

**Association of Children's Prosthetic-Orthotic Clinics
2006 Annual Meeting, May 17-20, 2006
Hyatt Regency at Capitol Park, Sacramento, California**

Thursday, May 18, 2006

Scientific Paper Session I – Lower Extremity

7:30 – 9:05 am

7:30 am / Paper #1

**COMPARISON OF TEMPORAL-SPATIAL GAIT PARAMETERS USING AN
ELECTRONIC WALKWAY SYSTEM FOR CHILDREN WITH CEREBRAL PALSY
AMBULATING WITH DYNAMIC ANKLE-FOOT ORTHOSIS OR AMBULATING
BAREFOOT**

Valerie C Wondra, PT; Ken Pitetti, PhD, Wichita State University, Wichita, Kansas

Background: Previous studies have compared temporal and spatial gait characteristics in children with cerebral palsy (CP) with and without ankle-foot orthosis using kinematics^{1,2,3}. These studies have reported differences in gait parameters when comparing ambulation with and without an ankle-foot orthosis (AFO). However, few studies have reported these gait parameters in children with CP using an electronic walkway system.

Purpose: To compare temporal and spatial gait parameters of children with CP during ambulation with ankle-foot orthosis (DAFO; Cascade DAFO™, #3 and #4) with shoes and barefoot (BF).

Participants: 12 children (2-15 yrs, 6.8±4.1 yrs; 2 males, 10 females) with spastic CP (10 diplegic, 2 hemiplegic) participated in this study.

Method: All participants walked either independently without an assistive device (n=4) or independently with ambulatory devices (1 quad canes, 6 reverse walkers, 1 forward walker) at their preferred speed in the middle of the 12-foot long electronic walkway (GAITRite® Walkway System). Three trials were performed for each condition (DAFO, BF) and the mean of the three trials was compared for each of the following gait parameters: cadence, cycle time, stride length, step length, and gait velocity.

Results: No significant differences were seen between DAFO and BF for cadence (steps/min) and cycle time (sec). However, significant differences (p<.05) were seen in all the following conditions:

Parameters	Stride Length (cm)		Step Length (cm)		Gait Velocity (cm/sec)
	R	L	R	L	
DAFO	71.4±36.4	71.4±35.8	35.4±16.7	35.4±16.7	64.0±39.4
BF	60.9±29.8 *	62.7±30.4 *	31.4±15.4 *	29.3±16.1 *	56.4±37.8 *

* = DAFO > BF

Conclusion: Results of this study suggest that stride length, step length, and gait velocity are significantly increased when wearing DAFO versus BF ambulation. When compared to studies using kinematics, our results are similar for stride and step length^{1,2,3} but differ in cadence^{1,2} and gait velocity^{1,2,3}. That is, the present study did not demonstrate differences in cadence, yet the DAFO did improve walking speed. However, discrepancies between studies could be due to differences in participant disability levels (i.e., hemiplegic vs. diplegic, walking with and without an assistive device) and age.

Clinical Relevance: Determining the functional effect (gait parameters of stride length and velocity) of DAFO's on children with ambulation deviations will add to the information that is currently reported and assist therapists and practitioners with determining the benefit of prescribing and providing DAFO's on those with gait deviations.

1. Radtka et al. (1997)
2. Romkes et al. (2002)
3. Buckon et al. (2004)

7:40 am / Paper #2

RESIDUAL LIMB END-BEARING PRESSURES IN CHILDREN WITH SYME'S AMPUTATIONS: PRELIMINARY RESULTS

*Janet Walker, MD; Donna Oeffinger, PhD; Hank White, MSPT
Shriners Hospital for Children, Lexington, KY*

Introduction: Techniques to preserve the heel pad during lower limb amputation were designed to allow end bearing on the specialized tissues of the heel pad. Studies of adult amputees with Syme's or Boyd amputations, however, have suggested that few patients walk on the end of their residual limbs without their prosthesis and that the end bearing pressures in their prostheses are low [1]. Children with Syme's or Boyd amputations will often walk without their prostheses and frequently grow out of their prosthetic patellar tendon bar molds with few complaints of pain. The purpose of this study was to measure the end bearing and patellar tendon pressures of children with Syme's amputations in their prostheses and to compare those findings with those previously reported for adults. Information obtained about pressures within a socket may improve the clinical decision making process and improve the fit of the prosthesis for children with Syme's/Boyd amputations.

