

**Association of Children's Prosthetic-Orthotic Clinics
2009 Annual Meeting, May 20-23, Tempe, Arizona**

Thursday, May 21, 2009

Scientific Session I – Spine, Upper Extremity & Surgical Management

8:10 am / Research Award Winner

**INITIAL CORRECTION IN PROVIDENCE AND
CHARLESTON BRACES FOR IDIOPATHIC SCOLIOSIS**

*Matthew Paruch, BEO; Charles T. Price MD; Darrell Geyer, CO; Alistair Gibson, CPO
Nemours Clinic, Orlando, FL*

Purpose of Study: To determine whether the Charleston Brace or Providence Brace provides greater initial in-brace correction of the major curve in adolescent idiopathic scoliosis (AIS) and to determine whether the Charleston Brace (CBB) or Providence (PB) provides greater initial in-brace correction of the minor curve in adolescent idiopathic scoliosis.

Background: Initial in-brace correction of AIS has been shown to correlate with successful brace management of AIS. Thus, greater in brace correction is associated with improved prevention of progression. Successful Milwaukee Brace management has been associated with greater than 20% correction of the initial major curve. The Boston Brace and other daytime TLSO's are judged to be adequate when initial correction in the brace is 50% or greater. Brace wear with the Milwaukee or TLSO braces is recommended during daytime and at night for a minimum of 23 hours. The CBB and PB are designed to provide maximum in-brace correction during night-time-only brace wear with a recommended 8 hours. Advocates for both of these braces have indicated that in-brace correction should approach 80-100% of the initial curvature. The concept of these braces is that maximum correction provided over a shorter time period during recumbent sleep may affect growth and avoid daytime brace wear.

The Charleston Brace utilizes bending to obtain maximum correction. Several studies have reported success with single curves equal to success rates with full-time braces. Some authors have reported success with double curves using the CBB as long as rigorous criteria are applied for the initial in-brace radiograph. On the other hand, the Providence Brace provides maximum correction by direct pressure on the apex of the major and minor curvatures. In theory, the Charleston Brace would provide greater in-brace correction of the major curve with less correction of the minor curve. In theory, the Providence will provide slightly less in-brace correction of the major curve compared to the Charleston Brace, but there would be improved in-brace correction of the minor curves in the Providence Brace.

8:30 am / CS #1

KALIBUS AND ALTERNATIVE BRACE DESIGNS FOR SCOLIOSIS

*Richard Scott Hosie, CPO
Shriners Hospital for Children, Salt Lake City, UT*

Since Dr. Jacques D'Astous has focused on Early Onset Scoliosis and EDF (Elongation, De-rotation, Flexion) Casting techniques, we in the Orthotic Department at Shriners Hospital for Children, Salt Lake City, have seen a large number of TLSO fittings for Scoliosis. These fittings are used in conjunction with the EDF casting for a summertime break or in lieu of EDF casting because of anesthesia concerns, breathing issues, feeding issues or as a "weaning" device after EDF casting.

Keeping these issues in mind, orthotic design must accommodate these concerns most notably, breathing and eating issues. Additionally, these children are learning to walk, are playing and must be allowed to crawl, pull to stand and run and play as much as possible. While traditional, Boston style, 18-22 hour bracing is our first choice, several occasions have arisen when this is not possible.

As alternatives to traditional bracing, I will be showing two different brace designs. First, a minimalist TLSO for a hypotonic patient that initially had a 46 degree thoracolumbar curve at the age of 16 months. Now at 4 years of age and orthotic intervention alone (this patient was an anesthesia risk) his out of brace curve is 11 degrees. I have clinical photographs of the patient in the orthoses, and in and out of brace x-rays.

Second, is a case in which the child initially had a 36 degree thoracolumbar curve at the 7 months of age. After one EDF casting and successive TLSO fittings she was fit with a Kalibus style TLSO to allow her more freedom of movement, breathing and eating. At the age of 3 she has virtually no curve. Again, clinical photos of the patient in the brace as well as in and out of brace x-rays are to be presented.

We do not imply that bracing resulted in the resolution of the scoliosis, only that there was significant correction in the brace.

The instances in which we use these types of non-traditional braces are few and only used when necessary, but they do provide an alternative to the more traditional TLSO's. These devices were born out of necessity and have stimulated our thoughts about scoliosis bracing. I hope to stimulate further discussion and get ideas from others who have used these and other styles of scoliosis bracing.

8:50 am / Paper #1

**SYMPATHECTOMY EFFECT IN ANTERIOR SPINAL SURGERY IN
CHILDREN WITH SPINA BIFIDA**

*Nathan Hartin, MD; J. Ivan Krajbich, MD, FRCS(C)
Shriners Hospital for Children, Portland, OR*

One of the inevitable side effects of anterior spinal instrumentation in the lumbar spine area is the disruption of the sympathetic nerve chain on the side of the surgical approach. Effectively a unilateral surgical sympathectomy is the result. Lumbar sympathectomy has been used in the past to improve circulation in poorly perfused lower extremities. It

has been largely abandoned because of only very temporarily improvement. Our premise for the present study is that in children with the diagnosis of Spina bifida, this effect is more permanent. We reviewed our population of Spina bifida patients treated by ASIF for scoliosis. Permanent sympathectomy effect observed can be exploited for improvement of lower extremity circulation in this population protecting them from poor healing of pressure or ischemic ulcers.

9:10 am / Research Award Winner

NATURAL PROGRESSION OF NON-SYNOSTOTIC PLAGIOCEPHALY

Rebecca Spragg, MSPO, Georgia Institute of Technology

Aaron Smith, CO, LO, Children's Healthcare of Atlanta

The incidence of referrals to orthotic facilities for treatment of deformation plagiocephaly has increased dramatically since the 1990s. However, in many cases, cranial remolding treatment is either not indicated by our current standards or the parents decide not to pursue treatment. Current research does not indicate the expectations with growth or consequences of these untreated abnormalities of the skull. The purpose of this study was to determine the natural progression of non-synostotic plagiocephaly in children from infancy to 18+ months of age. The study also aimed to determine parent impressions about the current head shape of children with untreated deformational plagiocephaly. A survey and follow-up measurements were completed for twenty-two children diagnosed as infants with deformational plagiocephaly of severity level 3 or higher who declined orthotic treatment. Subjects were between the ages of 18 and 48 months at the time of the study. Cranial vault asymmetry index (CVAI), cephalic ratio (CR), and severity level were compared from the initial diagnosis scan and the current scan. Of the 22 subjects, 17 showed an improvement in CVAI, with an average decrease of 1.8%. CR had an average decrease of 4%. Parents perceived the head shape to have “improved” in 14, “stayed the same” in 6, and were “unsure of any change” in 4 subjects. Parents were “very satisfied” in 11, “somewhat satisfied” in 6, and “not very” satisfied in 5 subjects. Although there was a decrease in CVAI, it was not a significant enough improvement to move subjects into a non-treatment severity level. 77% of subjects would still be recommended for orthotic treatment based on their current head shape. Overall, parents are satisfied with the current shape of their children's heads despite the asymmetry that is still present.

Presidential Guest Speaker

10:30 am

LOOK AT ALL THE COOL GADGETS: EMERGING TECHNOLOGIES AND PRODUCTS IN O&P

Todd Anderson CP; Otto Bock Healthcare

We are constantly being presented with new technologically advanced products to make our lives easier. This is true in all industries including prosthetics and orthotics. In this presentation the speaker will explore emerging technologies that could have an impact on the lives of P and O related practitioners and the clientele they serve. This will be done by taking a brief historical and current view and then imagining the future. Where are these advances coming from? How fast will they be here? What do we need to do to

prepare for these advances? Do they really make life easier? How can they help the user? What is the common denominator that all advances need to succeed?

Scientific Session II – Ankle Disarticulation

11:30 am / Paper #3

**COMPLICATIONS OF MODIFIED SYME/BOYD AMPUTATIONS FOR
TREATMENT OF LIMB DEFICIENCIES**

Janet L. Walker, MD; Vishwas Talwalkar, MD

*Shriners Hospitals for Children & University of Kentucky, Department of Orthopaedic
Surgery, Lexington KY*

Introduction: Amputations that preserve the heel pad are recommended for treatment of congenital limb deficiencies and are designed to achieve end-bearing limbs for prosthetic fitting. Subsequent growth may result in migration of the heel pad from the distal end and can result in loss of that end bearing capability.

Methods: A consecutive case series of 60 patients were identified from the hospital surgical data base including all who had had a heel pad sparing amputation before the age of 3 years prior to April 2003. Retrospective review of charts and radiographs was performed to evaluate the effect of age, diagnosis, concomitant procedures including Achilles tenotomy, physal and calcaneal preservation on heel pad migration, revision or perioperative complications. Three patients were excluded due to lack of x-rays. Nine patients were excluded for inadequate follow-up. This study reviews 48 patients with 56 amputations who had 5 years or more follow-up. Statistical analysis was performed using chi square and ANOVA.

Results: There were 35 males and 13 females. Fifteen had involvement of the left side, 25 right and 8 bilateral for a total of 56 limbs. The limb diagnosis was fibular deficiency in 32, tibial deficiency in 11, proximal femoral focal deficiency in 8, and 5 with other congenital foot problems. Mean age at surgery was 1.4 years and mean follow-up was 11.8 years.

Concomitant Achilles tenotomy was performed in 38 limbs and other procedures such as tibial osteotomy or knee fusion were performed in 17 limbs. The distal physis was intentionally excised or congenitally absent in 25 limbs. All or part of the calcaneus was preserved for fusion to the distal lower leg bone in 41 limbs. Heel pad migration was noted in 12 limbs (21%) and revision surgery required in 3 of them.

Heel pad migration was not correlated with diagnosis, age at surgery, concomitant Achilles tenotomy, or retention of a portion of the calcaneus. Migration was statistically more common in those limbs where the distal physis was retained ($p=0.007$) and increased with increasing follow-up ($p=0.004$). Revision surgery for migration was not correlated with any of the above variables. Post operative skin complications, such as infection or partial skin slough, occurred in 11 limbs and was not correlated with additional surgery such as excision of the physis, calcaneus, or other concomitant procedures.

Conclusions: Heel pad migration is a common occurrence following heel pad sparing amputation in children. Its occurrence is associated with increased growth as manifested by a greater frequency with increasing time from surgery and in those limbs where the distal physis is preserved. Revision surgery for problems related to migration is rare following heel pad preserving amputations in children.

