The 4th National Paediatric Physiotherapy Conference was held over three days in Melbourne from September 10 to 12, 2001. The Conference theme, ‘Old Issues – New Focus’, was chosen to reflect our desire to re-examine, in the light of new research, some of the major issues that confront paediatric physiotherapists in their clinical practice. Special multi-disciplinary symposia on ‘Measurement Tools’ and ‘Disability and Policy in the 21st Century - Refocus on an Old Issue’ were held prior to the Conference. Pre- and post-conference workshops addressed adolescent sporting injuries, post-traumatic health and pain, seating, spinal care for children and splinting.

The two keynote speakers were Dr Susan Harris, Professor at the School of Rehabilitation Sciences at the University of British Columbia, Vancouver, Canada and Dr Eva Bower, Senior Lecturer at the University of Southampton Rehabilitation Unit, UK. Other nationally and internationally recognised speakers were invited to contribute to plenary sessions and workshops. There were 270 delegates, more than 200 of whom attended the whole conference. Delegates were from all regions in Australia, New Zealand, Malaysia, and Singapore.

The Symposium on Measurement Tools focused on the critical issues of measurement of performance and outcomes in children following particular interventions. The presenters discussed currently used clinical tools as well as emerging measures made possible through technological advances. Each day of the conference had its own sub-theme. On Day 1, ‘Getting a good start’, the presentations were directed towards the role of early physiotherapy intervention for children with developmental disabilities. Day 2 had as its focus ‘The school child in the computer age’ and the presentations and workshops were about therapeutic exercise and the role of exercise in the promotion of good general health. The theme of Day 3, ‘Adolescence: health non-compliance’, highlighted the importance of transition from school to the community. Of the 51 original papers presented at the Measurement Tools Symposium and Conference, only the peer-reviewed abstracts of the podium presentations are contained in this supplement, owing to lack of space. The proceedings of the Symposium on ‘Disability and Policy’ can be viewed on the Australian Physiotherapy Association website. They reflect the diversity of clinical practice in paediatric physiotherapy and the growing sophistication of its scientific basis.

Professor Mary Galea
Chair, Scientific Committee
**SETTING THE SCENE**

**OVERVIEW OF THE PURPOSES OF TESTING**

**Objective:** The goal of this presentation is to provide an overview of the purposes of testing, according to Kirshner and Guyatt (1985). Three purposes of testing will be defined: 1) to discriminate; 2) to predict; and 3) to evaluate change. Objectives of each of these types of tests will be provided as well as paediatric examples. **Definitions:** Discriminative tests are those that are designed to distinguish between individuals with and without a specific problem or function. Predictive tests classify individuals into a set of pre-defined measurement categories, either concurrently or prospectively. Evaluative tests are designed to measure change in function over time or with intervention. **Conclusions and Recommendations:** The presenter will describe how certain well-known paediatric tests have been mis-used, according to the Kirshner and Guyatt classification system, by well-known developmental researchers who have examined the effectiveness of early physiotherapy interventions during the past 20 years. The correct usage of tests, for the purpose(s) for which they were initially designed, will be stressed as a “take-home message” of this presentation.

**DEALING WITH MEASURES - AN EPIDEMIOLOGIST’S VIEWPOINT**

**Eve Blair**

**TVW Telethon Institute for Child Health, Perth**

**What is a measure?** A measure ascertains the magnitude of something by using a measuring instrument to make a comparison with an external standard. **Why do we measure?** We measure in order to introduce precision and objectivity into our observations. Precise and objective descriptions facilitate accurate communication and comparison. The dimensions we measure and the optimal methods and context of measurement are dependent on the goals we wish to achieve. Possible goals are very diverse and include such activities as tracking the progress of an individual patient, describing a patient to other members of a management team, evaluating a management strategy, identifying patients to whom the results of a published study may be applied. **What do we measure?** In paediatric management subjects, interventions and a range of outcomes may require measurement. The choice of outcomes is particularly broad. The most relevant outcomes may be subjective and non-quantifiable and it is these that present the greatest challenges to valid and reliable measurement. However, it is important that outcomes are chosen for their relevance to the goals rather than for ease of measurement. **How do we measure?** The optimal characteristics for a measurement tool vary with the reason for making the measurement, but all need to deliver valid (observers agree on the value of the measurement) and reliable (the measure measures what it is believed to measure) measurements. It is particularly challenging to meet these characteristics for the measurement of non-quantifiable and/or subjective outcomes, but even in these situations validity may be assessed by using inter observer reliability studies. Once the tool has been chosen the methods of its application remain important, as even the best measurement tools can only produce valid measurements when applied appropriately.

**TECHNOLOGY AND MEASUREMENT**

**ASSESSMENT OF CHILDREN’S SWALLOWING USING VIDEO FLUOROSCOPY**

**Katherine Ong and Libby Ferguson**

**Royal Children’s Hospital, Melbourne**

The videofluoroscopic swallowing study (VFSS) has been the gold standard for assessing pharyngeal swallowing function in both children and adults. VFSS has been used with children with cerebral palsy for some time and is increasingly used with a wider range of children including the neo-natal population. It allows detailed study of the dynamics of the pharyngeal swallow over a range of variables, including movement of oral structures, timing of initiation of the swallow, pooling in the pharynx prior to the swallow, laryngeal penetration and aspiration of food or drink into the trachea etc. The VFSS will be compared with the standard barium swallow and other tests of swallowing function. Advantages and disadvantages of VFSS will be outlined. Brief case material will be presented.

**THE ISMAR - A TOOL FOR DEVELOPING SKILLS IN SALIVA CONTROL, MEALTIMES AND SPEECH**

**Hilary Johnson¹ and Dinah Reddihough²**

¹Severe Communication Impairment, Outreach Projects, Melbourne, ²Royal Children's Hospital, Melbourne

**Objective:** To investigate the effects on dribbling, eating skills and speech development by introducing an orthodontic appliance (the Innsbruck Sensori-Motor Activator and Regulator, known as the ISMAR). **Design:** A group intervention study using the subjects as their own controls. **Method:** Subjects were 20 children with cerebral palsy aged between 4 and 14 years. Selection criteria included dribbling; breathing through the nose; being able to co-operate with the fitting of an intra-oral device; having parents or carers willing to attend the Royal Children’s Hospital every six weeks. The study took 18 months to complete. There were three stages of six months each. These were the control stage, the jaw stabilisation phase and the mobilisation phase. The assessments were completed at the beginning of each stage and on completion of the project. Assessments were carried out by a speech pathologist and a dentist. The Multidisciplinary Feeding Profile (Kenny et al 1989) was chosen for its quantitative assessment of feeding covering six areas. The drooling was rated by the parent and in one other environment of the child (eg by a teacher at the school). The rating was on a five-point scale for severity and a four point scale for frequency (Thomas-Stonell and Greenberg 1988). Any changes in speech were recorded, articulation skills were assessed (Atkin and Fisher 1996) and occlusion was measured (Proffit 1993). A questionnaire (including the parents’ perception of the problem) was completed with the parent to provide additional data for triangulation. After the control period at six months the ISMAR was constructed and inserted. The parents inserted the appliance on a daily basis. Once a subject could tolerate it for 20 minutes, overnight wearing was introduced. At the end of a further six months alterations were made to the device to assist in the further development of fine oral
motor control. The parents completed a diary of ISMAR use. Final assessments were made at 18 months. Results: Improvements were reported by 15 of the 20 children. Only nine children remained in the study. Exit interviews reveal a variety of reasons for leaving the study, including child refusal to wear the device, unstable epilepsy, Baclofen trial, metabolic therapy and URTI. Conclusions: Although the ISMAR can help with the development of oral skills, it is a long-term therapy and demands considerable commitment from the family.