Methods: IRB approval was obtained for this study. To date four children between the ages of 6 and 18 years with unilateral Syme's amputations were recruited from the hospital's Orthotic and Prosthetic clinic. Pressure measurements in the prostheses were obtained during walking. 4x4cm socket pressure sensors (Novel Inc) were placed on the patellar tendon region and the terminal distal end of the residual limb. Data were collected from three trials for each subject. The means of data from the three trials were calculated for each subject. Measurements were normalized to body weight (BW) without the prosthesis. The means from each subject were averaged and data between sensors compared for each of the study parameters using a t-test. Pressure measurements were obtained with each subject walking on their residual limb across an EMED pedobarograph.

Results: No differences between the patellar tendon and the distal end were found for contact area, maximum force, contact time, instant of peak pressure, instant of maximum force, mean

force and mean area. Peak pressures at the distal end (10.84 N/cm²) and the patellar tendon (12.83 N/cm²) were significantly different (p=0.02) from one another. These data show that the patellar tendon receives a greater peak pressure than the distal end region. The mean maximum pressures (average of the peak pressure over entire cycle) neared significance at p =.052 with the distal end region mean of 6.86 N/cm² and at the patellar tendon region mean 5.39 N/cm². The average maximum force obtained from walking on the residual limb was 127%BW (range 86-174%BW).

Conclusions: The data from these 4 children with Syme's amputations shows that they do weight bear at the distal end of the residual limb. These findings are different from those previously stated in the literature on adults. The pressures at the distal end and at the patellar tendon area are very similar to one another. The children were able to fully weight bear on their residual limb as evidenced by full weight bearing on the residual limb when walking without their prostheses.

Reference: ¹Hornby, R., and Harris, R. (1975). *JBSJ*, 57-A(3), 346-349.

Acknowledgments: Sarah Rogers, Wayne Cottle, Chris Burke & Eric Miller for their assistance with the study. Funding provided by Kosair Charities Inc.

8:00 am / Paper #3

OXYGEN CONSUMPTION IN CHILDREN WITH LOWER EXTREMITY AMPUTATIONS DURING OVER GROUND WALKING

Kelly Jeans, MS; Lori Karol, MD

Texas Scottish Rite Hospital for Children, Dallas, Texas

Over the years, amputee gait has been well studied in adult populations. Researchers have found that as the level of amputation ascends the leg, walking velocity declines, and oxygen consumption demands are increased. Very few studies have studied the effect different levels of amputation have on oxygen consumption in children. Herbert et al (1994) found that children with below knee amputations had higher energy needs than children without amputation. The current study was designed to compare amputee oxygen consumption across levels in children between the age of seven and 19 during over ground walking (OG). This paper is a preliminary report on Symes, trans-tibial (BK), and knee disarticulation (KD) amputees.

Thirty-two unilateral amputees between the ages of seven and 19 were enrolled in this IRB approved study (24 boys and eight girls). Fifteen had Symes amputations, nine had BK amputations, and eight had KD. All patients were asked to sit and rest for 5 minutes prior to the walking test. After the rest period, subjects walked for ten minutes at a self selected speed around a 40 meter walk-way. Oxygen consumption data was collected using the K4B² oxygen analysis telemetry unit (COSMED, Rome, Italy). Data was reduced over a one-minute steady-state interval and averaged. Velocity was measured during the walk and recorded.

