing children (p=0.010–0.029). In the sagittal and coronal planes, the deficits at the trunk and pelvis included significantly larger amplitudes and ranges of movement (p≤0.001–0.011). In addition, the timing of peak pelvic obliquity was found to be later in the gait cycle compared to unimpaired children (p=0.002). Contrary to predictions, the movements of the trunk and pelvis in the transverse plane showed minimal differences across the gait cycle when compared to typically developing children.

Conclusion: This study is one of the first to describe the kinematic gait deficits of the trunk and pelvis in the coronal and transverse planes in young people with HSP. The large deficits could potentially indicate that muscle weakness may have been a factor for this cohort, supporting recent evidence of strength deficits in people with HSP [1]. Further studies are warranted to explore the potential causative factors for gait deficits in children with this condition.

Reference: 1. Marsden, J., et al., Muscle paresis and passive stiffness: Key determinants in limiting function in Hereditary and Sporadic Spastic Paraparesis. Gait & Posture, 2012. 35(2): 266–271.

Sleep patterns of children with cerebral palsy: impact on caregivers’ sleep quality and psychological well-being

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Objective: To investigate the sleep quality of children with cerebral palsy (CP) and its impact on caregivers’ sleep quality and psychological well-being.

Design: Cross-sectional study.

Method: All parental caregivers of children with CP aged 5–13 years who were registered with a state-wide community rehabilitation service were approached to participate by mail, followed by telephone recruitment strategies (n=383). Caregivers completed the Pediatric Sleep Questionnaire (PSQ) to rate their child’s sleep quality; the Pittsburgh Sleep Quality Index (PSQI) to rate their own sleep quality; the Depression, Anxiety and Stress Scale short version (DASS-21), Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and a family demographic questionnaire. Surveys were completed either independently (web-based or mail) or via phone interview. Outcomes on each measure were compared to normative data and relationships between measures were evaluated using correlation analysis using SPSS v.20.

Results: Eighty-two caregivers (mean age 42yr; SD 8yr 0mo; 70 mothers, six fathers, one step parent, three grandparents and two foster carers) of children with CP aged 5–13 years (mean 8yr 9mo, SD 2yr 3mo; GMFCS I=23, II=19, III=15, IV=12, V=20; 34 quadriplegia, 12 diplegia, 35 hemiplegia) consented to participate. Poor sleep quality was reported for 45% of children and 44% of parents. As hypothesised, poorer children’s sleep quality (PSQ) was related to poorer caregiver’s sleep quality (PSQI) (r=0.452; p=0.000). Forty-two percent of parents screened positive for mental health issues; 14% depression, 17% anxiety and 22% stress at moderate or severe levels. Poorer caregiver sleep quality was related to higher depression (r=0.419; p=0.000), anxiety (r=0.369; p=0.002), and stress (r=0.510; p=0.000), and lower well-being (r=–0.460, p=0.000).

Conclusion: Sleep is a fundamental aspect of human well-being. This data shows that significant numbers of children with CP are experiencing chronic problems with poor sleep quality that extends far past infancy. As a result, their parents are experiencing chronic sleep problems. Approximately half of these parents screened positive for at least one mental health problem, many at severe levels. More research is required to develop effective treatments for sleep disorders in children with CP. In addition, support services are required to foster the health and resilience of parents managing their child’s sleep problems so that they can sustain long term caregiver roles and improve their quality of life.
**An RCT of a parenting intervention for improving parent and family outcomes following paediatric acquired brain injury**

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**Objectives:** To establish whether delivery of an evidence-based parenting intervention, Stepping Stones Triple P (SSTP), with an Acceptance and Commitment Therapy (ACT) stress-management workshop, will result in improvements in parent psychological functioning, family adjustment, and couple relationship following paediatric ABI.

**Design:** Randomized wait-list controlled trial with two groups (ACT+SSTP and care as usual [CAU]).

**Method:** Sample was 59 parents (89.8% mothers; mean age 39.13, SD=6.11) of children (35 male; mean age 7 years (SD=3yr, 1mo) with ABI (Traumatic injuries 57.6%, Tumour 16.9%, Encephalitis or meningitis 15.3%, Cardiovascular accident 6.8%, Hypoxia 3.4%). Randomisation to ACT+SSTP or CAU was conducted using a computer-generated sequence). CAU participants were offered the programme after the wait-list period. After the 10-week programme participants were assessed for: parent psychological functioning (Depression Anxiety Stress Scale [DASS]), psychological flexibility (Acceptance and Action for Acquired Brain Injury Questionnaire [AAABIQ]), family functioning (general function social scale of the Family Assessment Device [FAD]), couple relationship satisfaction (Relationship Quality Index [RQI]), and number of disagreements over parenting (Parent Problem Checklist [PPC]). A series of mixed-model repeated measures regression analyses were conducted on the intent-to-treat sample (SPSS21).

**Results:** Randomisation resulted in 30 families in ACT+SSTP group, and 29 in CAU group. Fifty-two participants (25 treatment, 27 control) completed the post-intervention assessment (88% retention). Significant improvements in the treatment group relative to the waitlist group from pre to post-intervention were identified for: DASS anxiety (t49.32=-2.12, p=0.039) and stress scales (t50.86=-2.0, p=0.032), AAABIQ psychological flexibility (t51.96=3.34, p=0.002), FAD general family functioning (t52.40=-3.33, p=0.002), and PPC number of disagreements (t57.62=-2.12, p=0.04). At 6-month follow-up, improvements in anxiety, stress and family functioning were maintained, however number of disagreements over parenting, and psychological flexibility returned to baseline levels.

**Conclusion:** Interventions incorporating ACT alongside parent skills training for parents of children with ABI lead to improvements in parent, couple, and family functioning. Future translational research considering the use of ACT interventions in this population will be important, given the impact of ABI on the psychological well-being of parents, and the vital role that parents play in rehabilitation and child outcome.

**Sagittal gait patterns in adults with bilateral spastic cerebral palsy**

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**Objective:** Gait classifications based on biomechanical presentation are used to describe walking patterns of children with bilateral spastic cerebral palsy (BSCP). Adults with cerebral palsy frequently report increasing difficulty and deterioration of walking. The aim of this project was to consider the applicability of paediatric gait classifications for adults with BSCP and ascertain the feasibility of implementing such a classification system for describing gait.

**Design:** Retrospective observational audit.

**Method:** Data from all adults attending the Clinical Gait Analysis Service between 2006 and 2013 were included in the audit. Two experienced physiotherapists independently reviewed sagittal plane kinematics of 41 adults who underwent instrumented gait analyses; average age 34 years (SD 8yr); males=24, females=17; GMFCS level I=2; level II=32; level III=7. Reasons for referral, falls frequency and previous surgical intervention were recorded. Gait patterns were categorised according to the classification system reported by Rodda et al¹. Disagreements were resolved by consensus.

**Results:** All participants had been referred because of concerns with gait deterioration. Eight individuals reported no falls, falls history was unknown in three individuals, and 30 reported a history of falls, with five falling ≥1/week and five describing frequent falls. Surgical interventions during childhood were reported by 32 participants and unknown by four participants. Gait patterns were identified for 66 limbs: Group I (true equinus)=1; II (jump)=6; III (apparent equinus)=31; IV=21 (crouch); mild=7. Sixteen of 82 limbs (20%) could not be identified according to criteria, reflecting 13 of 41 individuals who could not be classified.

**Conclusion:** Although the presentation of BSCP is heterogeneous, gait patterns may show similar characteristics. Classification of gait disorders may offer a useful system for describing longitudinal changes in gait patterns of individuals, providing clinicians with easily recognisable gait descriptors that may be useful to consider in management planning. Gait patterns used for children with BSCP apply to only a proportion of adults with BSCP. Patterns of gait dysfunction may have been influenced by surgical management during childhood and continued skeletal and developmental maturation. Further studies, including long-term population studies, are required to document the decline of gait in adults with BSCP.

**Reference:** 1. Rodda J et al (2004) J Bone Joint Surg (Br) 86 (2):251.
Femoral derotation osteotomy improves transverse plane pelvis symmetry in children with cerebral palsy: a systematic review and meta-analysis

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Objectives: Internal hip rotation (IHR) is common in children with cerebral palsy and a major contributor to an intoed gait. The accepted orthopaedic intervention to correct IHR is a femoral derotation osteotomy (FDRO). Currently there is no consensus regarding the effect of FDRO on pelvic rotation during gait in children with unilateral and/or bilateral cerebral palsy involvement. The purpose of this study was to determine this effect. We hypothesised that FDRO would improve transverse plane pelvic kinematic symmetry in all children with cerebral palsy.

Design: Systematic review and meta-analysis.

Method: The search strategy used MeSH terms and text words for ‘cerebral palsy’ AND ‘osteotomy’ AND ‘biomechanics OR gait OR locomotion OR kinematics’ across five electronic databases. References of key papers were also scanned. Inclusion criteria stipulated that studies incorporate a pre and post surgery 3D gait assessment of children with cerebral palsy who were treated with a FDRO. Quality assessment was undertaken independently by three authors (CC, TP and JE) using the STROBE checklist for cohort studies. Meta analysis was conducted using a variable effect model in Review Manager (RevMan).

Results: One hundred and ninety-five articles were identified and after the inclusion/exclusion process 13 studies were included for meta-analysis. Of the 13 studies (6 prospective, 7 retrospective), 5 included participants that received a unilateral FDRO, 6 included patients that received unilateral or bilateral FDRO and two studies included participants that received bilateral FDRO only. Meta-analysis results revealed that patients with unilateral cerebral palsy involvement (n=85) had improved transverse plane pelvic symmetry post surgery (mean angle difference=9.0 (5.5–12.5), p<0.01), whereas patients with bilateral involvement (n=160) did not [mean angle difference=1.9 (0.2–3.6), p=0.45].

Conclusion: In partial agreement with our hypothesis FDRO was found to significantly improve transverse plane pelvic symmetry in children with hemiplegia, whereas there was no significant effect for children with bilateral lower limb involvement. Potential reasons for this difference include: (i) many of the children with bilateral involvement had bilateral FDRO surgery, which if not accounted for in the model would have confounded the effect of FDRO on pelvic rotation, (ii) many of the children with bilateral involvement had symmetrical transverse plane pelvic kinematics pre surgery, (iii) children with bilateral involvement are more likely to have a primary abnormality at their pelvis and (iv) because children with bilateral involvement have impaired motor control of both the limbs they may be less able to compensate and fine tune their kinematics post FDRO surgery.

Movement training positively influences the motor function of upper extremities in infants with neonatal stroke

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Objectives: Infants with neonatal stroke (NS) are at high risk for motor dysfunction, particularly hemiplegic cerebral palsy. Infants with NS frequently have a period of neurological symptomatology before they show signs of reaching and grasping dysfunction. It is unknown if an early upper extremity training programme can improve arm and hand function in infants with NS. The purpose of this study is to examine if movement training improves reaching and grasping performance during early infancy in infants with NS.