HIP DISPLACEMENT IN CHILDREN WITH CEREBRAL PALSY: STATE OF THE ART
Roslyn Boyd, Fiona Dobson, Jennifer Parrott, Gary Nattrass and H Kerr Graham
Royal Children’s Hospital, Melbourne

Hip displacement is a common problem (Scrutton et al 2001) and, as delayed detection can lead to disastrous consequences, the challenge for the clinician is when to commence surveillance and how frequently to monitor children at risk. The aim of hip surveillance is to refer children young enough for preventative intervention to be taken. In order to recruit children for a prospective randomised study, a hip surveillance clinic commenced in Victoria in 1997. This was followed by hip surveillance clinics being developed in Tasmania, Western Australia and New South Wales as part of a multi-centre trial. Recently we reviewed the three-year outcomes of the Victorian clinic. Methods: Children with predominantly spastic type CP with motor delay or signs of hip displacement were referred to the clinic. This included 133 children with a mean age of three years, nine months (range 13 months to 15 years). All children underwent a clinical history, objective clinical examination and an anteroposterior pelvic radiograph. Standardised radiological measures included Migration Percentage (MP) and Acetabular Index (AI). Children were classified according to MP at presentation into three risk groups. Results: There were 35 children (26%) under 30 months with a mean MP of 30% (range 0-67). From these, 31/35 (89%) were true positives of hips at risk with a mean MP of 33% (range 9-67) and only 4/35 (11%) were false positives with a mean MP 2% (range 0-7). Thirteen children (37%) under 30 months were fast tracked to surgery with a mean MP of 47% (range 33-67). There were eight children (6%) from the total of 133 under the age of 18 months at referral with a mean MP of 22% (range 0-48). Four children (50%) under 18 months were fast tracked to surgery with a mean MP of 38% (range 31-48). There were three false positives with MP ranging from 0-7%. A total of 44 children were fast tracked to preventative surgery at a mean of 12.1 weeks (range 0-28) post initial detection. In order to detect change accurately over time, radiographic quality and positioning of the child needs to be consistent. Furthermore, all radiographs are measured by the physiotherapist with training in x-ray measurement and, where possible, repeat radiographs are measured by the same person in order to reduce error and improve the repeatability (Parrott et al 2000). Clinical implications/recommendations: The co-ordinated Hip Surveillance Clinic, run by physiotherapists in collaboration with orthopaedic surgeons, has a streamlined “user-friendly” profile aimed towards the early detection of hip displacement. We recommend children with bilateral cerebral palsy should have a pelvic radiograph at no later than 18 months of age and have regular follow-up surveillance with repeat radiographs every six months. Children with hemiplegia should have surveillance from age five years, as there is a risk of late silent displacement in early adolescence. Standardised protocols for positioning for x-ray and measuring MP and AI should be used. Serial x-rays should ideally be measured by the same person, to reduce error.

DATA SYSTEMS, CLASSIFICATION AND MEANINGFUL INFORMATION
A COMPARISON OF TWO MOTOR SEVERITY INDICES: THE STANDARD RECORDING OF CENTRAL MOTOR DEFICIT AND THE GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM
Eva Bower
University of Southampton, UK

The terminology used to describe children with cerebral palsy has never been successfully standardised. Maybe the time has come to use standardised functional motor severity indices when describing such children. Objective: To compare the discriminatory capacity of two different motor severity indices developed for children with a neurological deficit. Design: A retrospective survey of the results of 55 children classified on two different severity indices. Method: Participants were 55 children, each selected by a different physiotherapist for participation in a randomised controlled trial. All the children had a diagnosis of bilateral cerebral palsy and were aged between three and 12 years. The children's motor functional status was classified on the Standard Recording of Central Motor Deficit, Sections 5-7 (SRCMD, Evans et al 1989) and the Gross Motor Function Classification System (GMFCS, Palisano et al 1997) by the researcher and the child's own physiotherapist before entry to a randomised controlled trial. Results: Ten children classified at Level 5 on the GMFCS all had a total score of 14 on the SRCMD, 28 children classified at Level 4 had a mean score of 11.4 (range 10-13), 13 children classified at Level 3 had a mean total score of 9.4 (range 9.10) and four children classified at Level 2 all had a total score of 7. Discussion: The differences in children classified on the SRCMD who were at Level 4 on the GMFCS were largely in trunk control/sitting abilities. The differences in children classified on the SRCMD who were at Level 3 on the GMFCS were largely in upper limb function. Conclusion: In these children, the greatest agreement in classification on the two severity indices was found in the least and most affected children. Further research may be needed to add precision to descriptions of children with intermediate levels of disability.

THE MYELODYSPLASIA DATABASE - WHAT HAVE WE LEARNT FROM IT?
Sharon Vladusic and Cathy Abery
Royal Children’s Hospital, Melbourne

Over 20 years ago, the late Malcolm Menelaus, orthopaedic surgeon, travelled overseas and saw at first hand the benefit of annual assessments for children with spina bifida. Subsequently, the Royal Children’s Hospital Melbourne became part of the International Myelodysplasia Study Group (IMSG), which is based in Seattle, USA. This service is considered a core clinical and research service at the Royal Children’s Hospital for a complex population of children and adolescents across Victoria. Research: The information collected from the database has been responsible for many research studies that have both defined the natural history of children with spina bifida and evaluated outcomes following interventions. Highlights of this published research include the management of the hip in myelomeningocele, and the natural history of hip and knee deformities in myelomeningocele. These long-term, multi-centre studies and
resultant publications have altered the orthopaedic management of children with myelodysplasia and provided a benchmark in terms of world’s best practice. Our current research focus is in tethered cord syndrome (TCS) in children with myelodysplasia. TCS is characterised by a progressive neurological deterioration and subsequent loss of physical function. As physiotherapists, we would like objective measures that anticipate rather than confirm neurological deterioration and thus allow earlier intervention and improved clinical outcomes for the child. A preliminary study in 1999 investigated if TCS could be predicted in a child with myelomenigocele by assessing growth parameters. It was concluded that further studies on the possible predictive factors in TCS are required. Currently, the natural history of muscle strength in children with myelodysplasia is being investigated and compared with those children diagnosed with and treated for TCS.

**Clinical:** The IMSG is also an invaluable tool in providing objective and regular monitoring of children with myelodysplasia through the use of a standardised comprehensive clinical assessment. The assessment takes approximately 1 hour for an experienced physiotherapist to administer and provides valuable clinical information, which is then conveyed to the relevant medical professionals. The IMSG does, however, have its limitations, including a lack of functional tests, and some components are not sensitive enough to detect minor change, eg muscle strength grading. **Conclusion:** The IMSG is an important research tool that has huge potential for future research across a number of disciplines. The focus, however, needs to move towards developing simple and inexpensive functional tests that are sensitive to change in children and adolescents with myelodysplasia and can be used in all clinical settings.

**UPDATE ON MEASUREMENT TOOLS**

**THE UTILITY OF THE FUNCTIONAL INDEPENDENCE MEASURE (FIM) IN MEASURING OUTCOMES IN SCHOOL-AGED CHILDREN WITH CEREBRAL PALSY**

Maree Dyson1, Felicity CL Allen2 and Anita Ghose3
1 Dyson Consulting Group, Melbourne, 2 Monash University, Melbourne, 3 Cerebral Palsy Association of Western Australia

**Objective:** To investigate the potential utility of the Functional Independence Measure (FIM) as a measure of outcomes amongst school-aged children with cerebral palsy. Design: A prospective design involving repeat assessments using the FIM, with 12 months elapsed between assessments. The FIM measures independence in self-care, sphincter control, mobility, locomotion, communication and social cognition. **Method:** The study was conducted with school age therapy services division of the Cerebral Palsy Association of Western Australia (CPAWA). Participants were all children receiving therapy services (occupational therapy, physical therapy and speech pathology) over a 12-month period in 1998 and 1999. The main outcome measurement was the difference between the FIM scores on the first and second assessments. **Results:** This study demonstrated a high degree of criterion (concurrent) validity, scale internal reliability and test re-test reliability when the FIM was applied to school-age children with cerebral palsy. The FIM was able to detect significant changes in functional skills in school-age children with cerebral palsy over a 12-month period ($t = -9.33, df = 134, p < 0.001$). Questions are raised in relation to sensitivity of the FIM where children have profound, multiple disabilities. **Conclusion:** The FIM has potential to be used as one of a suite of outcome measures in the evaluation of outcomes amongst school-aged children with cerebral palsy. Further investigation is warranted before this potential can be assured.

**MEASURING THE EFFECTIVENESS OF THERAPY IN THE COMMUNITY**

Tim Connell and David Farrington
Crippled Children’s Association of South Australia Inc.

**Objective:** The general aim of the project was to explore methods for routinely evaluating global progress of children with cerebral palsy who received physiotherapy, occupational therapy and speech therapy in a community setting. Sensitivity to change and comprehensiveness without being unduly complex and time-consuming are essential if such procedures are to be routinely used. While various outcome measurement procedures have been described in the literature, their suitability for routine use can only be established by trying them out, and looking at the results.