11:40 am / Paper #4

HEEL PAD SPARING AMPUTATIONS FOR FIBULAR DEFICIENCY

Janet L. Walker, MD; Vishwas Talwalkar, MD

Shriners Hospitals for Children & University of Kentucky, Department of Orthopaedic Surgery, Lexington KY

Introduction: Syme or Boyd type amputations, modified for immature patients, are recommended for the management of severe foot and ankle abnormalities and limb length discrepancy in fibular deficiency. Sparing the heel pad facilitates end bearing but subsequent growth may result in migration of the heel pad from the distal end. This results in loss of that end bearing capability and affects their prosthetic management.

Methods: A consecutive case series of 40 fibular deficiency patients were identified from the home hospital surgical data base and combined with 23 consecutive patients involved in a multicenter study of fibular deficiency. To evaluate the effect of growth, all subjects had to have had a heel pad sparing amputation before the age of 3 years. Retrospective review of charts and radiographs was performed to evaluate the effect of age, concomitant procedures, including Achilles tenotomy, physeal and calcaneal preservation on heel pad migration, revision or perioperative complications. One patient was excluded due to lack of x-rays. Eight patients were excluded for inadequate follow-up. This left 54 patients with 58 amputations who had 5 years or more follow-up. Statistical analysis was performed using chi square and ANOVA.

Results: There were 42 males and 21 females. Twenty two had involvement of the left leg, 28 right leg and 4 bilateral for a total of 58 limbs. Mean age at surgery was 1.2 years and mean follow-up was 15.5 years.

Concomitant Achilles tenotomy was performed in 30 limbs, not performed in 11 and unknown in 17. Other concomitant procedures, such as tibial osteotomy, were performed in 12 limbs. The distal physis was excised or congenitally absent in 13 limbs, persistent in 43 and unknown in 2. All or part of the calcaneus was preserved for fusion to the distal tibia in 26 limbs. Heel pad migration was seen in 16 limbs (28%) and revision surgery was required for 6 of them.

Heel pad migration was not correlated with age at surgery, concomitant Achilles tenotomy, physeal preservation, or retention of a portion of the calcaneus. Revision surgery for migration occurred in children with a mean age at surgery of 8.4 months compared to those without revision of 14.4 months. ($p=0.02$) Revisions were more

common in patients with a longer follow-up (mean 19.8 years) compared to shorter follow-up (mean 15 years, p=0.03)

Post operative skin complications such as infection or partial skin slough occurred in 7 limbs and was not correlated with additional surgery such as excision of the physis, calcaneus, or other concomitant procedures.

Conclusions: Heel pad sparing amputations in fibular deficiency are frequently associated with heel pad migration from the distal end. While revision surgery for this migration is uncommon, it is more frequently required in patients with amputation at a very young age and the rate increases with follow up time from surgery.

11:50 am / CCP #1

SYME AMPUTATION FOR GOLTZ SYNDROME (FOCAL DERMAL HYPOPLASIA): REPORT OF TWO CASES

Robin C. Crandall, MD

Shriners Hospital for Children, Minneapolis, MN

Focal dermal hypoplasia, also known as Goltz syndrome is an extremely rare condition and involves many body systems. Extremity anomalies consist frequently of lobster claw deformities, syndactyly, polydactyly and often require amputation surgery to create an adequate residual limb for prosthetic fitting. Abnormal skin areas however may cause prosthetic fitting problems. The purpose of this report is to review this syndrome in two children with respect to the amputations and fitting problems, radiographic findings and to discuss other systemic aspects of this syndrome.

12:00 pm / Research Award Winner

EXPLORING THE APPLICATIONS OF SEMI CUSTOM SILICONE PARTIAL FOOT PROSTHESES IN A PEDIATRIC AMPUTEE POPULATION

R. Dwight Putnam, Prosthetics Residency Research Project

Texas Scottish Rite Hospital for Children, Dallas, Texas

A well crafted custom silicone prosthesis can not only aid in scar tissue management and residuum protection but it can also restore the patients' self confidence and psychosocial well being (1). While enhanced cosmesis and durability are definitely desirable, outsourcing a custom or semi custom silicone prosthesis can be cost prohibitive. Due to the high cost of the labor intensive fabrication process, custom silicone prosthetics are not an option for all amputees. In the pediatric amputee population, where prosthesis's average life expectancy is 12 to 15 months, funding is definitely a challenge (2). During a year long Prosthetics residency at Texas Scottish Rite Hospital for Children, the author had access to a very diverse group of amputees. This experience offered a unique opportunity to fabricate semi custom silicone prostheses for a wide variety of patients, without burdening them with a price tag. Partial foot amputees, who would otherwise be candidates for traditionally fabricated prostheses, were given an opportunity to try a semi custom silicone prosthesis. In the course of identifying the benefits of silicone devices for this population, this pilot study emphasized cost effectiveness and functionality over

cosmesis. This study attempted to establish and document an inexpensive and reliable semi custom silicone partial foot prosthesis fabrication system using the different techniques and materials available.

Patients, for whom a flexible “slipper” style prosthesis would be indicated, had an opportunity to participate in this pilot evaluation. These devices were fit as a usual and customary treatment option, along with other styles, such as thermoplastic AFO’s and foam inserts. It is not uncommon for many of these patients to have several styles of partial foot prostheses.

Alginate impressions of the patient’s amputated side were made and filled with a lab stone. The patient’s sound side was matched to an “off the shelf” foot shell to determine the size and shape of the prosthesis. A wax sculpture of the prosthesis was constructed on the stone positive, which had been modified to achieve tension. A three part mold was fabricated and the lost wax method was used to replace the wax with tinted silicone. The end result was a semi custom silicone prosthesis that intimately surrounds the residuum providing protection, cosmesis and excellent suspension. These devices were delivered then monitored through follow up visits. The patient’s acceptance or rejection of the prosthesis was documented. Any patient comments regarding fit, cosmesis, or comparisons to past prostheses were noted.

Workshop B

3:45 pm

THE DYNAMIC MIDTARSAL CONTROL ORTHOSIS (DMC) AND ENERGY STORAGE AND RETURN ANKLE FOOT ORTHOSIS (ESR AFO) : ASSESSMENT CRITERIA, BIOMECHANICS, ORTHOSIS DESIGN AND CLINICAL APPLICATIONS

Donald H. Weber; Hamilton Health Sciences Hospital, Hamilton, ON, Canada

The DMC (an SMO level orthosis) and the ESR AFO uses a hybrid of common orthotic materials (a copolymer base material reinforced with polypropylene) to create dynamic control of the midfoot, subtalar and ankle joints. The dynamic resistance to motion from these orthotic designs creates improved shock absorbing characteristics thus decreasing peak brace/body interactive forces while increasing patient comfort and compliance. The ESR AFO simulates normal muscle activity at the ankle producing a smooth more efficient walking pattern with increased endurance. The dynamic resistance of the ESR AFO allows running and other high force sporting activities for your more active patients without the restriction often seen with more conventional AFOs.

Goals for this workshop include:

- Prescription criteria for DMC and ESR AFOs
- Assessment of ankle, subtalar and midfoot deformities related to DMC and ESR AFO prescription
- Biomechanical and gait characteristics related to the DMC and ESR AFO including shock absorption, energy storage and return, range of orthotic designs to accommodate for different pathological gait patterns, etc

- materials and plastic architecture of “energy storage section” of the DMC and ESR AFO
- casting, fabrication and fitting for DMC and ESR AFO
- case studies using the DMC and ESR AFO illustrating the wide range of clinical applications including cerebral palsy, spina bifida, Downs syndrome, polio, multiple sclerosis, muscular dystrophy, CMT, etc.

Friday, May 22, 2009

Scientific Session III – Lower Limb

8:00 am / Paper #5

MOBILITY, PAIN AND QUALITY OF LIFE IN CHILDREN WITH LOWER LIMB DEFORMITIES

*K. Montpetit, OT; R. Hamdy, MD; J. Ruck, PT; M. Rinaldi, BScN; S. Takahashi, MScN
Shriners Hospital for Children, Montreal, Quebec, Canada*

Children with lower limb length discrepancies greater than 3 cm and/or severe angular deformities of congenital or acquired origin have difficulty walking and running and can experience pain and discomfort either at rest or during these activities. These impairments restrict how they function and participate in daily life leading families to seek surgical correction of the deformity. Correcting the deformity is thought to normalize gait and appearance as well as prevent or reduce hip and knee pain and consequently improve the child’s quality of life.

Children with these deformities walk with a limp and many studies have explored the impact of an LLD on physical function from a technical perspective particularly measuring gait parameters or radiographic changes after a lengthening. However few studies have measured the functional mobility and pain experienced by children with congenital or acquired deformities pre operatively and its impact on their quality of life.

The purpose of this study was to measure the baseline functional status in these children before intervention using three valid and reliable outcome tools; the Adolescent and Pediatric Pain Tool (APPT), the PedsQL (generic module) and the Gillette Functional Assessment Questionnaire (FAQ), to compare these results with the normal population and report on the responsiveness of the PedsQL (generic module) in this population experiencing the surgical interventions.

The sample consisted of fifty two children (36 male and 16 female) with lower limb length discrepancy greater than 3 cm or angulation deformity who were enrolled in a feasibility study with ethical approval of a randomized controlled trial (RCT) investigating the use of botox to alleviate pain and improve quality of life during the lengthening or correction by distraction treatment. The children and/or their parents completed the questionnaires measuring HRQOL, functional mobility and pain. Only the baselines measures were used in the analysis.

At baseline the quality of life as measured by the PedsQL was slightly but statistically significantly lower than the general pediatric population. The functional ambulation as measured by the FAQ was 9.2; slightly lower than the maximal score of 10. Seventeen out of forty-six children reported pain and the mean intensity of pain was 10.2 mm (range 1-64) on the visual analog scale.

The PedsQL physical health subscale scores and the FAQ ambulation scores drop significantly through the distraction phase gradually returning to pre-operative levels by 3 months post frame removal. Quality of life scores were actually slightly higher than the baseline scores for the physical health domain as reported by both parents and child. The differences in HQOL scores between time points of the distraction process were statistically significant. This study validates that these tools are sensitive and responsive to the post operative changes in children with a lower limb length discrepancy or deformity and provides important information about quality of life, physical health and mobility in this population.