Design: This is a randomized controlled study with a longitudinal design.

Method: Twenty infants with NS who have enrolled in this study. NS were identified with MRI and randomly assigned to a movement training or social training (control) group. Preliminary analysis on five movement training (MT) infants (M:5; F:1) and six social training (ST) infants (M:5; F:1) who have finished all visits is presented here. Infants started the baseline evaluation at 2-month of age [MT: 73.0 (6.7) days; ST: 66.3 (7.9) days]. Infants in the MT group received 10 minutes/day on reaching and grasping training 5 days per week. Infants in the ST group received the same amount of intervention time on social activities without a motor component. Reaching behaviors were evaluated every month for a total of five visits. Reaching number and duration were recorded in sitting for three trials of 30 seconds. Grasping behaviors were evaluated every month for a total of three visits. The proportion of bilateral grasping was recorded in supine for six trials of 30 seconds.

Results: Both groups showed a developmental trajectory of increased reaching number, reaching duration and bilateral grasping. Infants in the MT group started to show more reaching number [MT: 34.2 (5.5) times/90s; ST: 21.4 (28.4) times/90s] and reaching duration [MT: 2549.8 (774.9) frames/90s; ST: 1141.8 (1347.2) frames/90s] at 7 months and more bilateral grasping at 3 months (MT: 18 (18) % of time; ST: 3 (4) % of time) and 4 months (MT: 44 (16) % of time; ST: 21 (19) % of time).

Conclusion: Preliminary analysis of infants in this training programme showed improvements in reaching and grasping function. Daily upper extremity training was feasible for infants with NS starting at 2 months of age – much earlier than currently prescribed. Current and future work investigates the intervention effect and long-term follow-up to help improve knowledge about motor outcomes and training in infants at risk for cerebral palsy.
Impaired motor and cognitive function in infants with complex congenital heart defects is detectable at 3 months of age

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Objectives: Infants with complex congenital heart defects (CCHD) require life-saving surgery in the first few days of life. These infants are at risk for poor long-term developmental outcomes including cerebral palsy as a result of possible poor fetal circulation and repeated hypoxia. Advances in surgical techniques have greatly improved the survival rates in infants with CCHD and the scientific focus is currently shifting from mortality to neurodevelopmental outcomes. The purpose of this study is to identify motor and cognitive impairments in infants with CCHD at 3-month of age.

Design: Case–Control study.

Method: Twenty infants have enrolled and completed this project. Preliminary data analysis on four infants with CCHD and four infants with TD is presented here. Infants’ motor and cognitive development were tested using the Bayley Scales of Infant Development (BSID-III). Uniquely, cognitive and motor functions were comprehensively tested with the mobile paradigm. In the mobile paradigm, an infants’ leg is tethered to an overhead mobile, and subsequent leg kicks cause the mobile to move providing reinforcement to the infant for learning the cause-effect relationship.

Results: Infants with TD show 4.7 times more kicks during the mobile paradigm; Infants with CCHD showed 2.4 times more kicks during the mobile paradigm. The averaged scaled scores of fine motor on the BSID-III, is slightly higher in infants with TD [9.25 (2.22)] than infants with CCHD [7.50 (1.29)]. The scaled scores of gross motor and cognition on the BSID-III are similar between infants with TD [8.25 (0.50); 9.50 (1.73)] and infants with CCHD [8.75 (1.71); 10.00 (2.45)].

Conclusion: Preliminary results suggest that the mobile paradigm may be a sensitive indicator of learning and motor (kicking) differences between typically developing infants and infants with CCHD. In addition, infants with CCHD may have fine motor delay that is identifiable at 3 months of age. This work proposes that infants with CCHD may show neurodevelopment delay that is identifiable during infancy. The results of this project will immediately inform clinicians to target intervention programmes.

Quality of life of Singapore children with cerebral palsy – an exploratory study at a special school

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Objectives: To study the quality of life of children with cerebral palsy (CP) enrolled at the Spastic Children's Association School in Singapore.

Design: Mail survey, personal interviews, and assessment data reported by school therapists.

Method: Parents of school children aged 12 and below with CP were invited to participate in a mail survey using the primary caregiver proxy version of quality of life questionnaire for CP children (CP QOL-child). Waters, Davis et al in 2006, developed the questionnaire. The children’s functional status was measured with the Gross Motor Function Classification System (GMFCS). Parents were subsequently invited for interview to seek their views on the most important issues that affect the quality of their children’s lives.

Results: Twenty-seven boys and 13 girls were recruited for study. Mean age: 9 years 6 months; SD: ±1 year 11 months. The QOL domain “Social Well-being and Acceptance” had the highest score of 75.0 with a standard deviation of 11.8, followed by the domain “Emotional Well-being and Self-esteem” which had a score of 67.1 and standard deviation of

Upper limb surgery in children with hemiplegic cerebral palsy: simple things that work

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Objective: Children with cerebral palsy almost always have upper limb limitations that present as a unique surgical challenge to surgeons. The decision process for surgical management can seem complicated. There are however, a few soft tissue procedures which provide small improvements with low risk in children with hemiplegic cerebral palsy. We present the outcomes on children treated in our local centre.

Design: Retrospective cohort study involving children with hemiplegic cerebral palsy treated at Starship Children’s Hospital.

Method: Twelve children with hemiplegic cerebral palsy (age range 5–18yr, mean 12yr) had received botox treatment and tendon surgeries. Most were high functioning (9 GMFCS1 and 3 GMFCS 2), eight of them went to mainstream school with normal intelligence while four had learning/cognitive difficulties. These children were assessed pre-operatively and approximately 6–12 months after surgery in a specialised rehabilitation centre. Non-parametric tests (e.g. active range of motion, patient / parent satisfaction scores, and the assisting hand assessment) were used for testing the effect of surgical treatment.

Results: Our preliminary results have demonstrated that not only the active motion increases after upper limb surgeries, but also there is significant improvement in bimanual hand function as shown by the assisting hand assessment (AHA) scores. The AHA score has improved from 58.5% (range 38–67) pre-treatment to 65% (range 41–70) post-surgery. There is consistently high satisfaction post surgery amongst patients and families.

Conclusion: Upper limb surgery improves the ability to use the hemiplegic hand in bimanual activities amongst children with cerebral palsy. A simple algorithm has been developed to allow inexperienced surgeons to safely manage these children.

Upper limb surgery in children with hemiplegic cerebral palsy: simple things that work
The effect of hydrotherapy treatment on gait characteristics of hereditary spastic paraparesis patients

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Objective: Hereditary spastic paraparesis (HSP) is a group of neurological disorders characterised by slowly progressive increasing muscle tone, predominantly in the lower limbs, with relatively preserved power. This leads to progressive difficulties in motor control and walking. The purpose of this study was to evaluate the effectiveness of hydrotherapy treatment when used as a means to increase locomotor function in individuals with late onset HSP.

Design: Pre-post intervention study.

Method: Nine people with HSP underwent a biomechanics analysis, followed by a 10-week hydrotherapy programme. Although tailored to the individual participants, this programme started with a group hydrotherapy session (two small groups) followed by 5 weeks of individual hydrotherapy twice per week, another group session and an additional 5 weeks of individual exercise. Each session was 45-minutes in length. The hydrotherapy was followed by a final biomechanics analysis. Ground reaction force and motion trajectories were recorded and used to calculate spatiotemporal gait parameters, joint angles and moments.

Results: The spatial-temporal parameters of the gait cycle pre- and post-hydrotherapy showed a significant 11% increase in walking speed after hydrotherapy (0.85m/s pre to 0.94m/s post, p<0.05). Only one participant decreased in walking speed while two stayed the same and the remaining six improved. There was also a trend toward greater step length (p<0.07). The normalised joint kinematics and kinetics profile revealed that the HSP biomechanics were similar to that of normal controls for most of the joints, but with lower range of motion and increased rotation. Post hydrotherapy there was a decrease in the rotational range of motion at the hip and knee and a further exacerbation of hip internal rotation throughout the gait cycle. These interesting observations suggest that the greater gait efficiency post therapy may have been due to a greater ability to compensate for stiffness, whether due to greater strength or greater range of internal rotation. Patients with HSP have less knee flexion during swing requiring circumduction (internal hip rotation) to ensure foot clearance. It would appear that the greater internal rotation and less knee flexion which we observed after hydrotherapy allowed better foot clearance and a faster gait.

Conclusion: Spasticity of muscles in the lower extremity limits range of motion and requires compensatory gait strategies to increase walking efficiency. Hydrotherapy increases the ability to perform compensatory strategies rather than resulting in a more normal gait.

Relationship between gross motor function and associated impairments in children with cerebral palsy in Queensland (birth years 1996–2005)

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Objective: Investigate relationships between gross motor function and cerebral palsy (CP) classification with presence of associated impairments in a population-based cohort.

Design: Population-based cohort.

Method: Participants were children with CP registered with the Queensland Cerebral Palsy Register (QCPR). All had a confirmed diagnosis at 5 years and were born, residing in or receiving health services in Queensland. The cohort included children born from 1996 to 2005 with pre or post-neonatal causes. Analysis included cross-tabulation of known values for Gross Motor Function Classification System (GMFCS) levels (I–V) and CP classification [spastic hemiplegia (SH), spastic diplegia (SD), spastic quadriplegia/triplegia (SQ), dyskinesia (D), ataxia (A) and hypotonia (H)], with associated impairments (vision, hearing, speech, intellectual status and epilepsy).

Results: The 10-year cohort of 906 children was characterised by: gender (M=57%); CP classification (spasticity=86% – tri/quadruplegia=20%, diplegia=36%, hemiplegia=30%; dyskinesia=5%, ataxia=4%, hypotonia=4%); GMFCS (I=31%, II=24%, III=13%, IV=13%, V=17%); and associated impairments (vision=46%, hearing=13%, intellectual=46%, speech=61%, epilepsy=30%). Vision impairment was present in approximately half of the cohort, with significantly higher prevalence in level V (n=812, p<0.001, I=26%, II=16%, III=13%, IV=26%, V=59%). Of all children with functional
blindness, 67% had spastic quadriplegia. Overall vision impairment was more evenly distributed (n=866, SH=30%, SD=34%, SQ=60%, D=30%, A=37%, H=52%). There was no reported hearing impairment for >85% of children in all GMFCS levels except level V (n=808, I=9%, II=14%, III=12%, IV=12%, V=23%). Prevalence according to CP classification ranged from 7% for spastic hemiplegia to 24% for dyskinesia (n=841, SH=7%, SD=13%, SQ=18%, D=24%, A=21%, H=16%). Intellectual impairment was common in each CP classification (n=837, SH=40%, SD=47%, SQ=71%, D=61%, A=60%, H=85%). Frequency tended to increase with higher GMFCS level (n=796, I=31%, II=54%, III=58%, IV=67%, V=79%). Speech impairment rose with GMFCS level (n=797, I=37%, II=51%, III=67%, IV=86%, V=96%), and was lowest for spastic hemiplegia compared with other CP classifications (n=840, SH=40%, SD=51%, SQ=89%, D=88%, A=78%, H=89%). The percentage of children with epilepsy at 5 years increased with GMFCS level also (n=807, I=14%, II=20%, III=20%, IV=48%, V=67%). Children with spastic quadriplegia or triplegia were more likely to have epilepsy compared to other CP classifications (n=838, SH=24%, SD=16%, SQ=58%, D=32%, A=25%, H=42%).