Level	N	Age	VO ₂ Cost	Velocity	HR
Symes	15	11.13	0.24	71.52	112.39
			109%	102%	98%
BK	9	10.89	0.25	74.96	127.11
			114%	107%	111%
KD	8	14.50	0.25	70.37	114.93
			139%	96%	119%

Table 1- VO₂ Cost= ml/kg/m; velocity= m/min; HR= beats/min. % age matched normal* values given beneath absolute values for each group. (*Perry, 1992)

Oxygen consumption cost (VO₂ cost), velocity and heart rate (HR) are reported in Table 1. Significant differences were found in age between groups (BK being the youngest and KD being the oldest); therefore each level was compared to published age-matched normals.

Findings show that compared to normal, HR and VO₂ cost increase with level of amputation. Velocity, however, is maintained. These children do not have to slow down due to energy requirements and they can tolerate the increase in HR.

This study demonstrates that as the level of amputation ascends the leg, that although the energy requirement increases, speed is maintained in children. Distal level should be preserved whenever possible.

Perry: Gait Analysis- Normal and Pathological Function, SLACK Inc, 443-489, 1992.

Herbert, et al.: A Comparison of Oxygen Consumption During Walking Between Children With and Without Below- Knee Amputations, Physical Therapy, 943-950, vol. 10, 1994.

8:30 am / Paper #5

EFFECTIVE PREVENTION OF STUMP OVERGROWTH WITH AN AUTOLOGOUS PROXIMAL FIBULAR GRAFT

*Anthony A Scaduto, MD; J Paul Ballesteros, MD; Hugh G Watts, MD
Shriners Hospitals for Children, Los Angeles. Los Angeles, CA.*

Purpose: Terminal overgrowth is a common problem in children with transosseus amputations. Appositional bone growth produces an elongated tapered bone tip which prevents end-bearing and proper fit of the prosthesis. It is characterized by distal swelling, tenderness, bursa formation, and occasional skin perforation. The high incidence of recurrent overgrowth after resection has been partially controlled by capping the bone with autogenous graft or a synthetic device. We have modified stump capping as originally described by Marquardt to take advantage of the ease in harvesting the ipsilateral fibula in a below-knee stump and eliminate the need for screw or pin fixation of the cap. The purpose of this study was to determine the effectiveness of this technique in preventing overgrowth and identify any donor site morbidity associated with fibular head harvest.

Methods: Thirty-three limbs in 31 patients with trans-tibial amputations underwent stump capping utilizing the ipsilateral proximal fibula. The distal tibia segment was resected, periosteal flaps were elevated and the distal medullary canal was cleared with a curet. The proximal fibula including the cartilagenous epiphysis was freed from its soft tissue attachments. The tibia was then plugged with the reversed proximal. A snug fit was ensured by lightly impacting the graft so the fibular diaphysis/metaphysis filled the canal of the distal tibia. The periosteal flaps were then sutured to the periosteum or cartilage of the fibular head. We retrospectively studied all patients with trans-tibial amputations who underwent this procedure between 1991 and 2002. Average age at surgery was 8.1 years and mean follow-up was 7.1 years (2.0-13.7 years). Twenty (61%) were acquired amputations and 13 (39%) were congenital. Eleven (33%) of the stump cappings were done as part of the index surgery. Survival analysis was performed using the Kaplan-Meier product-limit method.

Results: Failure defined as revision secondary to bony overgrowth occurred in 4 limbs (12%). Skin problems unrelated to osseous overgrowth also required revision in one patient. The estimated survival rate at six years was 92% ($\pm 10\%$). The mean survival time was greater than the time needed to reach skeletal maturity (>18 years). There were no infections, fractures, or graft loosening. No graft harvest site complications were identified. All patients began prosthetic fabrication 4-6 weeks postoperatively. One patient required a change in the type of prosthesis used postoperatively.

Conclusion: The proximal fibula is an ideal osteocartilagenous graft to prevent tibial overgrowth in children with below-knee amputations. It effectively controls overgrowth with a low rate of morbidity.

Significance: Reported rates of revision for biologic and synthetic capping to prevent overgrowth vary from 25-75%. In below-knee amputees, plugging the tibia with the ipsilateral proximal fibula had a very low failure rate. Its advantages over other biologic or synthetic caps include a well hidden scar, intrinsic graft stability, rapid incorporation, and a low rate of infection/loosening.