8:10 am / CS #2

SURGICAL ROLE IN TREATMENT OF LARGE NEUROFIBROMAS IN CHILDREN WITH NFI

*Federico Canavese, MD; J. Ivan Krajbich, MD, FRCS(C)
Shriners Hospital for Children, Portland, OR*

We reviewed our experience with complete or partial excision of large plexiform neurofibromas. Our modification of surgical technique allows to a surgical approach to even very large, proximally situated tumors with significant vascularity. Only complications encountered were delay in wound healing with overall very satisfactory result in all patients. In our opinion, surgical treatment is a very viable option for children with these generally large lesions previously shunned by the surgeons.

8:20 am / Paper #6

RECONSTRUCTIONS IN CHILDREN WITH PERICOXAL MALIGNANCIES - SURGICAL, PROSTHETIC, ORTHOTIC AND REHABILITATION ASPECTS

Shannon Kelly, MPT; Kelly Alexander, RN; Sabrina Jakobson-Huston, CPO; J. Ivan Krajbich, MD, FRCS(C)

Shriners Hospital for Children, Portland, OR

Malignant lesions in the proximal femur and pelvis are relatively uncommon in children and adolescents. Yet, when they occur they invariably present a major challenge to the treatment team. Skeletal growth, high functional demand and potential long-term survivorship longevity may be significant factors. All modes of reconstruction may need to be applied - biological, endoprosthetic, exoprosthetic and Orthotic techniques all have their role.

We report on our experience with this group of patients with particular emphasis on biological reconstruction with the aid of orthotics and prosthetics.

8:40 am / CCP #2

**CHALLENGING CASE: THE USE OF DYNAMIC STRETCHING,
PROGRESSIVE ANKLE JOINTS AND QUICK RELEASES TO IMPROVE ROM
AND GAIT EFFICIENCY THROUGH PROGRESSIVE PREVENTION OF
CROUCH GAIT PATTERN IN THE PATIENT WITH CEREBRAL PALSY**

*Keith M. Smith, CO, LO,
Orthotic & Prosthetic Lab, Inc, St. Louis, MO*

The Problem: Our challenging case is not unique but rather very common in the patient with Cerebral Palsy population. The patient is a spastic diplegic that has tight hamstrings with resultant limited ROM in sagittal plane of the knee. A crouch pattern of gait is the result and only option for ambulation for this child. The compensatory gait pattern causes early fatigue of the Quadriceps causing limited ambulation time. The crouch pattern also leads to further progression of the tightening of the hamstrings and further deformity. Numerous ideas and modalities have surfaced in this highly debatable topic as the real question becomes how a practitioner treats this patient in the most beneficial manner to prevent further deformity and also allow for a better gait pattern that can lead to increased comfort and efficiency for ambulation.

The Solution: While the problem is quite common, our solution is quite unique. For this patient, we addressed our goal with two modalities. We used dynamic stretching to the knee nocturnally and long seated stretching as well for a short period each day while watching TV, reading a book, doing homework, etc. Our second faculty was to use an AFO that provided the patient ambulation with a GRAFO, or anterior AFO, that allowed the patient to be still crouched by setting the ankle in dorsiflexion, but that could be progressively changed to give more knee extension moment as the ROM increased at the knee to allow for the change. The use of quick release components also allowed for the thigh section and lateral bar of the dynamic orthosis to be added also for ambulation that gives a quick efficient way to add extension assist to the knee in ambulation. Again, the goal is increased ROM with less crouch gait pattern facilitated by the implementation of dynamic stretching and also progressive adaptations to the ambulating AFOs as ROM increases.

8:55 am / CCP #3

**BILATERAL HIP DISLOCATIONS WITH MULTIPLE SITES
OSTEOMYELITIS AND PSOAS ABSCESSSES - TREATMENT AND
REHABILITATION: CASE REPORT**

*J. Ivan Krajbich, MD, FRCS(C); Shannon Kelly, MPT; Kelly Alexander, RN
Shriners Hospital for Children, Portland, OR*

Case presentation of a Sudanese boy with history of traumatic fracture dislocation of the right hip complicated by bilateral septic hip dislocations, spinal and pelvic osteomyelitis and unilateral psoas abscesses. This occurred as a result of traumatic injury in his native Sudan, followed by unconventional, though culturally acceptable, treatment by the village medicine man.

Discussion of staged management and rehabilitations with emphasis on the long term issues.

9:20 am / Paper #7

THE INCIDENCE OF FALLING IN AMBULATORY CHILDREN WITH CEREBRAL PALSY

*Michael Brandt; Dennis Hart, MD; Anita Bagley, PhD
Shriners Hospitals for Children Northern California, Sacramento, CA*

Introduction: One indication for injections of botulinum toxin into the lower extremity muscles of ambulatory children with cerebral palsy is excessive falling. Frequency and severity of falling in this population has not been documented. The purpose of this preliminary study was to gather parent reports of issues related to balance and falling including impact on participation in activities and wear on clothing.

Methods: Parents of a convenience sample of 69 children ranging in age from 3 to 17 years and including 42 males and 27 females completed a “Fall Questionnaire”. The University of California, Davis Medical Center Institutional Review Board approved the use of this questionnaire. The questionnaire consisted of six sections: Balance, Falls, Activities, Clothing, Planned Procedures, and Recent Procedures. Children were categorized based on use of orthotics and assistive devices. An assistive device (AD) was crutches or a walker. Within the sample, 29 children walked independently, 22 children walked using orthotics, 12 children walked with an AD, and six children walked with orthotics and an AD. Analysis of variance was performed on reported frequency of falling using the defined categories above. Fisher’s Exact Test was performed on yes/no categorical data for five questions to determine the association between answer frequencies and ambulatory categories. For the Exact Test, the ambulation categories were collapsed to 51 children without assistive devices and 18 children with assistive devices.

Results: Table 1 shows the average falls per day for each ambulation category. There was no statistically significant difference between groups.

Table 1: Average and Range of Falls per Day

Ambulation Category	Average (falls/day)	Range
Independent	1.8	0.1 to 7.5
AFO	2.2	0 to 10
Walker/Crutches	1.9	0 to 7.5
Walker/Crutches and AFO	1.1	0.1 to 3

Table 2 shows the percent of “yes” responses. Parents of children who use ADs report significantly more problems with balance and more activity limitations due to falling than parents of children without ADs. There is also a trend for parents of children with ADs to be less concerned about their children tripping and falling. There was no difference

between groups regarding children falling more than peers or the impact of falling on clothing or shoe wear.

Table 2: Frequency of Concerns

	Balnce Problem	Concern with Falls	Fall more than Peers	Prevent Activities	Clothing Wear
No AD	75%	76%	80%	31%	45%
With AD	100%	56%	89%	56%	33%
p-value	0.012	0.060	0.216	0.045	0.154

Conclusions: Overall, parents of ambulatory children with cerebral palsy report concerns with balance and falls, including falling more than their peers. Use of an assistive device reduced concerns about falling. About 40% of the parents queried reported that their child's falling had negative impacts on participation in activities and one clothing wear. This survey will be used to assess changes in falling patterns after botulinum toxin injections to the muscles of the legs.

9:30 am / Paper #8

FALLING EPISODES IN CHILDREN WITH CEREBRAL PALSY- ANALYSIS FOR RATIONAL DESIGN REQUIREMENTS OF PROTECTIVE HEAD GEAR

Vipul Shah, MS; Mansi Agarwal, BPT; Himanshu Singh, DPOE; Sunil Singh, BPT; Md Alim, BPT

Jubille Girls Degree College, Lucknow, India

Introduction: Protective helmets have been indicated in children with neurological conditions, this includes children with epilepsy and cerebral palsy, the aim of the study was to find out the incidence of injury to forehead /face /chin and the injury to back of the head due to falling episodes in children and to rationalize orthotic prescription for protective head gear.

Methods And Materials: From our hospital database 50 children with cerebral palsy were taken up for study, there were 24 Dopa Responsive Dystonics(DRD`S) and 26 pure spastic children responsive to tizanidine,all efforts were made to make sure that the two groups were matched in terms of age,gmfcs stage, amount of therapy and co morbidities no patients with concurrent epilepsy were taken up in either of the study group.

The parents were asked telephonically whether: 1) which direction does the child fall; 2) how often does the child get injured; 3) what is the general site of injury; 4) have they ever needed to go to a physician/hospital to get these injuries treated.

Concurrent analysis of hospital records was done to: 1) find out the subtype of dystonia; and 2) the physical parameters in examination which was all performed by the same pediatric orthopedic surgeon to reduce interobserver bias.

Observation: A total of 24 DRD`S were further divided by clinical records into 15 hypertonic type of DRD`S and 9 hypotonic type of DRD`S .Analysis of the hypertonic type of DRD`S showed that all except one fell backwards, All except one hypotonic type of dystonia fell forwards and all spastics except 2 fell forwards

Spastic children who fell backwards had grade 4+ spasticity predominantly in the hamstrings.

Though all children kept on getting minor cuts and bruises, only one child needed to go to the hospital for stitches and there were no major incidents of head injury

Results: We have been able to analyze the direction of falling episodes and found that the direction of falling episodes correlate with the type of cerebral palsy and vice versa,these observations give make it easier for the treating physician to make recommendations for orthotic head gear forward falling children need more protection on the chin and face/forehead while backward falling children need more protection of their caput.

Hector Kay Lecture

10:30 am

PRE-SCHOOL MYOELECTRIC FITTINGS: A 30 YEAR PERSPECTIVE

Sheila Hubbard, OT, PT

Bloorview Kids Rehab, Toronto, ON, Canada

This presentation has two major objectives. The first is to provide a historical account of the use of myoelectrics in the field of children's prosthetics and the development and evolution of a specialized, pre-school program at Bloorview Kids Rehab. The second is to utilize a literature review to identify the issues which have generated the greatest interest and/or controversy in regards to pre-school fittings and to see how the various events and investigations have led to agreement or continued debate today. Major issues of concern and results of the experiences of our selves and other prominent clinicians will be included in an attempt to determine what we have learned about the practice of younger age fittings over the past 30 years and ultimately address the question, is it worthwhile to fit myoelectric prostheses to pre-school aged children?