**Conclusion:** Knowledge regarding impairments associated with CP and their likely prevalence in relation to gross motor function and CP classification will help clinicians to provide prognostic information to families, initiate early intervention services and manage the functional impacts of these impairments for children and adults with CP.

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**“We just want him to be comfortable”: health related quality of life of young people in out-of-home care**

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**Objective:** This service initiative explored any differences between parents and Disability Support Workers’ (DSWs) perceptions of Health related Quality of Life (HrQoL) of young people with intellectual and physical disabilities living in out-of-home care.

**Design:** Survey and focus group.

**Method:** The CPCHILD questionnaire was sent to parents (n=30) of young people living in out-of-home care and to DSWs (n=30) who assist those same young people. This questionnaire covers six domains: Personal Care/Activities of Daily Living; Positioning, Transferring & Mobility; Comfort & Emotions; Communication & Social Interaction; Health; and Overall Quality of Life (QoL). There is a further section which identifies the importance rating of these domains to QoL. A focus group with parents and DSWs was held at the conclusion of analysis of results of the questionnaire. Focus group data was content analysed.

**Results:** Twelve parents and 16 DSWs returned the questionnaires. Parents scored HrQoL for their son or daughter consistently lower across most domains than did DSWs. Both parents and DSWs scored Comfort & Emotions the highest (63 and 80, respectively). The domains rated as most important to the Quality of Life by both groups were health, followed closely by comfort/emotions. Within this domain, DSWs rated comfort during functional activities as most important while parents rated emotional state as more important. Surprisingly both parents and DSWs rated communication as not important.

**Conclusion:** Parents and DSWs’ perceptions of young people’s HrQoL are different. Consistent with the literature, parents rated HrQoL lower than DSWs did. Both groups perceive that young people are essentially comfortable and happy, and indicate the importance of the domain of Comfort/Emotions to QoL. The interesting observation is that parents focus on happiness and overall comfort but DSWs relate comfort and emotions to functional activities such as positioning/mobility and ADLs/personal care. As well, both groups over-estimate comfort/emotions similarly to comparative research in the area of pain. It would appear that two priorities to address are the recognition of pain and strategies for better management of pain/discomfort. The findings posed more questions than they answered and a qualitative study is indicated.

**Reference:** Narayan UG, Weir S, Fehlings D, (2007). The CPCHILD Manual & Interpretation Guide, Toronto. The Hospital for Sick Children.

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**How to set collaborative and meaningful goals with families – a regional community paediatric service experience**

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**Objective:** To determine what are the most effective tools to capture what are meaningful goals for families in a community paediatric setting. Goal Attainment Scale (GAS), the Canadian Occupational Performance measure (COPM) were compared in conjunction with use of the Routines Based Interview (RBI).

**Design:** Retrospective cohort study.

**Method:** Forty-eight children with cerebral palsy (42% male), Gross Motor Function Classification System (GMFCS) I=8, II=11, III=6, IV=8, V=8 (spasticity n=39, dystonia n=5, ataxia n=2, hypotonia n=4) were recruited as part of their participation in 10 week block therapy programmes. Goals for these interventions were determined collaboratively with families using (i) GAS only or (ii) conducting a RBI then COPM with GAS. Qualitative data on use of the tools was collected.

**Results:** GAS showed changes in functional activities across both cohorts; changes in performance and satisfaction were identified using the COPM. Therapists reported on their perceptions of the tools as facilitators or barriers to determining meaningful goals.

**Conclusion:** GAS and COPM measure different constructs in therapy interventions and both have clinical utility in detecting change in therapy intervention programmes. However, therapists report that using a semi-structured interview (RBI) prior to using either tool facilitated more meaningful goal setting, as families could prioritise interventions more collaboratively with their therapists.
Training and support is necessary for these tools to be used effectively, and these are some of the determinants of how successful their implementation will be in clinical practice.

**Advanced diffusion weighted magnetic resonance imaging of the extremely preterm infant’s brain**

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**Objective:** To determine whether advanced diffusion magnetic resonance imaging (MRI) provides additional information compared to standard diffusion tensor imaging (DTI) in the brain of infants born very preterm when imaged at 30 and 40 weeks post menstrual age (PMA).

**Design:** Prospective longitudinal cohort study.

**Method:** Ten preterm infants (four female) born at <30 weeks gestational age underwent research 3T MRI around 30 weeks PMA. Three infants (one female) undertook a second MRI at term equivalent age. Two diffusion MRI datasets were acquired for each infant: one employing a standard acquisition at low b-value along 30 encoding directions, and one employing an advanced acquisition at a high b-value along 64 encoding directions. Data were analysed using the standard DTI model to generate colour-encoded anisotropy images and an advanced model of diffusion (constrained spherical deconvolution) to resolve crossing fibres.

**Results:** The major white matter tracts could be observed with both acquisition types and both analysis techniques at 30 and 40 weeks PMA. At 30 weeks PMA, we also observed a radial coherence of fibres in the cortical grey matter. This radial coherence pattern was more pronounced when constrained spherical deconvolution was used, and was better defined for the advanced diffusion acquisition. At 40 weeks PMA, the radial coherence pattern had mostly resolved presumably due to the increased cortical transverse interconnectedness that occurs over this period. Only the advanced diffusion acquisition in combination with constrained spherical deconvolution was able to show residual radial organization and emerging transverse organization.

**Conclusion:** Advanced diffusion imaging of the very preterm infant’s brain allows assessment of not only the major white matter tracts within the brain, but also enables investigations into the maturational processes occurring in the cortical grey matter. It has been shown previously that advanced diffusion imaging at term age is superior to DTI in identifying patterns of white matter maturation. Advanced diffusion imaging is currently employed in a cohort of very preterm infants scanned at 30 and 40 weeks PMA, with a target sample size of 80 participants. All infants will receive extensive neurological, neuromotor and neurobehavioural assessments, including General Movements, Premie Neuro, Dubowitz, NICU Network Neurological assessment, at 30 and 40 weeks PMA, and will be followed up at 3 and 12 months corrected age to determine motor and neurodevelopmental outcomes. Results of this study will aid in the earlier prognostication of adverse outcomes following premature birth.

**The effect of progressive resistance training on skeletal muscle morphology in children and adolescents with cerebral palsy: a systematic review**

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**Objective:** Loss of muscle strength and power is commonly seen in children with cerebral palsy (CP) secondary to the brain lesion. Progressive resistance training (PRT) has been used as a conservative treatment to increase strength in individuals with CP, with little reported measureable transfer to gross mobility-related measures. The purpose of this study was to determine the effect of PRT on skeletal muscle properties in individuals with spastic type CP aged 4–20 years.

**Design:** Systematic review.

**Method:** The search strategy included the following Medical Subject Headings (MeSH) and related keywords across five electronic databases: (i) child* or adolescent; (ii) and cerebral palsy; (iii) and resistance training or strength training; (iv) and muscle (skeletal) or movement or function*. Reference lists of key papers were also scanned. Selection criteria for inclusion stipulated studies use a progressive resistance training intervention in participants aged >4 and <20 years old with cerebral palsy assessing the outcome on skeletal muscle morphology: Quality assessment was performed by two independent reviewers (JG and LB) using the STROBE checklist for cohort studies.

**Results:** One hundred and seventy-five articles were identified and after the inclusion/exclusion process three studies met full criteria. All three studies were prospective in design assessing outcome measures at baseline and after 10 weeks of PRT. Mean number of PRT sessions performed was 31.33 ± 8.08 across an average duration of 9.75 ± 0.43 weeks. The main finding of the review was gastrocnemius muscle volume (ES = 0.44, 95% CI = 0.35 to 1.22), upper limb CSA in the impaired limb (ES = 1.64, 95% CI 0.63–2.65), and rectus femoris fascicle length (ES = 0.34, 95% CI 0.09 to 1.37) increased significantly following PRT intervention.

**Conclusion:** Preliminary evidence suggests muscle size (CSA and volume) increases significantly following PRT in children and adolescents with CP. No conclusion can be drawn on the effect of PRT on muscle fascicle length due to study quality issues. Increases in muscle size may influence the mechanical properties of the musculotendinous unit and potentially slow the development of, or reduce muscle contracture. Changes in muscle morphology may also alter the interaction of the muscle and tendon during functional tasks such as walking. There is a paucity of studies that have assessed the effect of PRT on skeletal muscle morphology in individuals with CP. High quality randomised controlled trials are needed before PRT is discounted as an effective conservative treatment option in these individuals.
Early detection of cerebral palsy in high-risk infants: the role of clinical variables and cerebral ultrasound

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Objective: Cerebral palsy (CP) is a motor and postural disorder caused by insult on the developing brain. The incidence of CP increases with the increasing number of high-risk infants. There is a need for a simple method for the early detection of CP, especially in developing countries like Indonesia. The objectives of this study are: to determine the proportion of CP in high-risk infants, time to the occurrence of CP in the first year, risk factors associated with and the time to the occurrence of CP, to determine an early detection method using parameters of motor delay, neurological examination, and cerebral ultrasound.

Design: A prospective cohort study was done on 150 high-risk infants until 12 months of corrected age.

Method: We obtained perinatal and postnatal history to determine the risk factors. Head US has been done in all subjects. On follow-up we obtained history of motor ability and perinatal examination of five primitive reflexes and two postural reflexes. Infants were examined for premature of extension and parachute reflexes. Neurological examination was performed at six and 12 months of age; CP was detected in the first 6 months of life. Risk factors that influenced the occurrence and time to occurrence of CP were cerebral ultrasound abnormalities, hypoxic-ischemic encephalopathy, intracranial hemorrhage, and meningitis. At 4 months corrected age, abnormality on traction response test (Se 89.7% Spe 97.3%), fisting (Se 87.2% Spe 98.2%), positive palmar grasp (Se 100%, Spe 96.4%) predicted CP at 6 months of age. Motor delay (Se 97.2% Spe 93.8%), a positive palmar grasp reflex (Se 91.6% Spe 98.2%), fisting (Se 94.4% Spe 98.2%), and absence of the protective extension reflex (Se 97.2% Spe 92.9%) at 6 months of age predicted CP at 12 months of age. At 9–10 months of age, motor delays (Se 100% Spe 93.8%), an absent of protective extension reflex (Se 69.4% Spe 98.2%), and a negative parachute reaction (Se 72.2% Spe 100%), predicted CP at 12 months of age. Cerebral ultrasound abnormalities predicted CP at 6 and 12 months of age.