8:50 am / Paper #6

THE EFFECTIVENESS OF A PHYSICAL THERAPY INTERVENTION FOR CHILDREN WITH HYPOTONIA AND FLAT FOOT DYSFUNCTION

Charmayne Ross, DPTSc; Fernando Villar, PhD; Grenith Zimmerman, PhD; Bonnie Forrester, DPTSc; Everett Lohman, DPTSc

Dept of Physical Therapy, School of Allied Health Professions, Loma Linda University, Loma Linda, CA; Dynamic Therapies, Inc 50 E Foothill Blvd, Suite 100, Arcadia, CA

Purpose: The purpose of this study was to determine the effectiveness of physical therapy using Cascade soft orthotics and an exercise program for children with hypotonia and flatfeet.

Subjects: Thirty-seven children, aged 18 months to 5 years, who presented developmental delays and hypotonia with flat foot dysfunction, participated in this study.

Methods & Materials: Three groups (control, orthotic, and orthotic-exercise), were studied. The orthotic- exercise group practiced bilateral heel lifts besides wearing the orthoses. An arch index was used to assess the width of the medial longitudinal arch (MLA) pre/post interventions. Gait parameters (velocity, step-length, single-limb support, and cadence) were assessed four times in a 6-month period using the GAITRite™ system.

Analyses: A repeated-measures ANOVA for the dependent variables of arch index, velocity, step length, single limb support time, and cadence was performed by group, time, and with and without shoes as appropriate. The significance level for all comparisons was set at $P < .05$.

Results: Significant differences pre/post testing ($P < .05$) were found in the arch index for the orthotic group and positive trends were observed for the orthotic-exercise group. Velocity, step-length, single-limb support, and cadence changes were also significant for the three groups over time.

Conclusions: Interventions benefit children with hypotonia and flat feet. Future studies might consider a longer duration and larger sample size.

Summary: The results from this study indicate that interventions of orthoses wear and exercise benefit children with hypotonia and flat foot dysfunction. While all groups showed significant improvements in the four gait parameters (velocity, step length, single limb support, and cadence), the intervention groups demonstrated stronger improvements in arch development, velocity, single limb support, and cadence.

Creative Solutions Session

2:15 pm / CS# 1

SILICONE INTERFACES IN THE TREATMENT OF HIGH-TONE FOOT AND ANKLE DEFORMITIES

Eugene Banziger, CPO

Kelowna General Hospital, Kelowna, BC, V1Y 1T2, Canada

This paper will explore the challenging treatment for high tone ankle foot deformities in the more challenging client with neuromuscular deficiencies. Traditionally the Klenzak style, and later the thermoplastic AFO's have been utilized with variable success. Most recent the 360-degree style supports with flexible thermoplastics have been utilized to control ankle foot deformities. Once applied the materials become rigid in nature and skin breakdown may still occur. This requires heat relieve and or padding, sometimes compromising the expected corrective positioning results.

This paper consist of a informal study of five neuromuscular deficient individuals with current AFO technology verses AFO's with a custom silicone interface technology. This custom silicone technology allows the incorporating of Silicone gel support pads. Silicone and Urethane Gel technology is commonplace in prosthetic fittings for the lower extremity amputee and has proven to be an asset in weight-distribution and skin comfort. This challenged me to provide the same technology so to potentially increase wearing comfort to the client with lower extremity orthoses.

The results are increased wearing comfort due to silicone gel flow, resulting in no skin friction and better pressure distribution.

The presentation will demonstrate the history, current thoughts, fabrication process and results.

2:35 pm / CS #2

THE USE OF UPPER EXTREMITY PROSTHESES AS ACTIVITY SPECIFIC TOOLS

David Rotter CPO¹; Jeffrey Ackman MD²

¹Scheck & Sireess Advanced Orthotics & Prosthetics, ²Shriners Hospital for Children Chicago

What constitutes a successful outcome in upper extremity prosthetics? It is the intention of this presentation to build on the important studies conducted in previous meetings in regards to upper extremity prosthetic usage. We will present in case study form various instances of upper extremity prostheses used in the capacity of activity specific tools. We will relate anecdotal accounts from our patients as to the uses and benefits of these devices. It is our intention to further the discussion as to how upper extremity prostheses should be prescribed. Should we be presenting these devices as hand or hook like appliances for generic use or should we be relating and emphasizing the potential for use as activity specific tools for both vocation and avocation.