Scientific Session IV – Upper Extremity Prosthetics

11:15 am / Paper #9

AGE AT FIRST PROSTHETIC FITTING AND LATER FUNCTIONAL OUTCOME IN CHILDREN AND YOUNG ADULTS WITH UNILATERAL CONGENITAL BELOW-ELBOW DEFICIENCY: A CROSS-SECTIONAL STUDY

Karin Huizing, MD; Heleen A. Reinders-Messelink, PhD; Carel G. B. Maathuis, MD, PhD; Mijna Hadders-Algra, MD, PhD; Corry K. van der Sluis, MD, PhD

Introduction: Little evidence for a relationship between the age of fitting of a first prosthesis in children with a unilateral congenital upper limb deficiency and functional outcomes is available in literature. Clinical practice of the introduction of a prosthesis is guided by clinical experience rather than by evidence-based medicine.

It is suggested that initial prosthetic fitting at young age is associated with higher prosthetic skills as the child grows older in comparison to fitting at older ages. Early prosthetic fitting (less than one year of age) may lead to more motor strategies which allow for better adaptation to specific situations. As such, a higher rate of prosthetic use and a better functional outcome in those patients who were fitted with a prosthesis at a young age may be expected.

Aim: To evaluate whether prosthetic fitting before the age of one year is associated with better outcomes in children with unilateral congenital below-elbow deficiency compared to children fitted after the age of one. A better outcome is defined as better functional use of the prosthesis, higher number of years wearing the prosthesis, better motor skills or more satisfaction.

Design: Cross-sectional study

Subjects: Twenty subjects aged 6-21 years; 5 prosthetic users and 15 non-users.

Methods: The Child Amputee Prosthetics Project-Prosthesis Satisfactory Inventory and the Prosthetic Upper extremity Functional Index were used to assess patient satisfaction and functional use of the prosthesis. Videotapes of tasks of the Skill Index Ranking Scale were used to assess motor performance. Users were tested with and without their prosthesis.

Results: Initial prosthetic fitting before one year of age was related to use of a prosthesis for at least 5 years ($p = 0.01$). Age at first fitting was not associated with satisfaction with the prosthesis, functional use of the prosthesis or motor skills. Parents of prosthetic users were more satisfied (median score 3.0; range 1.0-4.0) with the benefits of prosthesis experienced by their child in daily activities than the parents of the non-users (with respect to their child's most recent prosthetic device) (median score 1.0; range 0.0-3.0, $p < 0.05$).

Children and young adults with unilateral congenital upper limb deficiency performed well in daily activities. A comparison of prosthetic users and non-users showed that the non-users performed tasks with more ease ($p = 0.003$). Discrepancies between ease of performance with prosthesis and usefulness of the prosthesis as well as between capacity and performance of activities were found. The video assessments showed impaired movement adaptation to some of the tasks in 6 subjects of which 2 were prosthetic users.

Conclusions: Early prosthetic fitting has a limited effect on prosthesis use during later stages of life. The limited effect may indicate that the disadvantages of prosthesis use in early life, i.e. interference with sensory exploration by the affected limb, outweigh the advantages associated with early fitting. Neuromotor condition may be one of the factors that determine whether a child will profit from a prosthesis.

11:25 am / CS #3

THE ANCHOR FOR UE USE

*Debra Latour, MEd, OTR/L
Shriners Hospital for Children, Springfield, MA*

Occupational therapists help clients develop skills to live as independently as possible and to improve the quality of their lives. I have invented a new way of harnessing a body-powered prosthesis that will help to achieve these goals. This design eliminates the harnessing which is often a source of complaint and one reason why users reject prostheses.

Traditionally, a body-powered prosthesis is activated by a figure-of-eight or -nine harness system, using the contralateral shoulder as the power source. Many users of this system complain of discomfort from the harness rubbing on the skin especially in the axilla, asymmetry of the shoulders, pain in the contralateral shoulder, difficulty performing bilateral tasks, and diminished cosmesis.

The Ipsilateral Scapular Cutaneous Anchor (“Anchor”) system derives its primary source of control from the ipsilateral scapula. The “Anchor” requires a tighter fitting socket for suspension. The cable is attached to a plastic patch in the center of which is a metal button. The patch is adhered to the skin at the scapula. The terminal device is then operated by abducting/protracting the shoulder on the same side as the residual short limb. Because the harness is eliminated, the benefits of the system include increased comfort, improved cosmesis and decreased impingement at the axilla. Other benefits include more symmetrical bilateral muscle development, decreased repetitive motion in the contralateral shoulder and increased function particularly during bilateral upper extremity tasks. This technology is in patent-pending status with the US Patent Office. The Anchor has been used in treatment since August 2006.

Method: Twenty four subjects; ages 6 -20 years with congenital or acquired unilateral trans-radial deficiency terminal device have chosen to use the Anchor. The Anchor is attached to the scapula ipsilateral to the limb deficiency.

Each patient is evaluated in a multidisciplinary clinic, using a screening tool and interview to identify suitable candidates. Once prescribed by the MD, the prosthetist fabricates a tighter fitting forearm socket. The prosthetist and the OT fit the patient with the Anchor. Prosthetic training is provided which includes application, skin hygiene, use and care of the Anchor. Baseline testing is completed using the PSI and the U-BET and clinical observations using both the traditionally-harnessed prosthesis and the new Anchor activated prosthesis. The patient uses the new prosthesis for three months and then returns for retesting utilizing the same tools.

Results: Data from retrospective chart review suggests ease in application, continued success with prosthetic use, increased use (tolerance, frequency), ease of use (intuitive motor planning during bimanual tasks) and patient satisfaction (improved comfort, cosmesis). The Anchor is simple in design and the parts are durable, easily available and affordable). Implications for use include an anchor power system for individuals with trans-humeral deficiency or to dynamize an elbow, wrist or hand orthosis to increase function among individuals with spinal cord, brachial plexus or hemiplegia.

Conclusion: This device enables individuals with upper extremity limb deficiency to achieve greater levels of functional independence and improved quality of life.

11:35 am / Paper #10

USEFULNESS OF A BELOW ELBOW PROSTHESIS

Joanne Shida, MA, OTR/L

Shriners Hospitals for Children, Child Amputee Prosthetics Project, Los Angeles, CA

Forty children with a unilateral below elbow limb deficiency were re-evaluated with the Prosthetic Upper-Extremity Functional Index (PUFI). These children were initially evaluated approximately 5 years ago in conjunction with the UCBED Multi-Center grant project headed by Michelle James, MD. For this study, children answered computerized questions regarding the usefulness of the prosthesis and how they functioned with the prosthesis for a variety of tasks. The current responses are compared with the responses collected 5 years ago: either to responses the child answered themselves (if they were 8 years or older at the time of the initial evaluation) or to their parents' responses (if they were under 8 years at the time of the initial evaluation).

PUFI Part I assesses the usefulness of the prosthesis for eight general types of activities (At Home Relaxing, At Play, At School, At Social Events, For Dressing, For Appearance, For Personal Care and For Sports/Recreation). For PUFI Part II, five questions each are asked about the completion of 38 tasks. Data and results, pertaining to how well the child uses the prosthesis and how useful the prosthesis is, were collected for the 40 children.

Older children initially scored themselves higher regarding usefulness of the prosthesis for general categories of activities. Parents also initially scored their child (younger than 8 years) higher than how their child now scored themselves in general activities. Therefore, combining all children, scores decreased in all general categories. Scores for usefulness at school remained the same for all children, with younger children indicating the most usefulness at school (96%).

For completion of 38 tasks with and without the prosthesis, older children initially reported higher scores in using the prosthesis actively and with the usefulness of the prosthesis than their reported current use. There was very little change in how well they used the prosthesis and in how well they did without the prosthesis. Parents initially scored their child lower in how their child actively uses the prosthesis, how well the child does with the prosthesis, and how the child functions without the prosthesis than the child

responded now. Children scores were lower now for usefulness with the 38 tasks than their parents reported initially. Combining all the children, scores increased in using the prosthesis actively, how well they used the prosthesis and how well they did without the prosthesis; only usefulness decreased. Usefulness with a prosthesis scores decreased in all ages and how the child does without the prosthesis scores increased in all ages.

Changes in usefulness will fluctuate depending on the child's age, activities, and needs. These children have all been wearing a below elbow prosthesis for a long duration of time, would be considered good users with the prosthesis, and have changes in their general use patterns over time.

Symposium I

12:05 pm

CONGENITAL, UPPER LIMB PATIENT HISTORY AT THE INSTITUTE OF BIOMEDICAL ENGINEERING

*Carly Genn; Jonathan Lajoie; Katlynn Craig; Wendy Hill, OT; Greg Bush, BA, CP(c);
Edmund Biden, PhD*

Institute of Biomedical Engineering, Fredericton, New Brunswick, Canada

The Institute of Biomedical Engineering (IBME) at the University of New Brunswick is in the midst of a review of all past and present clients. This was done by an extensive review of every individual's chart from the first time they were seen until their most recent visit. The main goal of the chart review was to describe individual and group wearing patterns of prostheses over time. These data represent both the congenital population, and individuals with acquired limb loss. The review also determined the client's frequency of visits and reason for visits based on what type of prosthesis they used and their age.

In 1981, the IBME opened its own prosthesis fitting center focussed on the fitting of upper extremity powered prostheses. Now, the IBME includes both clinical fitting facilities and a state of the art biomedical engineering research center. The clinic is available to people who have been referred by their physician, and has clients mainly from Atlantic Canada. The data collected up to this point represents approximately two thirds of the total population of clients who have attended the clinic. These preliminary results show that there are approximately 48% individuals with congenital limb loss deficiencies and 52% individuals with acquired limb loss. Currently IBME is one of the larger upper-limb prosthetics clinics in Canada. Many patients have attended the clinic over extended periods of time, so there is an opportunity to examine each individual's progress.

The clinic's targets for a congenital client are to fit a passive prosthesis at 3-6 months; fit their first active prosthesis at 12-18 months (usually myoelectric with a single electrode site); and then fit a two site electrode system at 3-5 years of age. These correspond to developmental milestones. Recreational attachments are most commonly requested by the clients after 4 years of age. Our results coincide with the upper limits of these targets as the median age of first prosthesis use for the passive and myoelectric are 7 and 19

months respectively. Passive usage was peaks at a median age of 12 months and declined the ages of 1 and 3 years when patients would have been fitted with their first powered prosthesis.

Our preliminary data suggest that the time between visits increases as the client gets older. Also, the nature of these visits are somewhat different for myoelectric and passive wearers. Passive wearers most commonly come to the clinic due to fitting reasons, and myoelectric wearers for component or function reasons.

The clinic has fitted over 2000 prostheses to date and averages approximately 45 fittings per year. This indicates the level of expertise and experience that is present at the clinic which gives the patient an excellent chance at successfully integrating of their prosthesis into their lives. A broader range of data for the natural history of prosthesis use will be presented at the conference.