Conclusions: Early detection of CP can be done since the first 6 months of life. Motor delays, physical examination, and cerebral ultrasound can be used for the early detection of CP.

Children with cerebral palsy: service utilisation and parental satisfaction

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Objective: The aim of this study was to determine: (i) the service utilisation patterns of children with cerebral palsy at 5, 10 and 15 years of age over a 12 month period, and (ii) the parental level of satisfaction with the frequency and quality of therapy their children received.

Design: This was a cross-sectional survey of medical, physiotherapy, occupational therapy and speech and language pathology services.

Method: Participants were the parents of children with cerebral palsy across all gross motor function classification system (GMFCS) levels. Eligible children were identified through the Victorian Cerebral Palsy Register. Random sampling in groups stratified by age and GMFCS levels was used to select families who were invited to participate. Data collection was via a custom designed survey collecting information on: demographics, funding sources, medical services accessed, educational setting, therapy services utilised and satisfaction with services.

Results: One hundred and fifty-six surveys were sent out to families and 83 surveys (53%) were returned or completed over the phone. Of the 83 parents surveyed, 29 had a child aged 5 years, 27 had a child aged 10 years and 27 had a child aged 15 years. Forty-three percent of therapy accessed by children aged 5 years was funded by the Better Start Initiative, whereas 53% of therapy accessed by those aged 10 and 15 years was funded through school-based funding. Sixty percent of children attended special schools consistently received more therapy. Of those who received no therapy, 65% were ambulant. Seventy-five percent of parents were satisfied with the quality of therapy received, however satisfaction with frequency of service varied and was lowest among parents of 10 year old children. Parents provided valuable qualitative data on therapy provision.

Conclusion: Inconsistencies in service delivery for children with cerebral palsy within Victoria appear to be influenced by amount and type of funding available, the child’s school setting and level of gross motor function of the child. This information is useful in directing future funds and is particularly pertinent with the imminent roll-out of Disability Care Australia. Future larger studies involving all states within Australia would provide more comprehensive information.

Endpoint kinematics and hand strength following transcranial magnetic stimulation in children with hemiparesis

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Objective: Children with hemiparesis have difficulty moving one side of their body, specifically their arm and hand. Com-
mon neurological impairments include spasticity and weakness and interfere with a child’s daily activities. Current treatment includes physical and occupational therapy, spasticity medications, and surgery, but there is a search for better therapies since these modalities have limited efficacy. Basic neuroscience research in the last 20 years has demonstrated that the nervous system is more plastic than previously expected. These discoveries have created widespread interest in methods to monitor brain functional activity and methods to modulate that activity. Our project investigates a novel treatment to immediately improve upper arm and hand function in children with hemiparesis. The goal of this project is to describe end point kinematics during reaching and hand strength in five children with hemiparesis before and after Transcranial magnetic stimulation (TMS).

**Design:** Case Series.

**Method:** Five children with hemiparesis ages 13–18 years participated in this study. Repeated TMS stimulation was delivered as 100% of the resting motor threshold at 1 Hz for a total of 1200 stimuli 4 days a week for 2 weeks. Outcomes assessments include: 1) reaching and coordination measured with 3D motion capture, 2) hand strength measured with dynamometry. Outcomes were evaluated in two sessions; baseline and at the conclusion of TMS intervention.

**Results:** All children show decreases in the number of movement units per reach, increases in speed, and increases in the length of the first movement unit suggesting improvements in arm coordination. In addition, all children showed an increase in hand strength.

**Conclusion:** This is the first project to look at kinematic outcomes during TMS in children. Repeated Transcranial magnetic stimulation on the contralateral side of the brain lesion may promote inhibition of damaged neural pathways in the brain resulting in better reaching, coordination, arm and hand use, and strength. TMS is an exciting new intervention option for children with motor dysfunction and could be used in combination with constraint induced movement therapy and bimanual training for children with hemiparesis.

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**Patient safety in hospitals for adults with cerebral palsy and complex communication needs: development of a detailed framework to benefit both patients and staff**

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**Objective:** Up to 80% of adults with cerebral palsy have communication disabilities and 25% will be non-verbal (Access Economics, 2008). These adults have a three-fold increased risk for preventable and harmful patient safety incidents in hospital. This study was recently awarded 3 years funding from NHMRC and ethically approved by The University of Newcastle and participating hospitals. The aims of the study are:

1. To identify the key factors within the patient, staff, caregivers, and the health environment that impact on patient safety for adults with severe communication disabilities in hospital.
2. To formulate an evidence-based framework of contributing factors and prevention strategies for patient safety incidents of adults with severe communication disabilities in hospital.
3. To develop and test a valid and reliable Clinical Audit Tool for Communication in Hospital (CATCH) using mobile technologies to enable hospital staff to audit and modify communicative environments to improve patient safety.

**Design:** Grounded theory with four data sources (i) interviews with adults with communication disabilities, carers, and hospital staff; (ii) review of medical records; (iii) review of patient safety database entries; and (iv) document analysis of group home records.

**Method:** Grounded theory, constant comparative analysis, medical record chart review, health informatics analysis of records, expert consensus panel.

**Results:** This study is in progress with data collection on 30 adult cases proceeding in 2014–2015. In this paper we will (i) review the literature informing the study, (ii) outline the theoretical basis of the design, and (iii) present the timeline of the study graphically. This will be important information for healthcare providers, consumers, family members, disability organisations, and health services as they aim to improve healthcare services to adults with cerebral palsy. Developing a detailed framework of patient safety will help to improve care and reduce the risk of healthcare-related harm to vulnerable patients. Future investigations in improving patient safety for other populations with communication difficulties will also benefit by the provision of a rigorously tested evidence based framework of contributing factors from which to undertake further research.

**Conclusion:** The findings of this study will translate into fundamental outcomes in patient safety and fundamental changes in health policy surrounding the health care of adults with developmental disability. This framework will not only benefit adults with developmental disability but also the health professional staff, paid carers and family carers who may struggle to provide safe and effective care.

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**Cerebral palsy check-up: providing the best service at the best time: a project protocol paper**

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**Objective:** This project protocol paper will describe an investigation of whether a tailored, multi-faceted intervention for allied health professionals (AHPs) results in (i) greater use of evidence-based outcome measures and interventions, (ii) improved AHP knowledge, and (iii) reduction in rates of adverse outcomes in a representative sample of Australian...
The scope of the organisations participating in the study in relation to implementation of the intervention will also be evaluated. Design: Controlled before and after study. 
Method: Up to 180 AHPs working in five community service providers for children with CP over four Australian states will be recruited. These AHPs provide services to over 600 children and young people with CP, of all motor types and levels of severity, who will also be recruited to the study. The intervention comprises four knowledge translation strategies implemented across all participating service providers. Outcomes will be measured at baseline, 6, 12 and 24 months and will include changes in AHP use of measures and interventions, measured using customised Goal Attainment Scaling; change in AHP knowledge, measured using the Evidence Based Practice and Outcome Measurement Competency Quiz; and longitudinal outcomes for children with CP relating to hip dislocation, joint contracture and scoliosis, measured from data extracted from a surveillance tool. Quantitative analyses using multivariate statistical models designed to allow for correlated longitudinal data structures, due to children being clustered within AHPs, and AHPs within organisations, will be employed. Results: This paper will provide clinicians with an overview of the evidence based interventions utilised in the project: (i) identification and support of knowledge brokers in each organisation; (ii) provision of a customised electronic evidence library of synthesised and critiqued evidence; (iii) education and training in evidence-based measures and interventions; and (iv) provision of a web-based CP clinical outcomes surveillance tool (CP Check Up). Conclusion: This project, funded by the National Health and Medical Research Council of Australia, will provide evidence of the effectiveness of a knowledge translation intervention to change workplace behaviours of AHPs, and evaluate its impact on outcomes for children with CP aged 3–18 years. Closing the research-practice gap in service provision for children with CP will support effective decision making by AHPs and families, improve outcomes and quality of life of children, and potentially reduce costs to the tax payer of delivering an inadequate service.

Narrative inquiry: useful techniques for understanding the stories of people with cerebral palsy

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Objective: Narrative inquiry methods are based on the premise that through listening to people’s stories we can make sense of their experiences and understand how they construct meaning in their lives within a broader social context. Narrative inquiry is seen to be particularly relevant for understanding the stories of people whose experiences may differ from normative experiences, including people with disabilities. Wide variation exists in both the data collection and analysis methods utilised within narrative inquiries. This paper details one example of narrative inquiry methods utilised successfully in an exploration of the stories of emerging adults with cerebral palsy (CP).

Design: A qualitative, narrative inquiry guided, but not constrained, by the work of Donald Polkinghorne.

Method: Multiple in-depth unstructured interviews were conducted with 18 volunteers with CP aged 18–25 to explore their experience of emerging adulthood. While the majority of interviews used a traditional face to face format, email and telephone interviews were also successfully conducted. These alternative formats facilitated access to the study by people unable to participate in face to face interviews for reasons including speech impairment and geographic distance. A number of techniques were usefully employed during interviews, including setting the narrative terrain, funnelling, recursive questioning, and drawing on background knowledge. Data was analysed using both narrat analysis and paradigmatic analysis of narratives. Paradigmatic analysis included both inductive methods, that is identifying key concepts directly from the data, and deductive methods, relating to data coded according to key domains from the theoretical frameworks guiding the study; the theory of emerging adulthood and the International Classification of Functioning, Disability and Health.

Results: Narrative analysis resulted in the construction of an individual story for each participant. Paradigmatic analysis of narratives enabled the identification of a typology of four different types of stories of emerging adulthood and identification of common and contrasting themes and concepts appearing across stories. Both types of analysis offered useful, and different, insights into the stories and experiences of emerging adults with CP.

Conclusion: A range of narrative inquiry techniques can be successfully used to engage effectively with people with cerebral palsy and to reveal their experiences and stories.

Activities of daily living measures for children aged 5–18 years with cerebral palsy: a systematic review

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Objective: To systematically review the psychometric properties and clinical utility of activities of daily living (ADL) measures for children and adolescents with cerebral palsy aged 5–18 years.

Design: Systematic review.