2:55 pm / CS #3

PEDIATRIC PATIENT WITH SYMBRACHYDACTYLY WHO ACHIEVED MUSICAL EXCELLENCE

Natalie L MacNeill, OTR/L; Greg Aaron, CO; Peggy Paradis, garment technician; Michelle A James, MD

Shriners Hospitals for Children Northern California, Sacramento, CA

Purpose: Like all children, those with symbrachydactyly (short, stiff fingers) want to participate in complex bimanual activities. We present a case where, at the child's request, our team developed a custom splint to allow a child with this diagnosis the opportunity to play the violin. Previous attempts to make a splint fabricated from standard thermoplastic material were not successful due to the inability of independent donning and damage to the bowstring.

Methods: An in-house burn garment seamstress fabricated a customer glove made of 75% nylon and 25% spandex powernet fabric as is typically used in pressure garment fabrication. An open-thumb design was used for the least interference with the grip of the thumb. Closure of the glove over the small fingers, and compression typical of burn pressure garments both contributed to the stability of the glove as a base for the clamping device. A dorsal zipper and an aluminum palmar stay in a leather casing were included in the design. The clamping device is of a two-part construction attached to the aluminum stay in the custom fabricated glove. One-quarter inch polyethylene plastic is attached to 1/8th inch thick aluminum sheet metal backing plate by 4-40 flat head screws. The two halves are clamped with the plastic together. A hole is drilled the length of the clamping device. The diameter is the nominal diameter of the violin bow. The bow is clamped in the groove of the device by 4-40 cap screws, which are tapped in the aluminum backing plate of one half of the holding device. The entire device is attached to the aluminum stay by 4-40 flat head screws. At the time of fitting only one screw holds the device to the stay. This allows the best angle to be set by the patient. Once the preferred angle is established a

second screw secures the clamping device to the aluminum stay preventing unwanted rotation. The use of polyethylene in this arrangement provided a positive grip on the violin bow and excellent control of the bow and proved very satisfactory to the patient without altering or marring the violin bow.

Results: An 8 year old female patient, with right symbrachydactyly, who was in a school based violin performance group, was fit with the custom adaptive splint. This splint allowed the patient to fulfill her role as a member of this peer group and also provided a leisure time activity that fostered independence and increased self-esteem. The design of the splint allowed her to don it independently (which was essential during public group performances), stabilize her violin bow (which allowed her to play the violin accurately) and the integrity of the violin bowstrings was maintained. A carrying case for the bow and splint assembly was then adapted from a poster tube.

Conclusions: The team that included an occupational therapist, orthotist, garment fabricator, patient, and the patient's father were able to successfully fabricate a splint that allowed the patient to play her violin independently. The overall satisfaction with this splint was high because it met all of the family's expectations for fit and function as well as improved the patient's quality of life.

Challenging Case Presentations

4:10 pm / CCP #2

UNCONVENTIONAL AMPUTATIONS IN TUMOR RECONSTRUCTION SURGERY

*J Ivan Krajbich, MD; Kelly Alexander, RN; Shannon Lisac, PT; Neil Turner, CPO
Shriners Hospitals for Children, Portland, OR*

Objective: To demonstrate a number of unconventional amputations done to improve individual limb functionality in children and adolescents facing significant limb loss.

Introduction: Patients with failed primary reconstruction for malignant bone tumors present a particular challenge to the treating surgeon. Infections, tumor recurrence or endoprosthetic failure frequently leads to high amputations. To improve the residual limb functionality the unconventional surgical methods can be employed. Limb length and joint preservation are the guiding principles.