Scientific Session V – To Knee or Not To Knee

2:00 pm / CS #4

**BRACKETT TIBIAL EPIPHYSIS - NEW TYPE OF TIBIAL HEMIMELIA:
CASE REPORT**

*J. Ivan Krajbich, MD, FRCS(C)
Shriners Hospital for Children, Portland, OR*

Brackett epiphysis also known as a delta epiphysis is an uncommon but well recognized congenital abnormality affecting the extremities. It has been described in a literature in both phalanges and metatarsal/metacarpal bones. We present a case of a child diagnosed as a tibial hemimelia with all the typical clinical manifestations.

Yet the underlying defect was a previously unreported brackett epiphysis of the tibia. Case demonstrations, management and expanded classification of tibial hemimelias are presented.

2:10 pm / CS #5

**BILATERAL LOWER EXTREMITY PROSTHESIS FOR AQUATIC
RECREATION ACTIVITIES**

*Eugene Banziger, CPO
Kelowna General Hospital, Kelowna, BC, Canada*

This paper will describe the innovative approach to fabricate and fit bilateral swimming devices for a bilateral KD amputee. The paper will describe an 8 year old male, who was born with Bilateral Longitudinal Medial Hemimelias, but subsequently ended up with bilateral Knee Disarticulations. Beside his daily prosthetics he wished to have some devices for aquatic use. The presentation will describe the history, assessment, fabrication, results and the innovating devices to be worn around the pool and can have fins donned once close to the water or pool's edge.

2:30 pm / CS #6

DEVELOPMENT OF AN INFANT/TODDLER PROSTHETIC KNEE TO ALLOW KNEE FLEXION FOR CRAWLING AND 'PULLING TO STAND' AND KNEE STABILITY FOR STANDING, CRUISING, AND WALKING.

Peter Kapelke, CPO

Shriners Hospital for Children, Salt Lake City, UT

Traditionally, infants and pre-ambulatory children who present with trans-femoral or knee disarticulation limb deficiencies are initially fitted with straight leg prostheses (no prosthetic knee). The initial 'cruising' (walking sideways while holding on to furniture or other supports) and early walking stages require total knee stability. Buckling of a prosthetic knee would make the fragile first steps considerably more frustrating. Moreover, therapists and parents cannot verbally communicate instructions to a toddler on use of the prosthetic knee.

On the other hand, recent studies have confirmed an improved mobility in crawling in children when fit with a free knee. A straight leg prosthesis serves only as an anchor to the early crawler - and most AK or transfemoral crawlers are much more mobile without a prosthesis. Despite advances in prosthetic knee technology, no pediatric knee addresses the need for free flexion for crawling/pulling to standing and stability during cruising and early steps: those that provide stability do not flex adequately for crawling, they are generally too heavy in weight for an infant, and they can rarely be mounted to match the contra-lateral knee center

Presented here is the evolution of a solution to address the need for an infant knee which allows free flexion during crawling and stability during cruising and early ambulation.

For Bridget, a congenital knee disarticulation amputee aged nine months: a single lateral stainless steel free motion joint with optional drop lock was riveted to the side of a laminate socket with knee center approximating that of the sound side. A hollow laminate shin section with an attached baby sach foot was riveted to the distal bar of the side joint. Results: the baby crawled and moved very well with the prosthesis. Bridget learned to pull to stand, extend the prosthesis and even 'cruise'. However, the knee flexed during Bridget's attempted at a sagittal plane step and she fell without the knee locked. [VIDEO]

Parents were instructed to manually lock the knee when Bridget pulled to stand. This proved to be overly burdensome as they would have to run over to Bridget wherever she was, bend down, and drop the droplock - by which time Bridget was ready to sit down and crawl again. In fact, Bridget - as any early walker - sat down and pulled up over and over again in the span of minutes.

To address this inconvenience, I developed a remote control electric locking joint which parents could activate at a distance without having to bend over. Unfortunately when I finished the prototype Bridget seldom crawled and was fitted with a straight leg prosthesis. Nonetheless, this idea was submitted to Shriners H.Q. for patent consideration.

In pursuit of a self regulating mechanism (so that parents don't have to watch their kids get up and down and try to remotely lock the knee) I developed the gravity activated electric locking knee. No direct conflicts were revealed in a patent search and patent application was submitted by Shriners H.Q. in Sept. 2008. This knee uses a gravity activated electric switch and other control mechanisms to lock the knee at standing (when the shin section is vertical) and unlock the knee when the child sits, falls down, or crawls. I am currently working on a model prototype of this device.

Symposium II

2:40 pm

MULTI CENTER EXPERIENCE IN USING PROSTHETIC KNEES IN INFANTS AND TODDLERS

Brian Giavedoni, CP¹; Colleen Coulter-O'Berry, MSPT, PCS¹; Owen A. Larson, CP²; Janet G. Marshall, CPO³; Sandy Smith, MSPT³; Michael L. Schmitz, MD¹, Moderator

Multi Center Symposium

¹Children's Healthcare of Atlanta, Atlanta, GA

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³Shriners Hospitals for Children, Tampa, FL

The practice of early prosthetic fitting with articulated knees has generally created controversy within the medical community. Currently, the literature indicates that the knee unit may be present but locked or not present at all in the transfemoral or knee disarticulation prosthesis. The consensus in the literature is that activation is delayed until the patient is between four and six years of age. Currently, as the number of facilities placing knees in infants and toddlers increases, treatment protocols vary from clinic to clinic. Several pilot research studies (Scottish Rite Texas and Children's Healthcare of Atlanta) have confirmed that the subjects are capable of flexing the articulated knees with no apparent stability concerns. Observational results of additional activities suggest developmental advantages with the articulating knee.

Incorporating knees into this population presents its own distinctive set of challenges due to both space limitation and lack of appropriate technology. Those centers that have been placing knees in initial or very early prosthetic fittings have the very young amputee overpowering and working the prosthetic knee beyond its functional limits. The expertise from three clinics will be presented to help integrate treatment protocols and unique problem solutions. Case studies with emphasis on early intervention will demonstrate the capacity for beneficial change of various interventions. Audience participation will be strongly encouraged.

Objectives:

1. To identify prosthetic knee function in infants and toddlers with high amputation levels that were provided with prosthetic knee units
2. To identify the challenges in using knees with this population
3. To discuss prosthetic knee options for the infant, toddler and young child
4. To demonstrate the efficacy of various treatment protocols
5. To challenge current convention with evidence based practice

Goals: the participants will:

1. Gain knowledge of how an infant and toddler can incorporate prosthetic knee function into age appropriate gross motor activities
2. Understand the effects of early prosthetic fittings on walking and running in the toddler and very young child
3. Familiarize themselves with the types of prosthetic knees currently available to the infant, toddler and very young child.
4. Discuss the effectiveness of early prosthetic knee fittings in this young population
5. Discuss the challenges of clinical research at the same time identifying the need for multicenter collaboration to provide the evidence to substantiate the cost benefit of providing prosthetic knee units at initial or early fitting.

Scientific Session VI – Evidence-based Medicine

4:15 pm / Paper #12

**CRITICALLY APPRAISED TOPIC: APPLICATION OF EVIDENCED BASED
MEDICINE PRINCIPLES TO REVIEW THE LITERATURE FOR THE
TREATMENT OF CHILDREN WITH UNILATERAL CONGENITAL BELOW
THE ELBOW AMPUTATIONS**

*Colleen Coulter-O’Berry, PT, MS, PCS; Stephen Allison, PT, PhD
Children’s Healthcare of Atlanta, Atlanta, GA
Rocky Mountain University, Provo, UT*

Critically Appraised Topic (CAT), is a standardized summary of research evidence organized around a clinical research question.¹ A CAT serves as a means for translating the information found in the literature to clinical practice through a systematic search and review of the literature to answer a clinical question about the patient or diagnosis of interest.^{1 and 2} Components of a CAT include: development of the clinical question; clinical bottom line (clinical value of the research); summary of key evidence (study design, sample, methods and procedures; outcome measures and results); strengths and threats of the study; and the CAT authors judgment of the validity of the study and clinical value to their patient. The purpose of this CAT is to apply the principles of evidence based medicine to support the best current treatment of children with unilateral congenital below-elbow amputations at Children’s Healthcare of Atlanta.

Prosthetic management of children with unilateral congenital below-elbow amputations has drawn controversy over the years. Following extensive search of the literature, 4 articles relevant to the clinical question were reviewed with 2 studies specific to the question. In a combined retrospective and prospective case series study of 260 children from 1954 to 2004, Davids et al. reported optimal outcomes of prosthetic fitting in children before the age of 3 years and with those children who received intensive OT training at the time of activating the terminal device. However, this study is reported to be of Level III evidence.³ James et al. in a larger multicenter study of 489 children comparing wearers to non-wearers concluded that prostheses may help with social acceptance and certain specific activities, but they do not appear to improve function or

quality of life.⁴ This study was reported to be of Level II evidence. Due to the higher level of evidence, larger number of subjects enrolled in the study, multicenter investigation and incorporation of existing internationally recognized measures, the James et al. study was chosen for the CAT to answer the clinical question posed for this review: *In a 6 month old infant with congenital below the elbow amputation, does prosthetic fitting offer increased function and patient satisfaction compared with no prosthetic fitting?*

The results will be presented addressing each of the components of the CAT. Following the CAT analysis of the James et al. study, the CAT author's clinical bottom line concluded that the assessment of functional data in this study does not support prosthetic fitting of children with congenital below the elbow amputations even at early ages. There are many threats to both internal and external validity in the measurement of function that should make the reader cautious if applying the results to patients in their clinical practice. However, the Health Related Quality of Life and QOL measures appear valid and apply to the patients in Children's clinical setting. However, these do not support the treatment philosophy at Children's Healthcare of Atlanta as our patients receive intensive therapy throughout all aspects of prosthetic management with coordination and collaboration of therapy providers in the child's community. Perhaps the research question should be modified to investigate the effects of training on function and satisfaction outcomes in children with congenital below the elbow amputations.