Method: Five electronic databases were searched to identify ADL measures that (i) measured ADL performance, capacity or capability; (ii) consisted of at least 60% ADL items in the full assessment or in a domain that can be administered and scored independently; (iii) had published validity and reliability data for children aged 5–18 years with CP; and (iv) were available for use. A modified CanChild Outcome Rating Form was used to determine the validity, reliability, responsiveness and clinical utility of measures.
Results: Twenty-six measures were identified and eight met inclusion criteria. The Pediatric Evaluation of Disability Inventory (PEDI) (Haley et al, 1992) was the best measure of ADL capability. The PEDI had strong psychometric properties but is limited by its upper age limit (7.5yr or older children with functional abilities <7yr old). The Assessment of Motor and Process Skills (AMPS) (Fisher & Jones, 2010) was the best tool to evaluate ADL performance or capacity for children and adolescents of all ages. The AMPS is useful to link ADL ability with underlying motor and processing difficulties but further work is required on the reliability of the AMPS in this population.

Conclusion: Activities of daily living play a central role in supporting participation and therapists must incorporate ADL measures into clinical practice and research with a judiciously chosen assessment tool. The PEDI is the best measure of ADL capability and use of the AMPS is recommended to evaluate ADL performance or capacity. Future research should examine the test-retest of the AMPS to determine its stability in children and adolescents with CP.

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2. Fisher AG, Jones KB. Assessment of Motor and Process Skills: Volume 1 – Development, standardization and administration manual. 7th ed. Fort Collins, CO: Three Star Press; 2010.

HOME-Safe: identifying caregiver safety risks and barriers to independent participation of young people and adults with cerebral palsy at home

OBJECTIVE: Long term support from family caregivers is essential for people with cerebral palsy (CP) to live at home. However, health of caregivers is at risk due to many experiencing musculoskeletal injury through providing personal care support even before their child reaches adolescence (Johnston et al. 2012). Parents identify poor home design as a major contributing factor. The HOME-Safe study aimed to quantify environmental caregiver safety risks and barriers to client independence in homes of young people and adults with CP.

DESIGN: Cross sectional study.

METHOD: All people over 13 years with a confirmed diagnosis of CP living in South East Queensland were invited to participate (n=621). Home-based audit of environmental safety and access features of each client’s home were performed using the Residential Aged Care Services Built Environment Audit Tool (Department of Health and Ageing) modified for domestic homes (Nitz 2013). Capacity for families to make physical changes to the environment was coded according to home ownership (own home, renting or public housing). Need for mobility or personal care support was coded according to gross motor function (independent walking: equivalent to GMFCS I/II; marginal ambulation: equivalent to GMFCS III, or wheeled mobility: equivalent to GMFCS IV/V). Data were analysed descriptively.

RESULTS: Ninety-three families consented. To date 47 clients have participated (aged 13–62yr; mean 27.9yr; 32 males). Mobility status was: 11 (23.4%) independent walking, 12 (25.5%) marginal ambulation and 32 (68.1%) wheeled mobility. Home ownership was: 24 (51.1%) own home, 7 (14.9%) renting and 14 (29.8%) public housing. Environmental audit indicated that 89.4% (42/47) of homes required some remediation, with a very large number of issues identified per house (mean=19.2, SD 15.53). Remedial action needs were distributed throughout homes. Most in need of remedial action were Bedrooms (n=35 houses needing at least one action resolved, mean=5.6 items, SD=5.20) and Bathrooms (n=39, mean=4.4, SD=4.18); followed by Entrances/Hallways (n=37, mean=4.1, SD=3.77) and External Areas (n=35, mean=3.8 items, SD=3.43); and then Communal Areas (e.g. lounge, kitchen) (n=26, mean=1.2, SD=1.44).

CONCLUSION: Injury to family caregivers during provision of personal care support is a major factor limiting the residential choices and participation levels of people with CP. Poorly designed home environments and lack of funds to pay for home modifications are major risk contributors. A nationally funded home modification programme, for example through DisabilityCare Australia, is required to assist families to resolve environmental risks to caregivers and to improve the independent function of people with CP at home.

Relationship between severity of brain lesion and ambulation in pre-school aged children with cerebral palsy

OBJECTIVE: To assess the relationship between brain lesion severity (structural MRI) and ambulatory status and gait patterns in pre-school aged children with cerebral palsy (CP).

DESIGN: Cross sectional prospective population based cohort study.

METHOD: One hundred and fifty children (mean age 3.8, SD=1.8yr, 86 males including GMFCS level I=60 [40%], II=22 [15%], III=24 [16%], IV=22 [15%], V=22 [15%]; diagnosed with CP were assessed on motor capacity, ambulatory status and gait patterns between 24 and 60 months corrected age. Structural MRI neuroimaging (T1, T2, Flair) performed at mean age 1.9 (SD=1.4) yrs were classified with (i) novel semi-quantitative scale for structural MRI (global severity score from 0 to 40) (Fiori, 2013) and (ii) Krageloh–Mann’s qualitative classification of brain lesion pattern according to location, extent and presumed timing. Children’s ambulatory status (ambulant unaided, ambulant aided, non-ambulant) and
gait pattern classification for unilateral CP (Winter, Gage & Hicks, 1987) and bilateral spastic type CP (Sutherland & Davids, 1993; Rodda, 2004) were assessed by two experienced physiotherapists. The association between MRI global severity scores and qualitative MRI classification was compared to ambulatory status and gait patterns using multinomial logistic regression (SPSS version 21).

Results: In our cohort 107 (71%) children were ambulant, of these 25 (16%) were aided and 43 (29%) non-ambulant. Gait Patterns were classified for bilateral spasticity (true equinus=30; apparent equinus=2; jump knee=19; crouch=6) and for unilateral CP (WGH I=4, II=29, III=1, IV=3). Quantitative global MRI severity scores (median 11, IQR=6.375–16.5) had a significant moderate correlation with children’s ambulatory status ($R^2=0.138$, $p=0.001$). Quantitative global MRI scores had a positive but non-significant association with severities of gait patterns in children with bilateral spasticity ($R^2=0.05$, $p=0.106$) but no association with gait patterns in unilateral CP. Qualitative classification (KM) of lesions did not correlate with ambulatory status ($p=0.874$).

Conclusion: Global severity scores of the brain lesion using a semi-quantitative MRI scale has a significant correlation with ambulatory status in young children with CP. There was a trend towards an association between more severe gait patterns (crouch gait) as brain lesion severity increased in preschool age children with CP. The ability to predict ambulatory status and gait pattern has potential to aid the tailoring of interventions and streamlining of surveillance based on early brain injury.

Objectives: To systematically review the available literature on the relationship between habitual physical activity levels (HPA) and motor capacity in children with cerebral palsy (CP) aged 3–12 years for all gross motor functional abilities (GMFCS I–V) compared to typically developing children.

Method: Searching was conducted on five electronic databases (Pubmed, Cochrane, Embase, Cinahl and Web of Science from 1989 to July, 2013) using keywords ‘children with cerebral palsy’, ‘physical activity’, ‘motor capacity’ and ‘motor function’ including their synonyms and MeSH terms. The inclusion criteria were studies (i) conducted in children with CP aged between 3 and 12 years, (ii) assessed HPA or time spent sedentary (iii) assessed motor capacity in order to evaluate the relationship between HPA and motor capacity. All articles retrieved were reviewed by two independent reviewers and discussed until they reached consensus. Study quality of

**Systematic review of the relationship between habitual physical activity and motor capacity in children with cerebral palsy**

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Objective: To systematically review the available literature on the relationship between habitual physical activity levels (HPA) and motor capacity in children with cerebral palsy (CP) aged 3–12 years for all gross motor functional abilities (GMFCS I–V) compared to typically developing children.

Design: Systematic review.

Method: Searching was conducted on five electronic databases (Pubmed, Cochrane, Embase, Cinahl and Web of Science from 1989 to July, 2013) using keywords ‘children with cerebral palsy’, ‘physical activity’, ‘motor capacity’ and ‘motor function’ including their synonyms and MeSH terms. The inclusion criteria were studies (i) conducted in children with CP aged between 3 and 12 years, (ii) assessed HPA or time spent sedentary (iii) assessed motor capacity in order to evaluate the relationship between HPA and motor capacity. All articles retrieved were reviewed by two independent reviewers and discussed until they reached consensus. Study quality of
How mobile for school are they? Relationship between habitual physical activity, motor capacity, and performance for children with cerebral palsy

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Objective: This study aimed to examine the relationship between motor capacity, performance and their relative contribution to habitual physical activity (HPA), in children with cerebral palsy (CP) at entry to school age (4–5yr).

Design: Cross-sectional study.

Method: Fifty-one children with CP aged 4–5 years, a subset of two birth years of a population based cohort were recruited in this study (NHMRC569665). Participants were 20 females, 31 males, mean age 4 years 8 months (SD=2.31) years (range 5–13yr) and included children at all GMFCS levels (two studies), while three studies only recruited GMFCS level I–III and one of these studies used fundamental movement skills as a capacity measure. HPA measurements were either subjective (Children’s Assessment of Participation and Enjoyment; (CAPE) and a Dutch Questionnaire of Participation in physical activity) or objective (StepWatch, ActiGraph®164). Four studies found that motor capacity was strongly associated with HPA, with independently ambulant children (GMFCS I) higher than marginal ambulators (GMFCS III) (motor capacity was positively correlated with ambulatory activity [StepWatch], physical activity intensity [ActiGraph®] and intensity of participation [CAPE]); while one study reported no relationship between HPA and GMFCS level (HPA was measured by questionnaire, a potential limitation).

Conclusion: There is preliminary evidence for a positive relationship between HPA and levels of motor capacity (GMFCS) in school aged children with CP but no data from objective measures of motor capacity (GMFM). Further studies are required to further elucidate HPA levels (active, sedentary behavior) according to objective motor capacity measures, age and gender to inform healthy lifestyle behavior (active/sedentary) in children with CP.

A novel education initiative enhancing the rehabilitation care of children with cerebral palsy in the Western Child Health Network, NSW

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Objective: This 2 years project (2011–2013), funded through Western Child Health Network (WCHN) and based from The Children’s Hospital at Westmead, sought to improve the rehabilitation care of children with cerebral palsy (CP) through the development of an education intervention targeted at health professionals working with children with CP. The project encompassed the implementation of an education intervention in metropolitan and rural sites in the WCHN; and evaluation of the appropriateness, effectiveness and sustainability.

Design: Descriptive study of an education initiative.

Method: The learning needs of key stakeholders (clinicians throughout the Network) were ascertained prior to implementation through an educational needs analysis survey. This informed the curriculum and education methods. Knowledge
acquisition was assessed through pre and post workshop questionnaires.