**Design:** Pre-test/post-test study with established, reputable and newly created evaluation tools. Whether the newly created Crippled Children’s Association (CCA) Therapy Outcome Scales were sensitive to change, and valid in terms of association with reputable scales was assessed. **Method:** A stratified (by severity), random sample of 42 children, between three and nine years of age, receiving therapy across three therapy disciplines (physiotherapy, occupational therapy and speech therapy), was recruited and assessed over a pre-test/post-test interval of six months. The therapist completed specially created rating scales (CCA Therapy Outcome Scales). A research assistant and a research psychologist administered three reputable validation measures, the Vineland Adaptive Behaviour Scale, the Wee FIM and the Gross Motor Function Measure (GMFM). **Results:** Vineland and GMFM significantly detected greatest change. Wee FIM and CCA Therapy Outcome Scales were insensitive to change. Greatest change revealed by Vineland and GMFM instruments occurred among children with mild to moderate physical disabilities. Criterion instruments significantly discriminated between disability levels (mild, moderate, severe and multiple). Frequency with which particular goals were targeted by therapist was identified. **Conclusions:** These findings have two important practical implications. Firstly, any outcome measurement instrument needs to have the level of detailed skill/activity breakdown used in the GMFM or Vineland to detect change in this group. While the Wee FIM appears to be winning acceptance as a brief, comprehensive outcome measure, this study found that it did not have the sensitivity to reveal the outcomes actually being achieved by these children. Secondly, the mild and moderately disabled younger children appear to have the strongest potential to make functional gains from therapy, compared with more severely affected children.

**UPDATE ON RESEARCH ACTIVITIES**

**TIMED UP-AND-GO TEST IN CHILDREN: TUG FOR CHILDREN WITH DISABILITY**

Elizabeth Williams, Sara Carroll and Mary Galea
The University of Melbourne

**Objective:** Our earlier studies have shown that the Timed Up-and-Go test (TUG), a test of balance commonly used to examine functional mobility in frail elderly, modified for children, is a reliable, sensitive and simple measure of functional mobility in children between three and nine years. It was hypothesised that it would be useful as an outcome measure in clinics, home or school for children with physical disabilities. This study was conducted to compare the results of the TUG in disabled children with those of normal children of the same age. **Design:** A comparative study of the TUG in normal and disabled children. **Methods:** Subjects were 10 children with disabilities, seven with cerebral palsy and
three with spina bifida, recruited from the Royal Children's Hospital and special schools, classified according to diagnosis and severity. Ethics approval and informed parental consent was obtained. A modified protocol of the TUG for children was used, with scoring in seconds to one decimal place by the same examiner. The children performed three TUG tests sequentially, then repeated these on the same day half an hour later. Testing was in the same setting for each child and performed in usual footwear, and with gait aids or walkers if used. Scores were then compared with those of children of the same age in the normative study. Results: The age range for the cerebral palsy group was three to six years, mean 4.8 years. Three had spastic hemiplegia (one mild, one moderate and one severe), two had spastic quadriplegia (one mild and one moderate), one had severe spastic diplegia and one had moderate athetosis. The children with hemiplegia and the child with mild spastic quadriplegia, in ankle foot orthoses, were not significantly different in scores or variability from normal children of the same age. The children with moderate spastic quadriplegia, severe spastic diplegia and athetosis were very much slower with greater variability in performance. The children with spina bifida were six, 11 and 18 years old, all with low lesion levels (sacral). The performance of the six-year-old was comparable with that of his age-matched peers, while the older children performed at levels comparable with eight-year-old normal scores, with minimal variability. Conclusion: The TUG test is a simple and appropriate test of functional mobility in children with disabilities, even the very young. It is sensitive to the severity of the child's disability, while providing an objective outcome measure. Further work is currently being undertaken on the use of the TUG in the disabled population.

THE INTER- AND INTRA-RATER RELIABILITY OF THREE CLINICAL MEASURES IN THE LOWER LIMB FOR CHILDREN WITH CEREBRAL PALSY
Adrienne L Fosang1, Mary P Galea2, Dinah Reddiough1 and Anne McCoy1
1 Royal Children's Hospital, Melbourne 2 The University of Melbourne

Objectives: To determine the reliability and magnitude of error of three lower limb clinical measures for children with CP: 1. Modified Ashworth scale of Spasticity (MAS). 2. Passive Range of Movement (PROM or R2). 3. Dynamic Catch Range of Movement (Modified Tardieu Scale: MTS or R1). Design: Repeated measures design with all data collected over six days. Time interval for between-rater testing was one to two days. Time interval for within-rater testing was three days. Method: Six physiotherapists measured 18 children with CP, whose severity spanned the five levels of the Gross Motor Function Classification System. Subjects were selected to ensure a broad range of age (median 6.7 years; range 2-10 years) and severity for children with CP and physiotherapists were chosen for paediatric experience (median 10 years; range 4-21 years). Nine lower limb measurements were recorded twice by each therapist for each child. Measures of MAS, PROM and MTS were recorded in tandem with activity diaries and Uptimer recording in order to validate the Uptimer. Results: Mean proportion of uptime (as measured by the Uptimer) was 22.5% (5.4 ± 1.3 hours) over a 24 hour period. Uptime followed a normal distribution in this population and did not have a linear relationship with age, height, weight or BMI. The approximate four-fold difference observed in levels of uptime between the lowest 2.5% and the highest 2.5% may be indicative of hypokinetic diseases at the lowest levels and hyperkinetic diseases at the upper limit. In the validation study the average level of uptime (as measured by the Uptimer) was 37% of the four hours. This measurement did not differ on average from the measurement of uptime as recorded by behaviour mapping (mean of differences = -0.5%, SD 7.2%) or by questionnaire (mean of differences = 0.8%, SD 10.7%). There was evidence of a moderate tendency for the behaviour mapping to underestimate uptime with smaller proportions of uptime and overestimate uptime with larger proportions of uptime (correlation between means and differences of the Uptimer and behaviour mapping measurements \( r = -0.48, p = 0.012 \)). This pattern was stronger when...
the activity diary was used to measure uptime ($r = -0.74$, $p < 0.0001$). **Conclusions:** Children aged between eight and 15 years spend on average approximately 5.4 hours of a typical school day upright. The Uptimer is a valid tool for measuring time in this population. The results of this study have been used as a normative database for the evaluation of uptime in children with physical disabilities.

**A MEASURE OF PARENTS’ PERCEPTION OF FUNCTIONAL CHANGES IN CHILDREN WITH CEREBRAL PALSY**

Pam Thomason¹, Adrienne Fosang¹, Anne McCoy¹, Dinah Reddihough¹ and Mary Galea²
¹Royal Children’s Hospital, Melbourne; ²The University of Melbourne

**Objectives:** To validate a measure of parental perception of physical function, the Parent Perception Questionnaire (PPQ) in children with cerebral palsy (CP) by establishing whether: parents’ perception of physical function correlates with findings on the Gross Motor Function Measure (GMFM); the PPQ can discriminate between differences in severity as measured by the Gross Motor Function Classification System (GMFCS); and the PPQ can demonstrate changes over time. **Design:** The opportunity to assess these objectives was through participation in a larger study investigating the role of Botulinum toxin A (Botox) in the treatment of young children with CP. This was a randomised crossover trial where one group received Botox and physiotherapy (the intervention period) while the other group received physiotherapy alone (the control period), during each of two six-month periods. **Method:** Fifty children with spastic diplegia or mild or moderate quadriplegia, aged between 18 months and six years 11 months, were consecutively recruited. The two study groups were matched for age and functional level using the GMFCS. The PPQ and GMFM were administered on four occasions. Assessments were carried out at study entry, at six months, 12 months, and at the mid point of the intervention period (either three months or nine months). An additional assessment was added, at the mid-control point, which 19 children completed. **Results:** Pearson correlation coefficients comparing PPQ scores with GMFM scores for each assessment time were moderately strong for PPQ and GMFM total scores, fair for GMFM with gait aid, and very good for GMFM with no aid. The PPQ and GMFM goal scores were poorly correlated and did not reach significance. A univariate analysis of variance for both the PPQ and the GMFCS as a factor and age as a covariate for each assessment time showed that there was a significant difference in both GMFM and PPQ scores between the GMFCS levels. However a pair-wise comparison revealed that, for the PPQ, there was no significant difference between Levels I-II and II-III with an inconsistent result for Levels I-III. A significant difference was found between all Levels for the GMFM, except at six months between Levels II and III. Repeated measures analysis for both the GMFM and PPQ over both the intervention and control periods and the total 12-month study period showed a significant change over time for the intervention period and 12-month study period. However, the PPQ did not demonstrate a significant change over the control period, in contrast with the GMFM. **Conclusion:** The results have established that the PPQ correlates moderately well with GMFM total scores. It has some discriminative ability but is not sensitive enough to discriminate between all GMFCS levels. The PPQ demonstrated change over time, though this may be affected by parent expectation or bias. The PPQ could be used to evaluate the functional outcome in children with cerebral palsy. However, the sensitivity still requires evaluation.