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Saturday, May 23, 2009

Scientific Session VII – Femoral Abnormalities

8:00 am / Research Award Winner

**PHYSICAL APPEARANCE OF PROSTHESIS AFTER SYME/BOYD
AMPUTATION VERSUS VAN NES ROTATIONPLASTY IN ADULTS WITH
PROXIMAL FEMORAL FOCAL DEFICIENCY (PFFD)**

Olga V. Vigna, MS

Boston VA Healthcare System, Boston, MA

Largely due to the abnormal appearance, the birth of a child with PFFD often engenders feelings of guilt, disappointment, fear and anxiety in parents and physicians alike. This negative reaction to the child's abnormal appearance continues through adolescence and into adulthood. A child affected by such a negative reaction to his appearance will find it much harder to experience the joys of childhood. Thus, as the child grows, he lacks the social skills and confidence that his peers have. This, coupled with the abnormal appearance, may affect future social successes in such varied areas as romance and career advancement. As a result, physical appearance must be taken into account when determining whether a patient should get a Syme/Boyd Amputation versus a Van Nes Rotationplasty procedure.

Three PFFD amputees were recruited for the study: 1) after Van Nes Rotationplasty; 2) after Boyd Amputation; 3) initially, Van Nes Rotationplasty, then 2 years later - Syme Amputation. Photographs of amputees from waist down were taken from 3 angles: front, prosthesis side of the body, back. Two different Questionnaires were composed: for amputees and for the independent viewers.

One hundred and seven (107) adult subjects were recruited. The Independent Viewers were shown photographs of PFFD patients, first, with prosthesis after Van Nes Rotationplasty amputation, and second, with prosthesis after Boyd amputation. The subjects had been asked to complete a questionnaire giving their opinion of the physical characteristics of the prosthesis and physical appearance of the people in the photographs. The amputees were asked to fill out the Amputee Survey over the phone interview.

The result of this research indicates that superior physical appearance of the prosthesis after Boyd/Syme Amputation has a positive impact on the social, professional, and private life of a patient. The purpose of this research paper is to aid orthopaedic surgeons and all who are involved to make the best surgical and prosthetic management decision for patients with PFFD, to improve their social acceptance and to make their life easier.

8:20 am / Paper #13

**LIMB LENGTH DISCREPENCY IN PROXIMAL FEMORAL FOCAL
DEFICIENCY**

Scaduto, Anthony, MD, Shriners Hospitals for Children, Los Angeles, CA

Farnng, Eugene, MD, UCLA Department of Orthopaedics, Los Angeles, CA

Longacre, Matt, MD, USC Department of Orthopaedics, Los Angeles, CA

Sohn, Roger, MD, Mission Hospital, Mission Viejo, CA

Bowen, Richard, MD, Shriners Hospitals for Children, Los Angeles, CA

Purpose: Treatment of patients with proximal femoral focal deficiency (PFFD) depends upon the prediction of limb length discrepancy at skeletal maturity, often when the child is only an infant. Treatment may include foot ablation and knee arthrodesis; unfortunately, the residual limb length is often too long. Our goal is to evaluate limb lengths in the affected and unaffected limbs to help predict the ideal nature and timing of treatment.

Methods: Hospital records from a single institution were reviewed to identify patients with unilateral PFFD, with or without fibular deficiency. The date and type of any relevant surgeries was recorded, along with the lengths of the affected and unaffected femora and tibiae.

Results: 62 patients with unilateral PFFD and adequate radiographs were identified. Grouped according to Aitken classification (A, B, C, D), the affected femur measured (67%, 43%, 42%, 22%) of the contralateral side, while the affected tibia was (92%, 87%, 94%, 98%) of the unaffected side. Limb proportionality remained constant in the 30 patients that had observation prior to any surgery (femoral change: 0.49%; +/- 1.28%; Tibial: 0.14%; +/- 1.72%). 36 patients were candidates for knee arthrodesis (femoral length <60%). Average combined length of the femur and tibia on the affected side was 114% (+/-6.2%) of the unaffected femur. 34 of the 36 patients (94%) would have a stump length too long (>90% of unaffected femur) if both physes were preserved at the time of arthrodesis. The average combined length of femur and tibia at time of presentation was 25.9 cm (range 15.2 to 50.0). If a femoral physis excision was done, all 36 patients would have an estimated residual limb at maturity at least 20 cm in length.

Conclusion: In most cases of PFFD, the tibia on the affected side is nearly normal in length (92% of contralateral side). Preserving the femoral physis at the time of arthrodesis will lead to inadequate room for the prosthetic knee joint. There was no apparent risk of producing too short a residual stump by early resection of the femoral physis in our population.

Significance: Contrary to what is recommended in the literature, the distal femoral physis and often the tibial physis should be excised at the time of knee arthrodesis in most cases to avoid excessive length of the converted limb and need for additional surgery.

8:30 am / CCP #4

CHALLENGING CASE STUDY

*Janet G Marshall, CPO; Pamela Versage, PT; Rene vanWieringen PT
Shriners Hospitals for Children, Tampa, Florida*

The patient is a very active six year old male with right PFFD Aitkens Type A and fibular deficiency who received a symes amputation at one year of age. His first prosthesis was a straight leg without a knee joint. The subsequent three prostheses until the age of five

were modified above knee sockets, exoskeletal, pelite liners, auxiliary silesian belts suspension, with outside hinges at the knee. Clinical evaluation of the patient revealed an adequate femoral length, knee strength and stability to warrant trying a below knee type socket and prosthesis. The patients left side was within normal limits for range of motion and strength. The right PFFD side had hip extension strength of 3.5, but all other strength ranges scored 4 and above. His range of motion on the right had limitations for hip extension, hip internal rotation, and knee extension, but not prohibitive for the plan.

A below knee PTB socket with pelite liner, self suspending symes, exoskeletal construction with a Childsplay dynamic response foot was prescribed. He was admitted for one week to receive physical therapy for transitional gait training. A motion analysis of his previous hinged "AK" prosthesis was performed during his admission. A subsequent motion analysis of the below knee prosthesis was performed six months later for comparison. Technical results and satisfaction of the patient and family will be presented.

9:00 am / Paper #14

FUNCTIONAL COMPARISON OF PROXIMAL FOCAL FEMORAL DEFICIENCY (PFFD) PATIENTS WITH NO CONTIGUOUS HIP JOINT

Kimberly Savarino; Anita Bagley, PhD; Joel Lerman, MD; Sherry Middleton; Richard Haynes, MD; Douglas Barnes, MD

Shriners Hospital-Northern California, Sacramento, California

Shriners Hospital-Houston, Houston, Texas

Introduction: PODCI scores were compared for patients with PFFD with no contiguous hip joint who 1) use an extension prosthesis, 2) underwent a foot amputation and knee fusion, or 3) underwent foot a amputation without knee fusion. Their scores were also compared to the PODCI scores of normal children.

Methods: Nineteen patients were assessed, and nineteen parent PODCI scores were collected. The average age of the children when the PODCI was taken was nine years old. Fourteen of the patients were males; five were females. All of the patients were unilateral.

Results: (Table 1)

Patient ages among PFFD groups were similar.

P values are in comparison with normals. No differences with $p < .05$ were obtained when comparing the three treatment groups.

Discussion: There were no significant differences between the groups of extension prosthesis, knee fusion, and non knee fusion patients. All three categories of patients were significantly different from normal children in sports scores. In global function, the surgically treated patients (knee fusion and non knee fusion patients) were significantly different from normal children. While transfer scores were lower for extension prosthesis patients and non knee fusion patients than normal children, the same patients showed

happiness levels higher than normal children. Despite some functional challenges in PFFD patients, the data suggest they remain a well adjusted group.

Table 1				
Mean scores for functional outcomes in PFFD patients				Normal PODCI Scores (Parent)
	extension prosthesis n=7	amputation and knee fusion n=5	amputation and no knee fusion n=7	
Upper	90.1	94.2	93.6	97.6
Xfers	87.6 (p=.03)	94.0	88.7 (p=.02)	99.4
Sports	72.0 (p=.01)	67.6 (p=.0004)	66.0 (p=.02)	93.6
Pain	88.5	78.4	84.3	91.6
Global	84.6	83.6 (p=.0005)	84.0 (p=.02)	95.5
Happiness	94.9 (p=.04)	92.0	93.7 (p=.02)	88.0

9:10 am / CCP #5

A PROSHETIC KNEE JOINT COMPARISON IN AN AMPUTEE WITH AITKEN D PFFD

*Robin Crandall, MD; Matt Morel CPO
Shriners Hospital for Children, Minneapolis, MN*

Above knee prosthetic fitting in patients with PFFD is challenging. Normal walking can be compromised by weakness and instability of the hip. This study compares a 3R60 knee joint and a microprocessor controlled knee joint on a patient with PFFD and unstable hip (Aitken Type D). The socket was duplicated to achieve correct alignment for the C-Leg; the foot remained the same for both prosthesis. The patient was given 4 months to adapt to the C-Leg with data and questionnaires collected before and after C-Leg use.

There were minor measurable changes in the kinematic and kinetic data between the two knees with less pelvic obliquity asymmetry. The oxygen consumption remained the same in normal walking. There was slight improvement in speed on a downhill timed test. There were two questionnaires given pre and post C-Leg. The more favorable results were after C-Leg use. There was a perceived increase in speed with less falling or stumbles. Overall the patients experience was more positive with the C-Leg while the objective data provided little difference between the two knees.

CLINICAL CLASSES OF GEL LINERS

Gerald Stark, CPO/L, FAAOP

Vice-President of Education and Product Development

The Fillauer Companies, Inc., Chattanooga, TN

Flexible gel liners are currently regarded as the predominant suspension choice for a majority of lower limb prostheses because serve multiple purposes such as suspension, shear relief, and cushioning. This is especially critical for the amputee at the boundary layer of the skin and interface where studies have shown 74-79.5% of amputees claim to have chronic skin conditions including irritations, ulcers, inclusion cysts, verrucous hyperplasia. 60% of amputees claim to have conditions that can be characterized as moderate to severe to limit prosthetic wear. In the vibrational stiffness profile of the prosthesis which is arranged in series the boundary layer serves as the main component of shock and shear absorption. The popularity of a material that fits intimately, absorbs shear, and feel skin friendly becomes apparent. The design of gel liners has evolved to include many different configurations and can be separated into a number of clinical classes based on: Material Type, Softness, Construction Matrix, Suspension, and Surface Matching. The number of designs currently marketed can be classified and matched to patient need.