Results: Ten education workshops at six key sites in the Network were conducted during the 2 year period, including a regional parent information evening. 235 health professionals attended the workshops in person; 17 joined via videoconferencing. Physiotherapists (38%), occupational therapists (27%) and doctors (19%) made up the majority of participants. Spasticity and dystonia management; classification of CP; therapy interventions and assessments; hip surveillance; oral medications and botulinum toxin-A were identified as the highest priorities. Education methods utilised included lecture-based, small group, practical and clinical sessions. Attendees reported that the workshops met or exceeded their expectations (97%), teaching methods were appropriate (96%) and content was relevant to their clinical workload (89%). Of those participating in the pre/post workshop questionnaires (n=104), 89% had improved their score following the workshop, confirming knowledge acquisition. Scores improved between 22% and 47% at different sites. Resources generated from the project will be made available on the internet. Networking required by this project has facilitated clinically-orientated communication between Kids Rehab and regional agencies.

Conclusion: Education surrounding the rehabilitation of children with cerebral palsy was highly valued by participants in our education initiative, and resulted in knowledge transfer, at least in the short term. This highlights the potential for such initiatives to enhance the rehabilitation care of children with CP in regional and remote areas, particularly where outreach services are not feasible. Further funding is being sought to continue education initiatives.

Incidental findings on hip surveillance in cerebral palsy

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Objective: Hip surveillance is becoming part of routine care for children with cerebral palsy. This paper looks at incidental findings on hip radiographs and highlights the need for comprehensive review of all radiographs and processes in place to action incidental findings.

Design: Prospective review.

Methods: All hip surveillance AP pelvis radiographs taken over a 12 months period (January – December 2012) were identified and reviewed for incidental findings.

Results: During the 1-yr period, 214 children with cerebral palsy (GMFCS I – V: 57; 47; 30; 37; 43; mean age 9yr; range 1–18yr) had AP pelvis radiographs as part of regular hip surveillance. Five children were identified with incidental findings (GMFCS III=2; GMFCS IV=2; GMFCS V=1), a prevalence rate of 2.3%. Of these, incidental findings in four children were identified and followed up through the orthopaedic service at the time of the radiograph. One child was identified and followed up on the audit review of all 2012 radiograph surveillance reports. Incidental findings included Perthes disease; benign exostosis; aneurysmal bone cyst; and traction apophysitis. These findings led to a total of nine additional imaging investigations; six additional clinic appointments; and one surgical intervention. None of the five children had had previous hip surgery or any orthopaedic surgery in the past 12 months.

Conclusion: Whilst hip surveillance is now accepted practice to monitor for silent hip dislocation, clinicians should be aware that surveillance radiographs give rise to an increased risk of incidental findings. Although these findings can be of significant benefit for the patient, there is also the risk of false positives and patients often require additional tests and procedures, referred to as the ‘cascade effect’. We recommend that children and families should be informed of the possibility of incidental finding when they consent to participate in surveillance and that surveillance programmes have protocols in place to identify and manage incidental finding.

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Gait improvement surgery in children with hereditary spastic paraparesis

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Objective: Children with Hereditary Spastic Paraparesis (HSP) present with a similar range of gait disorders and clinical phenotypes to children with Cerebral Palsy (CP). However there is more uncertainty about the natural history of gait and function in HSP which translates to uncertainty about appropriate management, especially invasive surgical procedures. We report the gait and function of 10 children with HSP with short and medium term follow-up based on instrumented gait analysis (IGA).

Design: Retrospective cohort study.

Method: Children with a diagnosis of HSP, based on gait disturbance with no abnormal birth history, normal brain/spine MRI, family history and/or genetic testing were extracted from a clinical database. Children who had a baseline IGA used for surgical decision making and were followed post operatively with accordance to principles derived from the management of children with CP were included. Serial assessment including GMFCS, functional mobility scale (FMS) and Gait Profile Score (GPS) were also recorded.

Results: Ten children had a baseline IGA within 12 months of surgery (T1) and at 12–24 months post operatively (T2). Eight children had an additional IGA at 4–6 years post operatively (T3). At T1, mean (SD) age was 10 years 6 months (2yr 7mo). Two children were classified as GMFCS I, five were GMFCS II and three were GMFCS III.

Seven of 10 children showed a clinically significant improvement in gait parameters at T2 and/or T3 in comparison to baseline, based on a minimal clinically important difference (MCID) of 1.6°. Encouragingly only one of 10 children showed a deterioration in GPS in excess of the MCID. However, given the heterogeneous nature of the cohort and the wide standard deviation at baseline, these values did not reach significance for the cohort as a whole. In terms of mobility assessed by FMS, 5/7 showed maintenance or improvement
on the 5 m scale, 6/7 showed maintenance or improvement at 50 m and 6/7 showed maintenance or improvement at 500 m.

**Conclusion:** For the majority of this cohort of children with HSP gait was maintained or improved following surgery and standard rehabilitation. Individually, some children with patterns such as crouch gait showed very significant improvements in gait and functioning which were maintained at T3. Others with milder gait impairment showed less evidence of change. It would seem appropriate therefore to refer such patients for IGA and consider targeted surgical intervention followed by intensive rehabilitation using protocols based on the management of children with cerebral palsy.

**Classifying cerebral palsy: are we nearly there?**

**A MANDALESON**; **Y LEE**; **C KERR**; **HK GRAHAM**

**Methods:**
A literature search using the term ‘cerebral palsy’ was conducted using the Medline database for studies published between 1 March 2005 and 31 December 2011. Systematic reviews, meta-analyses, review or commentary articles, and/or studies including upper limb studies and papers reporting surgical techniques were excluded, as were outcome studies of botulinum toxin and selective dorsal rhizotomy. Utilisation of the GMFCS was assessed via report of this data in the methods or results section of the latter journal over time.

**Design:** Literature review.

**Results:**
One hundred and fifty-four studies met the inclusion criteria, of which 85 (68%) used the GMFCS. Forty two papers were retrieved for JBJS Am and DMCN, of which the GMFCS was reported in 72% and 88% respectively. In JPO, 51 of the 112 included studies (46%) utilised the GMFCS, however reporting of the GMFCS in JPO improved from 13% to 80% over the 7 years study period. Mean MINORS percentage score for studies reporting GMFCS was 68%, compared to 65% for those not reporting GMFCS. This difference was not statistically significant ($p=0.16$).

**Conclusion:** Utilisation of the GMFCS has increased rapidly over the past 7 years in JPO; however there is room for further improvement. Although non-reporting of GMFCS level did not result in significantly reduced methodological quality, it is recommended that all studies involving children with cerebral palsy utilise this classification tool.

**Adapted Hanen Learning Language and Loving It™ – leading the way to interaction and communication for students with multiple disabilities**

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**Objective:**
This study evaluated the effectiveness of an adapted Hanen Learning Language and Loving It™ (LLLI™) training programme, which aimed to support professionals working with school aged children with severe and multiple disabilities (SMD) in the use of strategies that promote children’s language, literacy and social skills.

**Method:**
Eight teachers from an education support school for students with disabilities took part in the study. The teachers attended an adapted and approved Hanen Centre LLLI™ training programme. Adaptations were made to meet the needs of teachers working with students with SMD. The Teacher Interaction and Language Rating Scale (TILRS) was used to evaluate participants’ interaction and engagement prior to and following participation in the programme. The TILRS rates the frequency and accuracy in using a particular strategy from one to seven. A score of one indicates that the strategy is ‘almost never used’, 3 ‘sometimes used’, 5, ‘frequently used’ and 7, ‘consistently used’. The TILRS was determined by an independent, blinded assessor using videos of teacher:student interactions conducted pre-programme and 7 months post-programme.

**Results:**
Pre and post measures were available for five of the eight teachers who participated. Eight communication strategies were evaluated, resulting in 40 observations. Taking into account all of the strategies together (i.e. N=40 observations) there was an increase in all of the strategies to be ‘frequently’ or ‘consistently’ used post programme. The mean score pre programme was 1.9 (SD 1.0) and following the programme was 5.4 (SD 1.1). The mean change score post programme was 3.47 points which was statistically significant (95% CI 2.93–4.01, $p<0.0001$).

**Conclusion:** The adapted Hanen Centre LLLI™ programme is effective at increasing teachers’ language strategies that promote interaction and communication with students with severe and/or multiple disabilities. The results from this project are limited by the small sample size, lack of control group, and lack of long term follow-up to see if the changes in the use of child-centred strategies were maintained.
Development of a quality manual for the paediatric gait analysis service of NSW

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Objective: The Paediatric Gait Analysis Service of NSW (PGAS-NSW) has clinical and technical components. Formalised national standards for operation of a gait service do not exist in Australia. Quality control and transparency of processes are imperative to ensure safe standards of care. Our goal was to maximise the quality of service provision of the PGAS-NSW.

Design: Documentation, qualitative.

Method: The structure of the manual was based on the ISO15189 standard, used for medical testing facilities. The contents of the manual template were adapted for relevance to the PGAS-NSW. Medical, biomechanical and physiotherapy staff created procedures and protocols specific to their roles, which were approved by the Service director. Audit, equipment and change request templates were adapted from similar documents used by other laboratories within the Kids Research Institute. A master list document was created for document control, to keep track of document updates and dissemination, and a complete list of documents that belong to the Quality Manual.

Results: A manual was created, based on an ISO standard and the policies, procedures, instructions and protocols of the PGAS-NSW. The Quality Manual is read, understood and complied with by the entire staff of PGAS-NSW. Mechanisms were developed to ensure regular and documented quality checks of all aspects relating to the service. As a consequence of having the Quality Manual in place, clear documentation of audits and their findings, protocols, equipment checks and maintenance are available to current and future staff to enhance quality practices within the service. The Quality Manual was designed to ensure that processes and procedures are applied consistently and are reproducible but are also specific, useful and streamlined. The Quality Manual functions as a living document that is continually updated through audits and change requests; instigated from new knowledge about best practise derived internally and from published work.

Conclusion: The PGAS-NSW Quality Manual not only details the quality management system policies of the service but also provides the practical application of our quality objectives via technical instructions and procedures. The Quality Manual is an invaluable tool to help provide the highest standard of service provision. The PGAS-NSW Quality Manual will form the basis of an application for accreditation through the international body "Commission for Motion Laboratory Accreditation".

Adverse events and goal attainment following botulinum toxin A use in children with acquired brain injury and spinal cord injury

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Objectives: The safety of botulinum toxin A has been thoroughly investigated in children with cerebral palsy, however there is much less evidence surrounding its use in children with other neurological conditions. This study aims to assess the frequency and severity of adverse effects following botulinum toxin injections in children with acquired brain injury (ABI) and spinal cord injury (SCI), and provide a description of goal achievement.

Design: Retrospective database audit.