**Day 1 - Monday, September 10, 2001**

**KEYNOTE ADDRESS**

**CHALLENGING MYTHS IN PHYSICAL THERAPY**

Susan R Harris

University of British Columbia, Vancouver, Canada

This provocative keynote address will explore and challenge myths surrounding physical therapy practice. A myth has been defined as “an ill-founded belief held uncritically, especially by an interested group” (Webster’s Seventh New Collegiate Dictionary 1963). Like many other health professionals, physical therapists have held tight to beliefs that are now being explored, and in some cases exploded, by research. These include commonly-held beliefs that more treatment is better than less treatment, that physical therapy treatments are better than chiropractic treatments, that strength training is inappropriate for children and adults with CNS disorders, and that measurement techniques used to determine who will or will not need treatment are both reliable and valid. Audience participation will be encouraged as part of this session. **Objectives:** At the completion of this session, participants will be able to: define evidence-based practice and describe its relevance to challenging myths in PT; list Sackett’s five levels of evidence and describe their importance in categorising experimental research; and cite and discuss at least two recent studies that have challenged longstanding myths in physical therapy.

**PLENARY SESSIONS**

**ANIMAL MODELS OF DEVELOPMENTAL DISABILITY**

Sandra Rees

The University of Melbourne

**Objective:** There is now compelling evidence to support the view that adverse prenatal conditions are important antecedents of neurological impairment such as cerebral palsy and schizophrenia which manifest during postnatal life. Determining how specific insults, induced at various stages throughout gestation, affect the structure and function of the developing brain is therefore of importance to understanding how these disorders might develop. **Design:** Our approach has been to develop animal models of acute and chronic intrauterine compromise which mimic situations which could occur in pregnancy. They include insults which reduce the supply of oxygen and nutrients to the foetus, namely brief umbilical cord occlusion (10 minutes) and chronic placental insufficiency (20 days) in late gestation; exposure of the foetus at 0.7 gestation to repeated doses of lipopolysaccharide (LPS) which mimics foetal infection and the inflammatory response. **Results:** In relation to the effects of hypoxemia and malnutrition on the brain, we have shown that neurons in general can survive a chronic insult if it is of a relatively low level; they will die, however, if there is a sudden drop in arterial oxygen saturation. Neuronal migration will also be affected by rapid onset hypoxemia but not by chronic mild hypoxemia. The growth of neural processes (axons and dendrites) will be significantly retarded in the long term if acute or chronic hypoxemia occurs at an early stage of their growth but they can recover if development is advanced at the time of hypoxemia. Following chronic placental insufficiency, we have observed enlargement of the lateral ventricles probably resulting from reduced growth of neural processes. Ventriculomegaly is one of the most consistent findings in the brains of patients with schizophrenia. Significant
damage can occur to regions of the white matter when there is a rapid drop in oxygen saturation or if there is severe hypoxemia. In chronic mild hypoxemia, myelination will be retarded. Foetal exposure to LPS results in inflammation of the brain with gliosis, diffuse white matter damage and in some cases, periventricular leucomalacia (PVL). PVL is a “hallmark” periventricular infarct seen in cerebral palsy and prenatal birth injury. Conclusions: We have demonstrated that the duration and type of insult and the gestational age at which it occurs are significant parameters in determining the extent of damage to neurons and neuronal connectivity; ultimately this will determine the functional capacity of the individual postnatally. By comparison with neuropathologies in neurological disorders we are beginning to define the types of insults which could underlie these disorders.

EPIDEMIOLOGY AND CAUSES OF CEREBRAL PALSY
Dinah Reddihough
Royal Children’s Hospital, Melbourne

Cerebral palsy is the commonest physical disability in childhood. Studies from Western Australia, Sweden, the United Kingdom, and the United States have shown that the prevalence of cerebral palsy is between 2.0 and 2.5 per 1000 live births. While the overall prevalence has remained stable or increased since 1970, there has been a change in the relative contribution of the various sub-types including a consistent rise in the prevalence of cerebral palsy among low birth-weight infants. There are major gaps in our knowledge about the causes of cerebral palsy which remain unknown in a large proportion of children. In a large proportion of children with cerebral palsy, there appears to have been no single event but rather a sequence of events responsible for the motor damage. This has led to the concept of “causal pathways”, a sequence of interdependent events culminating in disease and being responsible for many cases of cerebral palsy. Birth asphyxia, previously thought to be a major determinant, is now considered to account for less than 10% of all cases. Recent research suggests that prenatal factors are of major significance and 75% of all cases of cerebral palsy arise from events during this period. Prenatal causes include: malformations identified by imaging techniques; evidence of previous vascular events such as middle cerebral artery occlusion; maternal infections; metabolic disease; and toxins. Postnatal cerebral palsy accounts for about 10% and infection and injuries are responsible for most cases. Premature infants are at particular risk for cerebral palsy. For infants born before 33 weeks, the rate is up to 30 times higher than those born at term. The diverse reasons for cerebral palsy in this group will be discussed. There is also an increased risk of cerebral palsy in multiple births that are associated with preterm delivery, poor intrauterine growth, birth defects, intrapartum complications and intrauterine death of a co-twin. Ongoing research to determine further causes of cerebral palsy is essential. This is the first step in the task of developing strategies for prevention. Knowledge of the causes is also vital for families and individuals with cerebral palsy.

RESEARCH AND CLINICAL PAPERS
THE SCOPE OF PHYSIOTHERAPY PRACTICE IN MECHANICALLY VENTILATED CHILDREN IN PAEDIATRIC INTENSIVE CARE UNITS IN AUSTRALIA
Anne-Mariee King and Julie MacDonald
Royal Children’s Hospital, Brisbane

Objectives: to improve quality outcome of physiotherapy practice in mechanically ventilated children; to establish the breadth of physiotherapy practice in the treatment of mechanically ventilated children in tertiary paediatric intensive care units throughout Australia; to explore unique physiotherapy practices in tertiary paediatric intensive care units throughout Australia; and to explore and collate outcome measures for physiotherapy practice in tertiary paediatric intensive care units. Design: A survey reviewing physiotherapy practice in tertiary paediatric intensive care units throughout Australia. Method: A comprehensive survey was developed, based on an adaptation of a questionnaire by Jones (1992). This survey was then piloted within the Royal Children’s Hospital Physiotherapy Department. The survey was distributed by post to the senior physiotherapist responsible for that unit. A covering letter outlining the main objectives for the survey was included. Follow-up consisted of a phone consultation within days to ensure prompt return of survey to the investigator. Results: The survey was returned by all (100%) participating paediatric intensive care units. All responses were collated and a descriptive analysis undertaken. Most respondents reported that physiotherapy intervention was initiated through discussion with the medical officer. They perceived CXR changes as the most relevant for the initiation of airway clearance techniques. While all respondents used most techniques, the criterion for selection varied. However, all respondents indicated that side-lying was the most commonly used position, while head down tilt was rarely used. Fifty-six per cent of respondents indicated suction was undertaken as required. All respondents suggested CXR and clinical assessment were the most effective outcome measures utilised to support physiotherapy intervention. Conclusions: We have documented the variance in physiotherapy practice in tertiary paediatric intensive care units within Australia. Outcome measures used by physiotherapists in tertiary paediatric ICUs should be standardised in line with the principles of total quality management. Recommendation: To sponsor evidence-based practice in the paediatric ICU.

USE OF TORONTO ACTIVE MOVEMENT SCALE IN ASSESSMENT OF INFANTS WITH OBSTETRIC BRACHIAL PLEXUS PALSY
Jane Bartlett, Keith Mutimer and John Meara
Royal Children’s Hospital, Melbourne

Objective: Obstetric brachial plexus palsy has an incidence of 1-2 per 1000 births in Australia. Although 80-85% resolve, the remaining children have significant to severe impairment of movement of the upper limb. The Toronto Active Movement Scale was designed by paediatric physiotherapists at the Toronto Hospital for Sick Children, to assess active movement in the upper extremities of infants and young children with brachial plexus injuries. The aim of this study was to evaluate children with obstetric brachial plexus palsy with this scale to assess their suitability for microsurgery. Design: This is a retrospective study of children referred to the Brachial Plexus Clinic, Royal Children’s Hospital, with a diagnosis of obstetric brachial plexus palsy. Method: One hundred and eighty children aged 0-8 months were recruited from the Brachial Plexus Clinic. All children were assessed initially and every three months thereafter until two years of age, using the Toronto Active Movement Scale by one experienced paediatric physiotherapist. These assessments were collated in order to evaluate management based on the child’s score on the scale. Results: Following analysis, it was shown that children scoring less than 5 or equal to 5 on the Toronto Active Movement Scale required microsurgery to the brachial plexus to improve muscle function. Those children scoring 6 or more did not require surgery. Conclusion: The Toronto Active Movement Scale as used by physiotherapists to chart muscle progress in
infants with obstetric brachial plexus palsy has been found to be a useful guide to surgeons in clinical decision making.