The main materials used for gel liners include thermoplastic elastomer (TPE), silicone, and urethane. Each manufacturer can greatly change the composition and softness of the material based on their proprietary formula. TPE is a low-density thermoplastic polyethylene with styrene-butadiene additives that adds rubbery cross linking. Silicone is a thermoset that differs in the catalyzation process with tin (condensation) cure or platinum (addition) cure. Urethane is essentially a highly resilient rubber that will not thin out after repeated loading. Production costs of gel Liners is directly associated with the high pressure molds to form them. From softest to less soft the material can be described as: TPE (20-30 shore 00), Urethane (30-50 shore 00), and Silicone (40-50 shore 00). Softness does vary with the type of fomulation and additives. Durability is usually the converse of softness depending on the construction matrix. TPE were not a viable socket until an outer fabric coating was added to the liner. Until then compression and shear created immediate breakdown. The distal matrix was essential in early silicone gel liners to prevent localized distal circumferential pressure. Custom molded liners can be made with urethane or silicone, but should be reinforced with pin type construction. Vacuum suspension can maximize the durability of liner and has been shown to minimize volume changes of 7-11%. Pin suspension retains the advantages of less proximal bulk and audible positive locking. The amount of surface matching has also changed with the addition of siffer liners and or reinforcing matrices. The stiffer the liner due to the more generic and round the shape. This has the effect of loading the prominences more than matching the surface. TPE may be thermomolded with light heat and custom designs can still be constructed by injecting gel into a simple overmold. Athletes tend to favor custom less soft designs to reduce energy loss whereas geriatrics favor softer designs.

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10:45 am / Paper #17

APPLICATION THE VACUUM ASSISTED CLOSURE IN PEDIATRIC PATIENTS WITH ORTHOPEDIC SEQUELAE OF MENINGOCOCCEMIA: REPORT OF A CASE SUCCESSFULLY TREATED

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Patients who survive the initial acute phase of fulminant meningococemia are at increased risk for serious complications as a result of poor tissue perfusion. It is rare that early surgical intervention is required, as it is relatively difficult to determine the degree of tissue loss early on. Once the patient is stable, debridement of all necrotic tissue is essential and may necessitate extensive removal of skin, subcutaneous tissue, and muscle. Widespread use of the VAC for complex soft tissue injuries has generally demonstrated accelerated wound healing compared to traditional methods.

We report a new possible application of the VAC system in very young patients with loss of tissue due to purpura fulminans secondary to meningococemia.

10:55 am / Paper #18

LANDING PATTERNS IN CHILDREN WITH UNILATERAL LOWER EXTREMITY AMPUTATIONS

*Markita L. Reid, MS, PT; Mark D. Geil, PhD; Colleen Coulter-O’Berry, PT, MS, PCS
Georgia State University, Atlanta, GA*

Most lower extremity prosthetic designs are based on the optimization of walking, and the literature on children with amputations tends to focus on walking and evaluation of the performance of prosthetic foot components during level over ground gait. This study’s aim was to investigate how children with unilateral lower limb amputation land from a vertical drop. Drop landing studies have been utilized previously in a variety of populations, most notably to help clinicians



Fig. 1: Drop landing apparatus, with adjustable height to maintain equal drop distance for each subject

understand the high risk landing pattern that is associated with non-contact ACL injury in male and female athletes. Though it has not been utilized in this context previously, drop landing also represents a useful tool to understand the response of children with limb loss to common functional activities including jumping, playground activities, and step descent.

Previous studies on the kinetics of children walking with unilateral lower limb loss have identified a strategy of force reduction in the intact limb toward symmetry, accomplished with slower walking velocity and decreased step length¹. In subsequent research when walking velocity was controlled, Engsberg et al.² found significantly higher loads on the intact limb. While understanding of asymmetrical loading is important due to long term implications on limb and joint health, no previous research has assessed the kinetics of landing in children with unilateral limb loss, despite the prevalence of landing activities in this population.

In a study approved by the Georgia State University IRB, children with unilateral lower limb amputation (n=5) and able-bodied children (n=5) performed five landing trials from a height of twelve inches. Height was chosen based on State of Georgia standards for maximum height of the last step of a school bus. All children with lower limb amputation had congenital deformities and Syme's amputation. The children included in this study ranged in age between 8-17 years old. Kinetic data were collected and recorded for each trial at 600 Hz using two AMTI force platforms mounted flush with the floor under a custom drop-landing apparatus (Fig. 1). The amputee group was compared to the able-bodied group to determine if child amputees utilized a landing strategy that was different from able-bodied children.

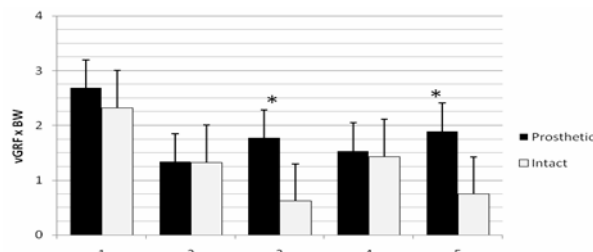


Fig. 2: Mean peak vertical GRF for subjects with limb loss. * denotes significant difference ($p = 0.003$) between limbs

Multiple landing patterns emerged from the results. Four of the five amputee participants experienced larger peak vertical ground reaction forces on their prosthetic limb, though only two of the subjects showed significant within-subjects differences for prosthetic vs. intact limb force (Fig. 2). The children with lower limb amputation had widely varying first contact strategies. One preferred

simultaneous contact, one contacted with the prosthesis first, and three preferred contact with the intact limb. The control group showed a similar mix, though time between foot contacts approached simultaneity in all cases. A difficulty encountered when analyzing the data was an understanding of limb dominance in children with limb loss. Participants self-reported dominant limb by identifying the limb they would use to kick a ball. Results varied in terms of whether the children identified the prosthetic or contralateral limb, and whether hand-dominance matched limb-dominance. When data were stratified by reported limb dominance, the largest temporal contact asymmetries were present in the one child who made first contact with the non-dominant limb. However, asymmetries were generally smaller than expected, implying that children with lower limb amputation

develop similar motor landing patterns and are able to participate in the same tasks as their able-bodied age matched controls.

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11:05 am / Paper #19

THE EFFECT OF POSTERIOR BACKPACK LOADS ON STATIC BALANCE AND POSTURAL SWAY IN CHILDREN WITH UNILATERAL LOWER EXTREMITY AMPUTATIONS

*Kevin J. Wasco, MS; Mark D. Geil, PhD; Colleen Coulter-O’Berry, PT, MS, PCS
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The current academic lifestyle of children requires them to carry a greater load of school supplies within their backpacks leading to increased reports of back pain in school children^{1 and 2}. The increased weight on the back can result in unfavorable forces on the spine and surrounding tissues, leading to compensatory postural adjustments that may increase stresses on the bodily structures leading to pathological back problems and hampering development. Heavy backpacks can be the cause of symptoms such as muscle soreness, back pain, numbness and shoulder pain³. Concurrently, the development of static balance control begins at the age of 2 and continues through the age of 14⁴. The ability of a child to maintain an erect posture is important to maintaining good health.

There has been some insight into the developmental mechanisms that control postural stability during quiet standing and the effects that backpacks have on posture and development; however, there has been one important population that has been neglected – children with lower limb loss. It is not known how the posture and balance of pediatric subjects with lower-limb amputations will change during backpack carriage due to changes in the muscular and structural components that will alter the subjects postural control mechanisms and how they will differ from their able-bodied peers.

Five children with unilateral lower limb loss and five able-bodied age-matched controls (age range: 8 – 17 years old) performed five 40-second quiet standing trials while carrying backpack weights of 0%, 10%, 20%, and 25% of the subject’s body weight. The middle twenty seconds (12000 data points) of each trial were used to

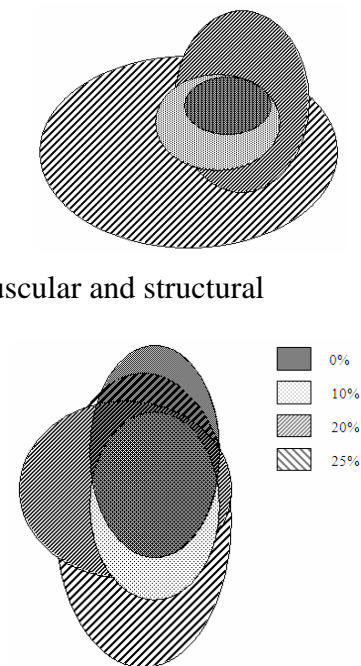


Fig. 1: 95% Confidence Ellipse for children with limb loss (top) and controls (bottom) at different backpack weights.

calculate a series of time-domain and frequency-domain measurements. The protocol was approved by the Georgia State IRB. Kinetic data were collected at 600 Hz using two AMTI force

platforms and used to calculate COP deviation and model the postural sway path. Results were compared across subjects to determine whether there was an effect on postural sway and limb weight-bearing symmetries between the subjects as backpack weight was randomly increased. A 2 x 4 repeated measures general linear model with a factor for group and backpack weight and a significance level of $\alpha = 0.5$ was used to investigate the differences in the postural sway parameters between children with lower-limb amputations and able-bodied children. Individual comparisons were also conducted to assess the differences in the postural sway parameters as backpack weight increased.

Significant differences were found in several variables between weights, but in none of the outcome measures between groups, implying that children with limb loss maintain a similar amount of postural sway as their typically developing peers, an idea that goes against current research focused on adults. It was however seen that the postural control mechanisms utilized by the PLLA subjects may be different from their able-bodied counterparts. Results of the 95% confidence ellipse (an ellipse with diameters that contain 95% of the points on the postural sway path) indicate that children with limb loss may use an entirely different control strategy to maintain balance (Fig. 1). The more medial-lateral sway pattern indicates that at higher backpack weights, children with limb loss may reduce anterior-posterior postural sway at the expense of medial-lateral sway, possibly due to the absence of ankle plantar/dorsiflexor muscles typically used for the maintenance of balance.

These results affirm the ability of children with limb loss to maintain balance during backpack carriage with similar overall results to their typically developing peers. Understanding the typical balance strategies utilized by children with limb loss during backpack carriage can help clinicians develop appropriate training protocols and guidelines for backpack weights.