Method: A retrospective analysis of Kids Rehab Database at The Children’s Hospital at Westmead was undertaken to identify children with an ABI or SCI who attend the botulinum toxin clinic between August 2008 and August 2012. Data from these injection episodes had been prospectively collected using a proforma including patient demographic information, health status before and after injection, goals set and achieved, muscles injected and dose. Data were analysed to determine frequency and severity of adverse events in the two populations and goal attainment described.

Results: A total of 49 children with ABI were identified, with a total of 158 injection episodes. Mean age at injection 10 years 3 months (range 3yr 1mo–18yr 0mo). Adverse events occurred following the injections in 33 (21%) injection episodes, most of which were mild and self-limiting (pain 5%, upper respiratory tract infection 4%, excessive local weakness 4%, vomiting 3%). Of the 158 injection episodes, 6 (3.8%) more serious ‘sentinel’ events occurred with five episodes of dysphagia and one episode of lower respiratory tract infection requiring a hospital admission.

Ten children with SCI were identified with a total of 34 injection episodes. Adverse events occurred in eight of these injection episodes, (pain on five occasions, local weakness on two occasions and bladder dysfunction in one occasion). There were no sentinel events.

The most common muscle goals identified in patient with ABI were heels flatter (42%), improve elbow extension (23%) and thumb out of palm (15%). 93% of patients achieved a majority (more than half) of their goals. In patients with SCI, the most common goals were heels flatter (50%), lower limb orthotic tolerance (19%) and more upright stance (17%), with a majority of goals achieved in 90%.

Conclusion: The safety profile of botulinum toxin A is similar to that in the cerebral palsy population. The description of goal attainment in these populations indicates that botulinum toxin is an effective treatment.
Self-concept and quality of life in children with hemiplegic cerebral palsy: is there an association with functional ability?
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Objective: To examine the association between self-concept and quality of life with functional ability in children with hemiplegic cerebral palsy (HCP).

Method: The participants were 107 children with HCP recruited from the South Australian Cerebral Palsy Register. Average age (SD) was 8 years 11 months (3yr 8mo); Male (n=61): Female (n=46) ratio=1.3:1; Right vs left hemiplegia 1.2:1. Self-concept was assessed using the Harter Self-concept scales [The Pictorial Scale for children <8yr (n=42) and the Self-perception Profile for Children >8yr (n=65)]. Quality of life was assessed using the Peds QL version 4 (quality of life) and functional ability assessed by the Assessment of Motor and Process Skills (AMPS) and the Pediatric Evaluation of Disability Inventory (PEDI), self-care section. The relationship between Self-concept and functioning and then quality of life and functioning were investigated using Pearson correlation coefficient. Multiple regression analyses were used to explore the relationship between function and Physical Competence (controlling for the effects of age, motor skills and burden of care) and then function and Cognitive Competence (controlling for age, gender and burden of care).

Results: The Self-concept domains of cognitive and physical competencies correlated significantly with AMPS functioning in younger children (Cognitive Competence r=0.52 p<0.01; Physical Competence r=0.63 p<0.01). The PEDI correlated with Physical Competence in younger children (r=0.54 p<0.01) and quality of life for the total group (r=0.43; p<0.01). The first regression model explained 36.4% of the variance in Physical Competence [F(4,26)=8.4; p=0.001] with the AMPS process score the variable that made the strongest unique contribution to the model (β=0.98; p=0.001). The second regression model explained 30.3% of the variance in Cognitive Competence [F(4,26)=2.83; p=0.045] with the AMPS process score as the variable that made the strongest unique contribution to the model (β=0.621; p=0.022).

Conclusion: These results indicate that a relationship exists between self-concept, quality of life and functional outcome that should be considered when undertaking interventions to improve function in children with HCP. The findings that better process skill ability predicts higher cognitive and physical competencies broadens the perspective that must be taken to understand functioning in children with HCP and has implications for future research.

Demystifying home programmes: resource development for families and clinicians to enhance upper limb intervention and outcomes in children
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Objective: In 2011 a project was established to define barriers for clinicians and families to provide and incorporate an intensive home programme into daily life following upper limb interventions, identify strategies to address these barriers and develop a suitable resource tool. Injections of Botulinum Toxin Type A [Botox] into upper limb muscles is a common intervention to manage spasticity and improve function in children with Cerebral Palsy. Current evidence supports intensive post-Botox therapy to maximize functional outcomes. Families involved in the project reported challenges in embedding intensive therapy into everyday routines.

Design: A needs analysis was undertaken using semi-structured interviews.

Method: The project was undertaken by three undergraduate occupational therapy students, in collaboration with Novita occupational therapists. Semi-structured interviews were conducted with a convenience sample of four Novita occupational therapists and 17 families of children with Cerebral Palsy. The children, aged 2–7 years, all had experienced upper limb botox interventions on one or more occasions.

Results: Families identified time, the range and relevance of activity suggestions as key barriers to implementing an intensive programme. Staff identified time and easy access to home programme resources as particular barriers for them. A book: ‘Home Guide to Therapy: Post Botox Arm Activities’ was developed for families and clinicians. The book contains a wide range of activity ideas that can be embedded into daily life. Photographs for each activity further clarify the descriptions. Activities are arranged into categories according to targeted upper limb movement and activity types. The resource is used across Novita Children’s Services. Families and clinicians report the resource is easy to use, time efficient and comprehensive in tailoring post-Botox intervention to the individual client and family. Resource content will be included in the presentation. In 2013 the first edition was revised and updated, based on experience over an 18 month period. The new edition is now being published to make it more widely available.

Conclusion: The Home Guide is one strategy for addressing barriers to implementing effective home programmes. Families and clinicians at Novita Children’s Services have found the Home Guide an invaluable adjunct to contemporary physical rehabilitation for children with CP.

Activity of allied health therapy funded by Medicare in the assessment and treatment of autism spectrum disorder in Australia in the last 5 years
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Objective: To determine Medicare-funded activity of allied health therapies for children with Autism Spectrum disorder
(ASD) and Pervasive developmental disorder (PDD) in Australia in the last 5 years.

**Design:** Retrospective cohort analysis of published online database via Medicare Australia – Statistics Item reports.

**Method:** Medicare item numbers for allied health practitioners for both the assessment and treatment of ASD in the last 5 years were accessed and analysed using Medicare Australia – Statistics Unit online public database (Items 82000, 82005, 82010, 820030 and 82015, 82020, 82025, 82035)

**Results:** There were over 43 000 occasions of service by allied health practitioners in the assessment for ASD and PDD for children in Australia in the last 5 years – 24 721 of these were from psychologists. In the treatment of ASD, there were 142 878 occasions of service. Speech therapy was the most common treatment, with 93 188 occasions of service at a cost of over $7 million in the last 5 years. For the treatment of children age 0–4 years, Medicare funded 27 960 allied health services and 114 918 occasions of service for children age 5–14 years.

**Conclusion:** There is significant Medicare funded activity in both the assessment and treatment of ASD and PDD for children in Australia. In the treatment of ASD, only 24.3% of allied health occasions of service are for children age between 0 and 4 years.

**Intrathecal baclofen: quality of life and goal attainment outcomes in NSW**

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**Objective:** Intrathecal baclofen therapy (ITB) is one intervention used to manage severe spasticity and dystonia in children with neurological impairment. As an invasive treatment with known benefits and complications, clinical use of ITB in Australia highlights the need for standardised assessment and reporting of adverse events. This led to the development and launch of the Australian National ITB audit tool in 2011 designed to capture outcomes and adverse events data for all Australian children receiving ITB therapy. The Children’s Hospital at Westmead is one of six Australian sites participating in the national study. This paper presents quality of life outcomes and goal attainment data as the initial phase in a broader study to determine clinical effectiveness and impact on caregivers.

**Design:** A NSW based prospective, longitudinal, clinical audit.

**Method:** Participants are children involved in the ITB programme at The Children’s Hospital at Westmead (n=8, mean age at implant=13yr 8mo, male=50%) from 2011 to 2013. All had bilateral involvement with predominant motor type dystonic (n=7) and dyskinetic (n=1), GMFCS levels (IV=6, V=2), MACS levels (III=1, IV=5, V=2) and CFC levels (II=1, III=4, IV=3). Diagnosis included cerebral palsy (n=5) and genetic (n=3). Outcome measures included Canadian Occupational Performance Measure (COPM), Goal Attainment Scaling (GAS), Caregiver Priority and Child Health Index of Life with Disabilities (CPCHILD), Cerebral Palsy Quality of Life questionnaire (CP-QOL) and Care and Comfort Hypertonicity Questionnaire (CCHQ). Clinical outcomes were collected at baseline, 6 and 12 months following pump implant.

**Results:** In the 12 months following pump implant all participants demonstrated a positive change in all quality of life outcomes across all domains. Mean change in COPM Performance scores was 2.2 (SD 1.8) and CPM satisfaction scores was 3.6 (SD 1.5).

**Conclusion:** Data obtained from this NSW prospective study supports worldwide literature on QoL in ITB however until correlates can be made with other patient factors such as movement disorder type, health status, side effects of treatment and adverse events, the complete picture of ITB treatment effects in Australian children and the impact on carers is limited. Further investigation of this will be addressed by pooling data through the National ITB Audit to enable robust statistical analysis.

**The SenScreen Kids – a tool to screen for upper limb somatosensation capacity in children**

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**Objectives:** The SenScreen Sensory Screening Tool (1) is an evidenced based measure of functional somatosensation capacity for adults experiencing somatosensory loss resulting from stroke. The test battery is comprised of five subtests, the Protective Touch Test (PTT), Tactile Discrimination Test (TDT), functional Tactile Object Recognition Test (fTORT), Wrist Position Sense Test (WPST) and Jebsen Taylor Hand Function Test (JTHFT) (1). Our first aim was to adapt the adult SenScreen for paediatric use, and examine the intrarater reliability within a typically developing population. Second, we aimed to characterise the touch, limb position sense and haptic object recognition capacities of typically developing children and adolescents aged 6–15 years.

**Design:** A test-retest design was used to investigate intrarater reliability. A cross-sectional design was employed to determine age related differences in somatosensation.

**Method:** Intrarater reliability was determined by one assessor screening the same children 3 weeks apart (N=22; aged 6–15yr M=8.8 (SD=2.6); female n=14, male n=8). To investigate differences in somatosensation (N=44) we divided children into three age groups 6–7 years (n=15, M= 6.7 (SD= 0.6); female n=7, male n=8), 8–11 years (n=20, M=10.2 (SD= 1.3; female n=12, male n=8) and 12–15 years (n=9, M= 14.0 (SD= 0.8); female n=5, male n=4).