**UPPER LIMB BOTULINUM TOXIN TREATMENT IN HEMIPLEGIC CEREBRAL PALSY: A RANDOMISED CONTROLLED TRIAL**

Kevin Lowe¹, Iona Novak², Anne Cusick¹ and Andrew McIntosh¹
¹Sydney Children’s Hospital, ²The Spastic Centre of NSW

The effect of Botulinum toxin treatment in the lower limb for children with cerebral palsy has been the focus of much recent physiotherapy research. Botulinum toxin has now become one of a range of standard treatments for children with calf muscle spasticity. It is recommended that Botulinum toxin be used in the young ambulant child, as there may be a positive influence on motor learning. Botulinum toxin is also used to attempt to delay or prevent the development of fixed lower limb contracture and the need for surgery. There is no current data available on the influence of repeated injections. Interest is growing about whether the same results could be replicated in the upper limb. **Objective:** A research study is currently being undertaken by the Sydney Children’s Hospital and The Spastic Centre of New South Wales investigating the effects of Botulinum toxin treatment in the upper limb in children with hemiplegic cerebral palsy. The focus of the research is to determine whether children receiving upper limb Botulinum toxin and standard occupational therapy show more improvement in upper limb function than those receiving standard occupational therapy alone. **Design:** The study utilises a single blinded, randomised controlled trial design. Subjects are randomly assigned to one of two groups. All subjects are reviewed at nine regular intervals over the one-year period. At baseline, Group A receives Botulinum toxin injections in combination with occupational therapy. At the 26-week re-evaluation, the subjects are eligible for a second series of injections should they meet re-injection criteria. Group B receives occupational therapy treatment for the first six months. At 26 weeks, they receive Botulinum toxin in combination with occupational therapy. **Method:** Hemiplegic children participating in the study must be between the ages of two and eight years, demonstrate some use of the affected limb and have dynamic spasticity of an Ashworth Grade 2 in the muscles for injection. The Botulinum toxin is administered via a dual localisation technique utilising electromyography and muscle stimulation. Therapy incorporates strength training, splinting and casting. Measures include: Ashworth Scale, range of motion, Quality of Upper Extremity Skills Test, Paediatric Evaluation of Disability Inventory, Canadian Occupational Performance Measure, Goal Attainment Scaling, and a timed task and motion analysis. **Results and Conclusion:** Preliminary results suggest that Botulinum toxin is an effective treatment for upper limb spasticity when used in combination with therapy.

**EARLY INTERVENTION – WHEN IS IT TOO LATE?**

Sue Durand and Sonya Murchland
Crippled Children’s Association of South Australia Inc.

The philosophy of early identification and intervention to minimise the impact of disabilities in children has underpinned government policy and service allocation for many years. Whilst early intervention has often been defined to refer to services for children under eight years of age, (eg Early Intervention Association), in reality early intervention services frequently target children under six years, optimising their pre-school years of development. However, despite this emphasis, some children’s needs are not identified until they reach school or, if identified earlier, fail to access appropriate services. For such children, it could be asked is it too late? Would therapy input be effective, and how should it be provided? A case study will be presented to describe a child who lives in a rural town in South Australia, who had significant developmental disabilities and had missed participation in early intervention occupational therapy and physiotherapy services. **Objective:** To determine if home and school programming could effect a developmental change in a school-aged child. **Design:** Single subject case study. **Method:** The subject was a male, aged six years and 10 months, with hypotonic cerebral palsy, who has speech and language difficulties and normal intelligence as determined by the Vineland Adaptive Behaviour Scales. Parental permission was obtained. Procedure included an initial assessment, a home and school program. There was a six-month review and updated home and school program. Reassessment was at 12 months. The outcome measure was the Peabody Motor Scales. **Results:** The subject made 18 months’ progress over a 12-month period. Greater progress was made in his gross motor skills in the first six months, while more significant progress was made in his fine motor skills over the later six-month period. **Conclusion:** For this subject, it was not too late for him to make developmental progress once he was over six years. This consultative model for providing specialist input, where the family and school are committed and active participants, was effective in gaining measurable progress. Further evaluation of this method of service provision is required to replicate these findings.

**AN INVESTIGATION OF THE CLINICAL TEST FOR SENSORY INTERACTION IN BALANCE (CTSIB) IN YOUNG CHILDREN**

Adrienne Harvey¹, Elizabeth Williams² and Sara Carroll²
¹Royal Children’s Hospital, Melbourne, ²The University of Melbourne

**Objective:** The CTSIB is a balance assessment tool which assesses the influence of sensory inputs ie visual, somatosensory and vestibular. The objectives of this study were to determine if this test using one-legged stance is a useful assessment tool in young children, to examine differences in balance as a result of growth and development by testing two different age groups of children and to determine any differences between dominant and non-dominant legs. **Design:** This is a descriptive developmental cross-sectional study examining differences between two age groups of children, between dominant and non-dominant legs and between six different test conditions using the CTSIB. **Method:** Two groups of normally developing children (male and female) were used in this study. There were 22 children in each age group (8±1 year and 11±1 year). The same examiner tested each child on one occasion only, using the CTSIB which involves timing one-legged standing under six different sensory conditions utilising different support surfaces and visual conditions to a maximum of 30 seconds. Data analysis involved a three-factor analysis of variance with two repeated measures and significance level set at 0.05. Post hoc analysis using paired t-tests was used for the different test conditions. **Results:** Results showed that the older children were able to balance on one leg for significantly longer (p = 0.020) than younger children. There was no significant difference between dominant and non-dominant legs. When vision was present and accurate, the children were able to balance for significantly longer than when it was absent or inaccurate. The children were also able to balance for significantly longer when somatosensory input was accurate than when it was inaccurate under conditions of absent or inaccurate
vision. There was no significant difference between vision absent and vision inaccurate conditions. **Conclusion:** The results suggest that children develop increased stability with increasing age and have a reliance on visual input for one-legged standing balance. Somatosensory input is important when vision is inaccurate or absent. The CTSIB could be used as a screening or evaluative assessment tool to document change over time in children but should not be used as a discriminative balance test in children.

**POSTURAL CONTROL AND MOVEMENT PERFORMANCE DURING UPPER LIMB TASKS IN CHILDREN WITH DEVELOPMENTAL CO-ORDINATION DISORDER (DCD)**

Laeanne Johnston, Yvonne R Burns, Sandra Brauer and Carolyn Richardson  
The University of Queensland

At least 6% of primary school aged children present with DCD, where co-ordination is substantially below the normal range for the child’s age and intelligence. Motor skill difficulties negatively affect academic achievement, recreation and activities of daily living. Poor upper-limb co-ordination is a common difficulty for children with DCD. A possible cause of this problem is deviant muscle timing in proximal muscle groups, which results in poor postural and movement control. While studies have been published investigating postural control in response to external perturbations, detail about postural muscle activity during voluntary movement is limited even in children with normal motor development. No studies have investigated the relationship between muscle timing, resultant arm motion and upper-limb co-ordination. Specifically, to investigate onset-timing of muscle activity, timing of arm movement, and resultant three-dimensional (3D) arm co-ordination during rapid, voluntary arm movement and to analyse differences arising due to the presence of DCD. This study is part of a larger research program investigating postural stability and control of upper limb movement in children. **Design:** A controlled, cross-sectional study of differences between children with and without DCD. **Methods:** This study included 50 children aged eight to 10 years (25 with DCD and 25 without DCD). Children participated in assessment of motor skills according to the Movement ABC Test and a laboratory study of rapid, voluntary arm movements. Parameters investigated included muscle activation timing of shoulder and trunk muscles (surface electromyography), arm movement timing (light sensor) and resultant 3D arm motion (Fastrak). **Results:** A MANOVA is being used to analyse between-group differences. Preliminary results indicate children with DCD demonstrate altered muscle timing during a rapid arm raise when compared with the control group of children. **Conclusion:** Differences in proximal muscle timing in children with DCD support the hypothesis that altered proximal muscle activity may contribute to poor proximal stability and consequently poor arm movement control. This has implications for clinical physiotherapy.