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APPLICATION AND BENEFITS OF THE Wii AND Wii FIT IN A PEDIATRIC ORTHOPEDIC THERAPY TREATMENT PROTOCOL

*Natasha Casimir, MS, PT; Sandra B. Smith, MS, PT
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Video games are used in pediatric facilities as age appropriate distraction or reward for behavior modification programs. The media has reported the popularity of the Wii as a treatment option for patients in nursing homes and rehabilitation units. However, a review of the literature found only two research articles on the benefits of the Wii system in children. The first evaluated the amount energy expenditure required to play the new generation of video games requiring more body involvement in normal obese adolescents. The other was a case study evaluating the functional improvement of an adolescent Cerebral Palsy with a Gross Motor Functional Classification Scale (GMFCS) Level III classification after training with the Wii system. Recently, our facility acquired the Wii system and the add-on Wii Fit with immediate successful integration as a treatment adjunct for several patients admitted for rehabilitation.

This poster will highlight two patients with Cerebral Palsy (GMFCS Level IV and GMFCS Level II) who used the Wii System and Wii Fit as treatment adjunct to help track and meet rehabilitation goals. Patient A utilized the Wii sports software package including boxing, table tennis and bowling. While, therapy treatment for Patient B (GMFCS Level II) focused on using the Wii Fit to apply the activities that addressed dynamic balance in both sitting and standing. The options for future research will also be discussed to objectively determine the benefit of this system which is highly motivating for the pediatric patient to help justify purchase of the Wii for both the clinic and home environments.

11:40 am / CS #8

REACHING PARENTS WHERE PROFESSIONALS CANNOT: THE PARENT SUPPORT NETWORK OF THE AMPUTEE COALITION OF AMERICA

*Charlene J. Whelan, LCSW, MBA
Amputee Coalition of America, Knoxville, TN*

Parents facing the birth of a child with limb difference – or of the amputation of their child's limb – are forced into an extremely intense grieving process. They must do “double duty” mourning: mourning their own loss in terms of the expectations they had of life with their child and the anticipated losses in their child's future, a process in which their child cannot truly engage. This excruciating emotional pain can impede parents' capacity to focus on processing the information necessary to make the wisest decisions on their child's behalf. Well-intended family and health care providers are sometimes frustrated in their attempts to calm these parents and to help them obtain perspectives for delivering the best in care for the child's welfare.

Parents who have successfully negotiated through the many pitfalls of this recovery process are keenly aware of insufficiencies in the emotional support they received in making their adjustments. Along with their newfound confidence that their child will live

a good life and that they can indeed help to facilitate that outcome, they repeatedly profess that they don't want to see other parents go through what they went through alone. These parents have learned the hard way that traumatized individuals cannot move forward emotionally until they can completely accept where they are at their starting point. That acceptance is more readily grown within the context of quality peer support, the power of which is derived through a capacity to "bear witness" on a level no others can achieve.

In January 2008, the Amputee Coalition of America (ACA) launched the first of its peer visitor trainings specifically designed for parents of children with limb loss or limb difference. Training materials and approaches were modified to better meet parents' needs from the ACA's long-running peer visitor program for adults with limb loss. ACA conducted in-depth interviews with more than a dozen parents in order to develop a value positioning statement for the program and then convened two pilot field tests through which participants provided extensive feedback through both anonymous surveys and open discussion.

The Parent Peer Visitor Training is a full-day seminar through which parents learn techniques in listening skills and communication and then practice them through varying forms of role play. Parents share with each other the expertise garnered through their own experiences to enhance everyone's learning, including the recognition of proper approaches and responses for differing phases of grief recovery. Parents peer visitors also learn about the important limitations inherent in the peer visitor role and are provided with exhaustive resource lists.

As of this writing, ACA has 31 trained, certified Parent Peer Visitors and is planning to conduct four parent trainings each year to continue to expand the network. This will both ensure the most immediate response to requests and the closest matches possible for distressed parents, a crucial ingredient for ideal peer support that can guide parents more readily on the path of celebration of their child's life.

Symposium III

11:50 am

AGING WITH A CHILDHOOD ONSET DISABILITY

Ronna Linroth, OT, MA; Nancy Mitchell, MA, OTR/L, ATP;

Sara Morgan, CPO; Lee Schuh, MD

Gillette Lifetime Specialty Healthcare, St. Paul, MN

Compared to previous generations, persons with childhood onset disabilities now have longer life expectancies. This means that health care professionals are treating these patients well into adulthood and are noticing changes in this population's needs and abilities through their lifespan. This symposium seeks to examine the changes that occur as people age with child-onset diagnoses such as cerebral palsy, spina bifida, muscular dystrophies, history of polio, and congenital limb deficiency. This presentation includes perspectives from a multidisciplinary team who will discuss both their individual experiences as well as the teamwork required to treat these patients. The aging process

for adults without disabilities will be contrasted with the changes observed in persons with disabilities. This presentation will focus on interventions that carefully consider the patient's life course. It will optimally result in a discussion regarding how observations in adult care may influence pediatric practice.

Objectives:

- To discuss strategies for enhancing successful aging with a disability
- To discuss the health care providers' role in educating people who are aging with disabilities
- To illustrate the role that healthcare providers play in assisting adult patients with their medical decisions
- To discuss existing and future models for high quality teenage and adult healthcare to which patients may transition from the pediatric coordinated care environment
- To evaluate the current scientific literature in this area and discuss opportunities for future research

Goals of the symposium:

- To create a forum for discussion about current care of adult patients who have previously been treated in pediatric specialty centers and improvements needed in these models
- To understand the complex changes that occur throughout the lifespan and how these findings will affect the care that is given at all stages of life (pediatric, adolescent, adult, advanced age)
- To understand the importance of continued multidisciplinary research on this topic

POSTERS

Poster #1

OUTCOMES OF A SURVEY FOR PARTICIPATION IN SPORTS WITH A PROSTHESIS OR ORTHOSIS

Barbara Kaniewski, OTR; Julie Honeycutt, PT; Patricia Stephan, MSW; Marcia Allen, RN; Laurie Lynch; Connie Brown-Olds, RN

Center for Limb Differences at Mary Free Bed Rehabilitation Hospital, Grand Rapids, Michigan

The mother of a talented 11 year-old athlete with a left terminal transverse below elbow deficiency asked our Center team for information on any official ruling regarding use of a prosthesis or modification of equipment for playing softball. Our team found more questions than answers. We developed a survey to send out to our families with children with upper and lower limb differences between the ages of 5 thru 21 years old to look at what organized team sports were played; what level of organizations were involved; whether a prosthesis or orthosis was used, modified or not allowed; what type of official ruling was cited and what was the rationale for the decision. The purpose of this survey is to develop information and resources to offer our families to facilitate participation in organized sports and hopefully advocate for the inclusion of more children in such activities.

Poster #2

SILICONE TRANSRADIAL PROSTHESES

*Thomas A. Lange, MD; Jennifer Klein, CPO
Gillette Children's Specialty HealthCare, St. Paul, MN*

The primary cause of upper limb deficiencies in children is congenital, with the majority of amputations being transradial (Burger et al, 2004). It is estimated that the incidence of congenital upper limb deficiency is 1: 4200 live births (McDonnell et al, 1988).

Upper extremity prostheses are typically fabricated with a hard exterior laminated socket. These do not allow for any tactile sensation from the external environment, therefore, we postulate that this may account for early rejection of the traditional prostheses. Because of the early age at which patients are typically fitted, it is difficult to get specific feedback as to why the prosthesis may have been rejected.

Factors such as age at fitting, prosthesis comfort, weight, suspension, parental acceptance, etc., all come into play. We feel an important reason for possible rejection of the hard socket BE prosthesis may be lack of sensory feedback through the device.

Custom silicone interfaces have been used in both upper and lower extremity prosthetics, primarily as inner liners. About 5 years ago we began to use a unique design of transradial prosthesis, which utilizes silicone as the socket while also serving as the suspension. A full rigid outer frame or shell is not used. Theoretically, this allows for increased sensory feedback by the child through the prosthesis, leading to increased patient and parental compliance, increased wear times, improved suspension and control, increased longevity of socket fit, and the allowance of bi-manual activities.

Ten silicone transradial prostheses have been fit at our facility on children ages 5 months to 4 years. All patients fit in this manner continue to use their prosthesis, some into their second and third fitting, due to growth and maturity. The first fitting is done with a passive hand of molded silicone connected to the silicone "sleeve" or socket. Once the child has reached an age to consider some dynamic terminal device, whether hand or hook, parental input is very important. Successful prostheses have been fabricated for either body-powered or myoelectric controls, by adding a narrow band of fiberglass to augment strength for the wrist unit and/or cable system. The potential for some expansion of the silicone has minimized revisions due to growth. Our index patient has been a user of a silicone prosthesis for more than four years and is wearing her third generation of the silicone prosthesis. She is a full-time wearer and a skilled user of the hook terminal device.

To date, there has been no known documentation on this particular type of prosthesis, and we feel that it has the potential for user acceptance throughout childhood. Our hope is that it may be used into the teen years when so many conventional prostheses for transradial amputees are abandoned.

Poster #3

BILATERAL TRANSRADIAL CRAWLING STUBBIES

Nicole T. Soltys, CP

Rehabilitation Institute of Chicago, Chicago, IL

This poster describes and pictures a simple solution for the child with bilateral transradial amputations who shows a readiness for crawling. Following meningococcal septicemia, this child was left with bilateral transradial, left transfemoral, and right transtibial amputations. The child's mother explained that he was showing a strong desire for independent mobility, however ambulation with lower-limb prostheses required maximum assistance. He was able to roll, but crawling on his elbows put his face too close to the ground, and he was unable to bear weight on his distal residual limbs due to bony prominences and thin grafted skin. We fabricated Bocklite liners with plastazote distal end pads to provide cushioning and additional length to the residual limbs for crawling. The Bocklite provided sufficient structure so that the child could don the liners independently, and the liners suspended over the humeral epicondyles. The liners could also be easily removed to allow sensory exploration with the residual limbs.

Poster #4

DEVELOPMENT OF A WEB-BASED RESOURCE FOR INTERNATIONAL VOLUNTEER SERVICE

Toni Thompson, MA, OTR/L, Ped. OT

Instructor, International Educational Resources, Evanston, IL

Volunteer, Shriners Hospitals for Children-Tampa, Physicians for Peace

FOOT Foundation, Mable's Kids

Health care professionals often seek out local, state, or international volunteer projects for focusing skills, talents, and experience. The process to locate an appropriate project can be time-consuming and frustrating. Discover how to use the web-based resource, DRFOP, that serves as a localized site to locate volunteer service projects and groups. The resource incorporates projects and organizations that utilize the services of orthotists, prosthetists, occupational and physical therapists, and medical staff as well as accept donations of orthotic, prosthetic, and medical supplies.