**Results:** High intrarater reliability was established for three [WPST (ICC 0.90), fTORT (ICC 0.76), PTT (%) exact agreement=99%)] of the five SenScreen Kids sub-tests. The JTHFT (ICC 0.38) demonstrated poor intrarater reliability and was removed from the SenScreen Kids battery. The brief TDT (ICC 0.43) also demonstrated poor reliability. Tactile discrimination is considered a vital modality when measuring functional somatosensation capacity therefore was re-examined using guided finger stimulus presentation (N=13, M=12.7
Child quality of life and parent psychological adjustment can be improved with Stepping Stones Triple P and ACT: an RCT

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Objective: To investigate, via an RCT, whether the parenting intervention, Stepping Stones Triple P, and parent Acceptance and Commitment Therapy (ACT) improves child functional performance, child quality of life and parental psychological adjustment in families of children with Cerebral Palsy (CP).

Design: Randomised controlled trial with three groups (SSTP, SSTP+ACT or waitlist control).

Method: Sixty-seven parents (97.0% mothers; mean age 38.72±7.13) of children (64.2% male; mean age 5.31±3.06) with CP (GMFCS I=22%, II=27%, III=18%, IV=27%, V=6%) participated. Participants were randomly assigned to: SSTP (10h group intervention+1h phone consultations), SSTP+ACT (14h group intervention+1h phone consultations) or waitlist control. Outcomes included child functional performance as measured by the Paediatric Evaluation of Disability Inventory (PEDI), parental psychological adjustment measured by the Depression Anxiety Stress Scale (DASS), and child quality of life as measured by the Cerebral Palsy Quality of Life scale (CP-QOL, parent report). A series of ANCOVAs with linear contrasts were conducted (SPSS 17).

Results: There were significant differences between the three groups at post-intervention in child functional performance on the PEDI mobility scale (F=3.59, p=0.03) and child quality of life, including CP-QOL acceptance (F=3.35, p=0.04) and the CP-QOL functioning (F=3.20, p=0.05). Further, there were significant differences in parental psychological adjustment on the DASS depression (F=3.08, p=0.05) and the DASS stress (F=3.53, p=0.03) scales. Linear contrasts revealed significant mean differences between the waitlist group and the SSTP+ACT group, with the SSTP+ACT group showing improvements on the DASS depression (5.33, p=0.017), DASS stress (5.50, p=0.014), CP-QOL acceptance (−9.01, p=0.012) and the CP-QOL functioning (−8.72, p=0.015) scales.

Conclusion: Parenting interventions incorporating Acceptance and Commitment Therapy may be an effective way to improve child quality of life outcomes and parental psychological functioning in families with children with CP. It is recommended that child quality of life is understood within a family context.

Does a motor imagery training programme improve motor imagery and planning abilities in children with spastic hemiplegia?

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Objectives: Previous research has demonstrated that motor planning and motor imagery are impaired in children with spastic hemiplegia, suggesting these deficits may be linked. Our objective was to determine whether a motor imagery training (MIT) programme would result in improvements in motor imagery and/or planning abilities. We expected that MIT would result in significant improvements to motor imagery and planning abilities when compared to traditional perceptual-motor training (PMT).

Design: Randomised controlled trial, where children with spastic hemiplegia were assigned to either MIT or PMT.

Method: Seventeen children with spastic hemiplegia participated; mean age was 10 years 11 months (SD=1yr 6mo); six of the participants were female; all children were ambulatory and without intellectual disability (IQ>70). Motor imagery and planning abilities were assessed pre- and post-intervention using the hand rotation task and an end-state-comfort task respectively. Outcome measures were response time and accuracy for hand rotation and proportion of trials ending in end-state-comfort for the planning task. Both the MIT and PMT programmes utilised the same activities, focusing on upper limb function. These included activities based on peg placement, nut-and-bolt construction, puzzle-board, lacing and tracing. Both groups received video demonstration of the task. The MIT group was then guided through an imagery rehearsal of the activity prior to completing each trial. This was repeated three times. The PMT group had more physical practice (four trials), but no mental rehearsal time was provided. Training for both groups was completed once per week for 5 weeks.

Results: Overall accuracy on hand rotation improved from 73% to 79% in the MIT group, but showed no change in the PMT group, with a mean of 71% both pre- and post-intervention. This difference was not significant (p>0.05). Response time improved slightly in both groups but was also not significant (p>0.05). The proportion of trials ending in end-state-comfort was low in both groups pre-intervention (approx. 40%) and improved only slightly, with no significant group by time interaction (p>0.05).

Conclusion: This study demonstrated that the MIT intervention used did not result in significant improvements to motor imagery or planning abilities when compared to a PMT programme. Given the growing body of research exploring these abilities in children with spastic hemiplegia and suggestions that MIT may be beneficial in improving planning in particular, the lack of improvement is an important finding.
Activity, participation and quality of life in children with cerebral palsy: can a combined approach of strength training and botulinum neurotoxin type-A help?

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Objective: To investigate the combined effects of strength training and Botulinum Neurotoxin type-A (BoNT-A) treatment on activity, participation and quality of life (QoL) in children with cerebral palsy (CP). It is hypothesised that children will show improvements in measures of activity, participation and QoL following the addition of strength training with BoNT-A treatment.

Design: Controlled before and after study.

Method: Three boys and five girls receiving BoNT-A for spasticity management, classified as Spastic Diplegic CP, GMFCS I-II, and aged 5–11 years (mean=8yr 3mo, SD=2yr 2mo) took part in the study. All eight children took part in a 6 months control phase consisting of a normal care routine with their BoNT-A injections. This was followed by an intervention phase whereby they undertook a 10 week individualised lower limb strength training programme, completing up to three sessions weekly either before or after their BoNT-A injection. Activity was assessed via the Timed-Up-and-Go (TUG) and the Six Minute Walk Test (6MWT) participation was assessed with the Assessment of Life Habits for children (LIFE-H) and the Canadian Occupational Performance Measure (COPM) assessed goal attainment across both activity and participation and the Cerebral Palsy Quality of Life Questionnaire for Children (CP-QoL) measured QoL.

Results: Whilst there were no changes in the TUG or 6MWT over the control period, the intervention resulted in a significant improvement in the TUG (p=0.043, ES=0.55), but no effect on the 6MWT at the level of activity. The LIFE-H indicated positive increases in the domains of relationships (p=0.043), nutrition (p=0.017), and education (p=0.037, ES=0.16) after the intervention period, with no changes measured after the control period. CP QoL indicated increases in the areas of family health (p=0.023) and emotional well-being and self-esteem (p=0.053) after the intervention, with no changes reported over the control period. A total of 20 goals were set by the children using the COPM; of these 12 (60%) had a clinically significant improvement in the parent score for satisfaction and 13 (65%) demonstrated a clinically significant improvement in the parents score for performance after the strength training.

Conclusion: By targeting two primary motor impairments of CP; spasticity and muscular weakness with combined interventions of strength training and BoNT-A, this study has demonstrated some positive effects at the levels of activity, participation and QoL. In view of reports of decreasing participation and QoL over time for children with CP, these results are encouraging.

Age-related changes in kinematic, kinetic and temporal-spatial data

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Objective: Normative data sets are necessary in diagnosing and comparing gait abnormalities, however few studies have compared kinematics and kinetic data across different paediatric age groups. The purpose of this investigation was to understand age related changes in kinematic, kinetic and temporal-spatial gait parameters across children aged 4–16 years in order to provide appropriate age-matched comparisons for pathological gait.

Design: Descriptive study.

Method: Fifty typically developing children with a mean age 9 years 10 months (3yr 10mo), mean height 140. Two centimetre (19.6) and mean body mass 39.0 kg (19) were recruited through distribution of flyers and circulars throughout the Children’s Hospital at Westmead. Kinematic, kinetic and temporal-spatial data were collected using Vicon Nexus motion capture system. Fourteen retro-reflective markers were positioned using the lower body Plug-in-Gait model. Participants were asked to walk barefoot at a self-selected pace along an eight metre walkway. At least nine successful trials were captured for each foot and the average trial from the right side was then calculated and analysed. Temporal-spatial parameters, peak flexion/extension angles, moments and powers and the timings of all peaks were calculated. Data were tested for normal distribution using the Kolmogorov–Smirnov test. Statistical analysis using either Pearson or Spearman’s test (for normally distributed or non-normally distributed data, respectively) was performed to identify correlations between variables of interest and age.

Results: Age related changes in 10 key temporal-spatial, kinematic and kinetic events were found with a strength agreement of r=0.5 or greater. Step length and stride time increased with age whereas cadence and single stance phase decreased with age. Peak hip and knee flexion in swing reduced with age and peak knee extension in stance increased with age. Peak hip flexor moment and ankle plantar flexor moment reduced with age and maximum hip abductor moment increased with age. A strong quadratic relationship was present between maximum ankle plantar flexor moment and age (R²=0.7).

Conclusion: Age related changes in kinematic, kinetic and temporal-spatial data were identified. Age related normative databases should be considered when comparing paediatric pathological gait for clinical gait analysis.
Effect of using thigh wands compared to flat-based markers on three dimensional gait analysis hip rotation measures

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Objective: Thigh marker placement protocol in similar clinical services locally and internationally was identified as different to our current practice. We found a lack of evidence for changing from a flat-based marker on the thigh to markers on a wand, or the effects of this change on hip rotation data. The purpose of this investigation was to evaluate the effect of changing the type of marker used on the thigh, and the position of the thigh marker on the resulting hip rotation measurement.

Method: Phase I included 11 children (four females) mean age 14 year 6 months (3yr 10mo), mean height 156.7 cm (10.8) and mean body mass 49.7 kg (12.4) who were scheduled for routine clinical gait analysis. Phase II included eight female able-bodied adults affiliated with the service (sample of convenience), mean age 32 years 5 months (6yr 4mo), mean height 168.3 cm (2.2) and mean body mass 62.7 kg (7.9). Kinematic data was collected using Vicon Nexus motion capture system using the Plug-in-Gait model. For phase I, two additional custom made wand markers were attached to the front of the thigh at the same height as the flat-based markers. For phase II, wand (right leg) and flat-based (left leg) markers were placed in the anterior and lateral positions. Walks were processed firstly in the lateral and then in the anterior position of the markers. Average gait traces with one standard deviation were visually inspected to identify differences between (i) wand and flat-based marker data in patients and (ii) wand and flat-based marker position in able-bodied participants. Knee varus/valgus and hip rotation kinematic data were compared.

Results: Patient data revealed minimal difference between marker type in stance phase. During swing phase the flat-based marker showed an increased peak in knee varus and internal hip rotation compared to the thigh wand. The range for both knee varus/valgus and hip rotation was reduced for the wand marker compared to the flat-based marker. In the able-bodied data minimal differences between the lateral and anterior positions of the thigh wand were observed across the gait cycle for both variables of interest.

Conclusion: Minimal differences were identified between the flat-based marker and wand marker during stance phase. Therefore placing a wand marker on either the lateral or anterior position of the thigh will not affect the clinical interpretation of hip rotation kinematics.