**DYSPRAXIA, DCD AND COMMUNICATION PROBLEMS**

Anna Cutler, Pauline Watter and Anne Ozanne  
The University of Queensland

**Objectives:** This retrospective study aimed to collate information on the co-occurrence of communication problems in children identified with developmental co-ordination dysfunction (DCD). Further, it evaluated the relationship between the presence of dyspraxic traits in DCD and specific communication problems. **Design:** Records of the last 201 children treated in the DCD Clinic, Department of Physiotherapy, The University of Queensland, were evaluated, and families contacted by telephone. Four declined to participate in a telephone survey about their child’s speech and language problems, and 23 were unable to be contacted. Information describing speech and language problems, as well as from the physiotherapy assessment, was obtained for 174 children (mean age 7.97 years; SD 2.31 years). **Method:** Scores on six items of the Physiotherapy Neurodevelopmental Assessment (Watter 1996, Watter and Bullock 1987) which most reflect praxic skill were extracted from records, namely: oculomotor co-ordination, auditory memory, verbal planning, visual planning, crossing the midline and diadochokinesia. Performances were compared with age expectations, and scored on a 1 (normal) through 2 (mild problem), 3 (moderate) to 4 (severe) scale. Children were scored on requirement for speech therapy, and on the presence of a communication problem in the area of speech, language (comprehension, vocabulary, semantics, syntax or pragmatics), fluency and voice. A speech therapist performed the motor assessment, while a speech pathology Honours student carried out the telephone interview. **Results:** All children scored normally on the oculomotor test, and at least one of the five remaining dyspraxia sub-tests, indicating that more than three-quarters of the DCD group had some dyspraxic trait. Forty-seven of the 174 (27%), had communication disorders co-occurring with DCD, and 91.5% of these had DCD with dyspraxic traits. On the physiotherapy dyspraxia sub-tests of visual copy, verbal copy and auditory memory, children who required speech therapy scored significantly more poorly than those who did not. **Conclusion:** This study confirms that a significant proportion of children with DCD also had one or more communication problems, and that many children with DCD also exhibited elements of dyspraxia. In the DCD group, those with communication disorders scored more poorly on tests of visual copy, verbal copy and auditory memory than did those without, suggesting that communication problems in DCD children may be related to dyspraxic traits and not only be motor based.

**MOVEMENT DEVELOPMENT IN CHILDREN WITH CEREBRAL PALSY: THE FIRST 4-5 YEARS**

Julie MacDonald and Yvonne Burns  
The University of Queensland

Considerable research emphasis is being placed on outcome of specific interventions in children with cerebral palsy (CP) but there is very little documentation of the characteristics of their functional development over time especially in the critical first five years. Although diagnosis should be confirmed after five years, to identify children who may have a progressive or other disorder, most parents want to know early, how their child will progress. The aim of this study is to examine the value of movement assessment at specific ages of children with CP in predicting motor function prior to school entry. **Objectives:** To identify the neuro-sensory-motor developmental trends at specific ages in the first four to five years, of children who have CP, and to investigate if assessment at a particular age is more predictive of outcome than at any other age. **Design:** The study involved a retrospective analysis of longitudinal data of children with CP. **Method:** Forty-three children were classified as having cerebral palsy at four years of age. All of the 27 boys and 16 girls with mild to severe CP were born prematurely (mean birthweight 881.9 ± 228.9g, birth age 26.8 ± 2.1 weeks), 23 had diplegia, eight hemiplegia and 12...
Participants were a convenience sample of 56 children with quadriplegia. The children were routinely followed at eight, 12, 24, and 48-60 months and assessed using the NSMDA administered by physiotherapists working with the research team. Children were classified according to the functional grading of this scale.

**Results:** The overall NSMDA grades over the four years indicate a gradual increase in the number of children falling within the moderate-severe disability classification. While gross motor grades remained fairly stable over time, there was a definite increase in the number of children with fine motor problems. Analysis of NSMDA scores for individual children over time indicates that, although problems were recognised by eight months, the best predictive age for overall motor outcome was two years of age. The risk of not being able to walk independently (without aids) by four years for this group of children was 18.6%. The best indication of independent walking at four years was assessment at 12 months.

**Conclusion:** Notwithstanding the complexity of problems associated with CP, the level of abilities and limitations based on assessment of gross and fine motor age appropriate motor development, together with neurological, sensory and postural aspects, can provide some possible benchmarks or range of expectations of motor outcome in the pre-school years.

**Day 2 - Tuesday, September 11, 2001**

**PLENARY SESSIONS**

**INTENSITY OF THERAPY INTERVENTION**

**Eva Bower**  
*University of Southampton, UK*

Our earlier studies have investigated the effects of two weeks (Bower et al 1996), three weeks (Bower and McLellan 1992) and five weeks (Bower and McLellan 1994) of more intensive goal-directed physiotherapy for children with cerebral palsy (CP) and we have detected improvement in motor function. The implication of this is that the eventual level of motor function acquired would be higher with such therapy than with current routine therapy. This longer study (Bower et al 2001) was to establish whether intensive physiotherapy or collaborative goal-setting accelerates the acquisition of motor function or performance over a six-month period and if so, to determine if the effect is cumulative.

**Design:** A prospective randomised controlled trial.  
**Method:** Participants were a convenience sample of 56 children with bilateral CP classified at Level 3 or below on the Gross Motor Function Classification System (GMFCS, Palisano et al 1997) aged between three and 12 years living in the community. Following a six-month period of baseline observation, a 2 x 2 factorial design was used with pre-stratified randomisation to compare the effects of routine amounts of physiotherapy with intensive amounts and to compare the use of generalised aims, set by the child’s physiotherapist, with the use of specific, measurable goals negotiated with each child, carer and teacher. Following the six-month treatment period, there was a further six-month period of observation. Changes in motor function and performance were assessed by a masked assessor using the Gross Motor Function Measure (Russell et al 1989) and the Gross Motor Performance Measure (Boyce et al 1995) at three-month intervals.  

**Results:** There was no statistically significant difference in scores achieved between intensive and routine amounts of therapy or between aim and goal-directed therapy in either function or performance using analysis of covariance in which the covariate was the mean of the three baseline assessments. Inclusion of additional covariates of age and severity levels showed a trend towards a statistically significant difference in children receiving intensive amounts of therapy at the end of the six-month treatment period. This advantage declined over the subsequent six months during which therapy reverted to its usual amount. Differences in aim and goal-setting procedures did not produce any detectable effect on the acquisition of gross motor function or performance.  

**Conclusion:** The results of this trial suggest that for children aged three to 12 years with bilateral CP at Level 3 or below on the GMFCS, altering their routine physiotherapy by increasing its intensity for a period of six months has little effect upon the outcome of gross motor function or performance at the end of this time. Such advantage as might occur is likely to be lost over the subsequent six months if treatment reverts to its routine amount.

**CONTINENCE – ‘OUTCOMES’ DOWNUNDER**

**Janet Chase**  
*Kingston Centre, Melbourne*

In the last two decades, the assessment and treatment of urinary and faecal incontinence in women has been the focus of much world-wide research. Women’s Health physiotherapists have traditionally formed an essential part of the team approach in the management of bladder symptoms and, more recently, faecal dysfunction. The physiotherapist’s role in continence management has expanded and consolidated such that in the state of Victoria, for example, the government considers physiotherapists with relevant skills to be core personnel in continence clinics. Continence physiotherapy in the paediatric arena is emerging and evolving. At present, there are at least four multidisciplinary paediatric continence clinics nationally that include physiotherapists. As in any developing clinical area, research efforts are critical in order to ensure that high quality effective treatment can be offered. At present, the basic benefits and harms of standard therapy in children who wet are being quantified, so that a largely empirical base can be replaced with proven intervention strategies. This paper will present an overview of the differing presentations of urinary and faecal incontinence encountered by the paediatric continence physiotherapist, along with current intervention strategies. The contribution of the physiotherapist to the treatment of faecal incontinence in children will be illustrated by a case study demonstrating the treatment of a child with congenital anorectal anomaly, with particular reference to current understanding of the interaction between abdominal muscles, small spinal stabilisers and the pelvic floor muscles and sphincters.

**DAY 3 Wednesday, September 12, 2001**

**PLENARY SESSIONS**

**FITNESS IN CHILDREN AND ADOLESCENTS WITH SPECIAL NEEDS**

**Susan R Harris**  
*University of British Columbia, Vancouver, Canada*

**Objective:** The goal of this presentation is to describe recent trends in evaluating and improving fitness levels in children and adolescents with special needs.  
**Design:** This lecture will provide a review of the recent literature examining fitness for children and adolescents with special needs, eg those with developmental disabilities or chronic illnesses.  
**Method:** Fitness will be defined and differentiated from the terms “physical activity” and “exercise”. Four components of fitness will be described, with relevant examples from the peer-reviewed literature: 1) cardiorespiratory
endurance; 2) muscle strength and endurance; 3) flexibility; and 4) body composition. **Results:** To establish the importance of this area of inquiry, descriptive research that has assessed fitness differences in children and adolescents with special needs will be discussed first, followed by examples of quasi-experimental and experimental research aimed at examining the effectiveness of different types of fitness interventions. **Conclusions:** There are many aspects of a child’s disability that cannot beameliorated through physiotherapy interventions, such as muscle tone abnormalities, paralysis, and retained primitive reflexes. Areas in which physiotherapists can make a difference for children with special needs include cardiorespiratory endurance and muscle strengthening. It is time to shift our focus from interventions aimed at impairments that are not responsive to treatment toward interventions that will enhance the quality, and perhaps the length of life, of children and adolescents with special needs.

**WORKING WITH ADOLESCENTS: TRANSFORMING THE FERAL TO THE FRIENDLY**

**Brenda M Button**  
Royal Children’s Hospital and The Alfred Hospital, Melbourne

Patients with the inherited chronic lung condition of cystic fibrosis (CF) are required to undertake one to three sessions of chest physiotherapy and regular physical exercise daily. As children mature and enter the stage of adolescence, it is normal for them to engage in challenging behaviour. In CF, this sometimes takes the form of non-co-operation and/or non-adherence to medication, chest physiotherapy and exercise. **Objectives:** To establish the factors that contribute to improved co-operation and adherence to chest physiotherapy and exercise in adolescents with CF, and to provide examples of useful strategies for improving the effectiveness of interaction between health professionals and adolescents with CF. **Design:** A descriptive study based on extensive clinical experience with adolescents with CF over a decade, incorporating strategies and case studies illustrating successful approaches. **Method:** Subjects comprised the inpatient adolescent population of the Royal Children’s Hospital admitted for 10-14 days for a “tune-up” to overcome acute exacerbations of their lung disease. Adolescents were required to attend the “Chest Room” for two sessions of airway clearance and exercise each day. Some patients challenged physiotherapy staff with decreased co-operation while in hospital, and non-adherence to prescribed treatment when at home between hospital admissions. A number of interventions were introduced: 1) alternative “user-friendly” independent airway clearance techniques were investigated and introduced; 2) a graphically portrayed data collection system collecting subjective and objective measurements during day-to-day practice was developed for each patient; 3) individualised treatment was introduced for each patient, selecting a regimen that was most effective, most preferred and had the fewest side-effects; and 4) longitudinal research was undertaken in a group who had changed from traditional postural drainage to upright positive expiratory pressure (PEP) therapy because of symptoms of gastroesophageal reflux during head down tilted chest physiotherapy. **Results:** Co-operation and communication improved between patients and physiotherapy staff, with a high level of patient satisfaction with the service as evidenced by positive feedback obtained. The graphic data collection system demonstrated the effectiveness of the individualised airway clearance techniques and exercise regimen. In a case series of six adolescents studied for two years with postural drainage followed by two years using upright PEP mask therapy, lung function improved significantly ($p < 0.001$); side-effects and annual hospital days decreased significantly ($p < 0.001$ and $p < 0.005$ respectively). **Conclusions:** An individualised treatment approach, together with subjective and objective evidence, improved communication, inter-personal relationships and level of co-operation. This in turn resulted in adolescents, health professionals and carers believing in the value of adherence to treatment.

**RESEARCH AND CLINICAL PAPERS**

**RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND BONE MASS IN ADOLESCENT FEMALE NOVICE DANCERS AND CONTROLS: A 12-MONTH LONGITUDINAL STUDY**

Matthews BL$^1$, Bennell K$^1$, Khan KM$^2$ and Wark JD$^3$  
$^1$The University of Melbourne; $^2$The University of British Columbia; $^3$Royal Melbourne Hospital

**Objectives:** Participation in regular physical activity in adolescence may be important in maximising peak bone mass and hence reducing the lifelong risk of osteoporotic fracture. Our objectives were to: (1) use a model of targeted weight-bearing exercise, ballet dancing, to study the effects of pre- and peri-pubertal exercise on bone mineral accrual; and (ii) investigate the influence of maturational stage on this association. **Design:** This is a 12-month longitudinal cohort study. **Methods:** Fifty-eight novice ballet dancers (mean age $= 9.6 \pm 0.8$ years) were compared with 55 age-matched controls. Bone mass at the total body, proximal femur and its sub-regions [femoral neck (FN) and trochanter], and lumbar spine (LS) as well as soft tissue composition were measured by dual energy x-ray absorptiometry. Bone dimensions were measured by anthropometry. Current and historical exercise levels, calcium intake and pubertal status were assessed by questionnaires. **Results:** At baseline, groups were well matched for age and height. However, controls had significantly greater fat and lean mass. Dancers had significantly greater bone density than controls at the total hip and femoral neck, sites loaded by balletic training. Over 12 months, 73% of controls and 91% of dancers remained pre or peri-pubertal. Controls had significantly greater fat and lean mass, and consumed more calcium. There were no significant differences in rate of change of bone accrual between dancers and controls. Within the dancer cohort a positive relationship was found between years of dance and rate of change per year in FN bone mineral apparent density (BMAD; $r^2 = 0.3, p = 0.01$), adjusting for age and height. A positive relationship was also found between weekly hours of dance classes and the rate of change in LS bone mineral content (BMC; $r^2 = 0.4, p < 0.01$), adjusting for age and height. Other bone sites followed similar trends but were not significant. **Conclusions:** The results suggest that dancers continuing with classes for longer may increase FN BMAD at a greater rate. Furthermore, attending dance classes at a greater frequency per week may induce greater rates of change in LS BMC. Any differences in bone mineral accrual may not reach significance until the later pubertal stages in females. This will be addressed in ongoing observations.

**THE EFFECT OF A FOUR WEEK LOWER LIMB STRENGTHENING PROGRAM ON THE FUNCTION OF CHILDREN WITH AN ACQUIRED HEMIPLEGIA: A PRELIMINARY INVESTIGATION**

Bronwyn Thomas and Jan Hancock  
The Children’s Hospital at Westmead, Sydney

**Objective:** Increasing evidence supports the value of strength training in adults with an acquired brain injury (ABI) caused by stroke or traumatic brain injury, and for children with cerebral
palsy (CP). There is no published literature available for children with ABI. This study’s hypothesis is that children with an acquired hemiplegia would respond in a way similar to that reported for other patient groups, to a strength training program conducted in a group treatment format. **Design:** Pre-post intervention study, multiple single subject design. **Method:** Subjects were a convenience sample of 10 children aged six to 13 years with a diagnosis of hemiplegia (seven ABI and three CP). Assessments were made on four occasions: a double baseline assessment one month before and immediately prior to the start of the group (Assessments 1 and 2), after completion of the group (Assessment 3), and at two-month follow-up (Assessment 4). Outcome measures used were: the 6-Minute Walk Test; gait measures of velocity, base of support, step and stride lengths; the lateral step-up test; a timed stairs item; lower limb strength measurement using a handheld dynamometer; and the Timed Up-and-Go test (TUG). The GMFM (Section E) was also done for Assessments 2 and 3. Parent questionnaires were completed at Assessments 2, 3 and 4. Group sessions were run twice weekly for four weeks in the Children’s Hospital physiotherapy gymnasium. The one-hour sessions consisted of timed rotation through a series of 10 supervised exercise stations, with pre/post group stretching. Activities focused on closed chain lower limb strengthening, especially of the involved limb. **Results:** Significant improvements were seen for the whole group in hip and knee extensor and knee flexor strength (hemiplegic leg), and for the lateral step-up test (both legs), compared with baseline measures. The trend for improvement was seen in both the ABI and CP subgroups. Improved GMFM scores were clinically significant, with changes seen in the strength-related tasks of jumping and hopping. Changes in other outcome measures were not seen. Seventy per cent of parents identified positive changes in their child post-intervention. Parent and child satisfaction with the group format was very high. **Conclusion:** Children with acquired hemiplegia showed improvement in measures of strength and function after participating in a 4-week lower limb strengthening program.

**MEASURING PRAXIS IN NORMAL BOYS AND THOSE WITH DEVELOPMENTAL CO-ORDINATION DISORDER (DCD) USING TWO OF CRATTY’S TESTS**

Janet Durrington and Pauline Watter  
*The University of Queensland*

**Objective:** Following the resurgence of interest in dyspraxia, this study aimed to investigate the use of two of Cratty’s (1994) tests which seemed particularly promising despite a lack of normative data. We hypothesised that boys in the normal group would outperform DCD boys when using different body parts and command modes, and that the scores on Cratty’s tests would relate to scores on three items of the Neurodevelopmental Physiotherapy Assessment (NPA) which most reflected dyspraxic traits (Watter 1996). **Design:** This study was comparative in design, used designated inclusion and exclusion criteria, and satisfied the ethical requirements of the National Health and Medical Research Council’s guidelines. **Method:** Twenty normal boys drawn from a local suburban school, and 13 children diagnosed with DCD in the Motor Clinic of the Department of Physiotherapy, University of Queensland, were tested. Three tasks were used, incorporating standard instructions and scoring: finger tapping task, Bimanual Co-ordination Test (BCT) and a pat/ball task. Each was scored for unimanual performance of preferred and non-preferred hands and for bimanual performance. The finger tap task scored the number of index finger taps completed in 10 seconds, and the pat/ball task scored the number of accurate bounces in 20 seconds (Watter and Burns 1995 and 1998). Using an “Etch-a-sketch” board, the BCT scored the time taken to draw a line from start to end of a target path for five different angles, and the number of errors made (number of times moved outside 1cm guidelines). **Results:** Normal children outperformed those with DCD for the preferred hand tapping task unimanually and for the non-preferred hand tapping bimanually. In the BCT, normal children were significantly faster than DCDs for both preferred and non-preferred hands working alone, and DCD children made significantly more errors than did normals. There was no consistent between-group pattern for bimanual tasks. No differences were found for the ball task, but large variance and small numbers masked apparent differences. Considering within-group differences, both groups performed similarly: unimanual performance was better than bimanual in the preferred hand, preferred hand tapped better than non-preferred hand, and either
hand alone was better than both for BCT. Conclusion: DCD children have specific performance difficulties compared with normals; bimanual performance may affect speed and accuracy of performance; and preferred hand outperforms non-preferred for both groups.

CURRENT EVIDENCE FOR THE NON-MEDICAL/NON-SURGICAL MANAGEMENT OF CHILDREN AND ADOLESCENT SPORTING INJURIES

Philip Calvert
Flinders Medical Centre, Adelaide

Objective: To critically evaluate the current available evidence for the non-medical/non-surgical management of children and adolescent sporting injuries. Design: A search strategy was devised and performed to locate to locate suitable evidence from available sciences and medical databases. Databases were accessed via the University of South Australia Library and the Department of Human Services (SA) Health Libraries Consortium. The search strategy was modified several times, so that the evidence was obtained on management of sporting injuries to children and adolescents that was of a non-medical/non-surgical nature. Method: Evidence that was available in South Australian libraries or electronically was collected. It was then examined for suitability in line with the guidelines set by the search strategy. Inappropriate evidence was discarded. Critical appraisal of the evidence was then undertaken using the PEDro scale for appraisal of clinical trials and modified scales taken from Crombie (1996) for appraisal of cohort, case series and cross sectional study designs. As there was no scale presented in the literature, a tool was developed to appraise anecdotal articles. Results: Studies utilising all research designs apart from randomised controlled trials were identified. The majority of the evidence was anecdotal. Of the remaining study designs, the quality was poor as revealed by the critical appraisal tools. Evidence describing strictly non-medical/non-surgical management of children and adolescent sporting injuries was limited. Discussion/Conclusion: There is a need for high quality research into the non-medical/non-surgical management of children and adolescents’ sporting injuries. Anecdotal evidence provides a basis for this to be done. The current available evidence suggests that the role of non-medical/non-surgical management may be compromised if high quality research is not performed.

RESEARCH AND CLINICAL PAPERS

INTRA-RATER AND INTER-RATER RELIABILITY OF THE TARDIEU SCALE TO QUANTIFY SPASTICITY IN BICEPS BRACHII IN CHILDREN WITH CEREBRAL PALSY

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Objective: To establish both intra-rater and inter-rater reliability of the Tardieu scale to quantify spasticity in biceps brachii in children with cerebral palsy. Design: Experimental, randomised, single blind, repeated measures design. Method: The Tardieu scale is a two-phase test. The first phase consists of passively extending the elbow to end of range at slow speed and measuring this angle (R2). The second part involves measuring the range at extending the elbow to end of range at slow speed and measuring this angle (R1). The difference between R2 and R1 is the Tardieu score which quantifies the degree of spasticity. Five subjects with CP in the age range of four to 16 years were randomly assigned to either Group 1 or Group 2. Each subject was tested over two consecutive days and at the same time of day. Both right and left arms were tested for one subject, resulting in a sample of six limbs. Rater A tested intra-rater reliability whereas two raters (A and B) tested inter-rater reliability. Both raters are experienced physiotherapists who use the Tardieu scale in clinical paediatric practice. An independent, experienced investigator measured joint angles with a goniometer and recorded the results. The Tardieu test was conducted twice in Sessions 1 and 2, with a five-minute interval between tests. During the interval, subjects were asked to sit on the edge of the plinth before being repositioned and retested. For intra-rater reliability, Rater A conducted both tests in the session. For inter-rater reliability involving Group 1, Rater A was followed by Rater B. This order of rater assessment was reversed for Group 2. The testing conditions were standardised to allow for consistency between testing and to reduce external influences on muscle tone. Intra- and inter-rater reliability were evaluated using intra-class correlation coefficients (ICC (1,1)). Results: Intra-rater reliability of the Tardieu scale was high (ICC (1,1) 0.80), whereas inter-rater reliability was low (ICC (1,1) 0.51). Conclusion: When one rater was used under these standardised conditions, the Tardieu scale was a highly reliable measurement tool to quantify spasticity in biceps brachii in children with cerebral palsy. However, difference in application of the test between raters reduced inter-rater reliability. Further studies are needed to determine the intra- and inter-rater reliability of this scale in other muscle groups and starting positions.

CAN WE DELIVER BETTER THERAPY? A COMPARISON OF THREE MODELS OF INTENSIVE PHYSIOTHERAPY INTERVENTION FOR CHILDREN WITH CEREBRAL PALSY

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Several children from Adelaide have attended The Euromed Rehabilitation Centre in Mielno, Poland, which offers an intensive 28-day (4 hours/day, 6 days/week) rehabilitation program in combination with the LK-92 Adeli Suit. The cost to access the treatment is at least AS15,000. The children from Adelaide were assessed, using the Gross Motor Function Measure (GMFM), prior to departure and on their return. Their total GMFM scores had increased by 5-6%. In light of these results, the question was raised as to whether the improvement was due to the intensity of the program, the use of the suit or the combination of both. Objective: A pilot study was therefore undertaken at the Crippled Children’s Association (CCA) to compare the rate of acquisition of motor skills of three models of intensity of physiotherapy intervention for children with cerebral palsy (CP). Design: A single case experimental design was used consisting of three phases: conventional intensive physiotherapy intervention; intensive holiday physiotherapy program; and intensive block of physiotherapy. Method: Three subjects with mild to moderate spastic diplegia CP and aged between four and seven years were involved in the pilot study. The study consisted of the following phases: Phase 1 - conventional intensive physiotherapy intervention (1 weekly, 4 weeks, 1 hour week); Phase 2 - 4-week non-intervention; Phase 3 - intensive holiday physiotherapy program (5 week, 2 weeks, 3 hours per day); Phase 4 - 4-week non-intervention; Phase 5 - 4-week intensive block of physiotherapy (1 hour, 3 week over 4 weeks); and Phase 6 - 4-week non-intervention. Phases 3 and 5 were conducted in a group setting at a central location, whereas Phase 1 was on an individual basis conducted at home. The GMFM was administered before and after each intervention phase. Parents and children were
MANUAL HANDLING TRAINING FOR ADOLESCENTS WITH INTELLECTUAL HANDICAPS

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Objective: Adolescents who have intellectual disabilities need to be provided with a good start when seeking employment. One factor that restricts their access to employment is the inability to perform correct manual handling techniques and the inability to learn these skills from the usual courses offered by companies and employers. These courses have not been developed to cater for, and do not target, people with intellectual and/or physical disabilities. The presenters of the courses would not know how to modify their talk to cater for adolescents with intellectual disabilities, allowing for the unique learning difficulties and motor planning problems that these children have. This paper looks at a model that is being developed to teach these children safe manual handling skills and how to perform a job safety analysis. The advantage of teenagers learning these skills is that they will be more attractive to a potential employer and if they can attain employment, they will be less likely to become dependent on the welfare system. Design: A pilot study was developed. An eight-week course was implemented that covered teaching and assessing skills in manual handling and job safety analysis for children who attend an educational support centre. The course was tailored to cater for their special educational needs. Method: Subjects were selected by meeting social, communication and travel criteria that would enable them to be considered for employment within the retail, domestic services or gardening industries or in a factory. The students needed to be in their post-compulsory school years. An eight-week course was developed. This included a basic talk on manual handling, possible injuries from poor technique and how to prevent an injury occurring. Four weeks are spent in the classroom learning basic lifting, lowering, pushing and pulling techniques, and working with a partner. Four weeks are spent teaching the students to generalise these skills. They are given workplace settings and taught to use the skills in different environments and circumstances and around different people. Students are continually being assessed on their performances and records are kept each week as to their progress. Ten weeks after completion of the course, the students are tested to ensure that they have retained the skill both in manual handling, job safety analysis and generalisation. Results: Initial results suggest that the students can learn correct manual handling skills and how to generalise them. Conclusion: Without specialised courses to teach adolescents with intellectual disabilities correct manual handling skills, they will be either unemployable or at risk at work. This pilot study is trying to address this issue and aid these adolescents to become independent.