Methods: Groups of patients with unconventional amputations due to failure of the original limb reconstruction are presented. Each represents a significant challenge for the treating surgeon, prosthetists and therapists. However in all of these patients, satisfactory below the knee amputation like function has been achieved.

4:35 pm / CCP #3

TREATMENT OF A PATIENT WITH AGGRESSIVE FIBROMATOSIS: ORTHOPEDIC, PROSTHETIC, AND MOBILITY CONSIDERATIONS

*J Ivan Krajbich MD; Shannon Lisac PT; Neil Turner CPO
Shriners Hospital for Children, Portland, OR*

The patient was diagnosed at 9.5 years of age with aggressive fibromatosis in the popliteal area with biopsy and removal. The mass recurred with involvement of the popliteal vessels. The patient underwent subsequent chemotherapy; excision of mass with multiple vascular grafts; admissions for managing contractures and neurogenic pain; and radiation related to positive margins and leg length discrepancy.

Over the next eight years the patient developed a knee flexion contracture; additional lesions in the foot, the dorsal aspect and the lateral aspect of the thigh, and the buttock and posterior thigh that extended into the pelvis. Treatment considerations were radiation and chemotherapy; orthopedic surgery; or conservative management with physical therapy, adaptive equipment and await possible regression of the mass after puberty. The patient ambulated with crutches, received outpatient physical therapy, utilized a prosthetic sitting device, and was appropriate for a study drug.

At the age of 19 the patient is still declining the surgical option for “disease free” amputation at the hemipelvectomy level. Her ambulation is energy consuming and her left leg is non-weight-bearing and contracted to the extent that it limits her ADL’s. The patient chose a staged orthopedic intervention of 1) extension osteotomy of the left distal femur and abduction and extension osteotomy of the left proximal femur to address knee and hip contractures with 2) subsequent amputation at transtibial level.

We will discuss the orthopedic, prosthetic, and rehabilitation considerations. The current challenge is maximizing patient efficiency and function by creating a limb that is minimally contracted, has adequate sensation and viable tissue to tolerate prosthetic use. Followed by fabrication of a prosthesis which is cosmetically acceptable, functional for both sitting and ambulation, and tolerable to the patient with regard to comfort and ADL’s.

5:00 pm / CCP #4

LOWER LEG RECONSTRUCTION IN LONGITUDINAL DEFICIENCY OF THE TIBIA: A REPORT OF TWO CASES INCORPORATING FIBULAR SHORTENING WITH DIAPHYSEAL RECONSTRUCTION OF THE TIBIA USING RESIDUAL HINDFOOT ELEMENTS

Robin C Crandall, MD

Clinical Associate Professor Orthopedic Surgery, University of Minnesota

Director Amputation Limb Deficiency Service, Shriners Hospital for Children, Twin Cities

The various forms of congenital longitudinal deficiency of the tibia represent some of the most difficult challenges to the orthopedic surgeon. The more severe forms of the defect (Kalamchi Type I) generally are managed with knee disarticulation and prosthetic fitting. In rare instances these patients may also be benefited with fibular centralization. Centralization of the fibula and preservation of a usable knee for motoring a prosthesis is the hallmark of treatment of Kalamchi Type II defects. Most Type II defects are managed by classic side to side tibiofibular synostosis. These operations may be very difficult if only minimal tibial elements are present. The purpose of this paper is to present a variation of classic fibular centralization. Two challenging cases are presented that demonstrate in selected patients that salvage of the hindfoot and diaphyseal reconstruction of the tibia even with minimal tibial bone elements may be a useful alternative to

classic side to side tibiofibular synostosis. Literature review and technical details of the procedure will be presented.

Friday, May 19, 2006

Scientific Paper Session II – Upper Extremity & Spine

7:30 am – 8:20 am

7:30 am / Paper #7

TEMPERAMENT AND CHILDREN WITH UNILATERAL CONGENITAL BELOW ELBOW DEFICIENCY (UCBED): A MULTI-CENTER STUDY

*Elaine Charest, MA, MBA, OTR/L; Michelle James, MD; Anita Bagley, PhD
and the UCBED Study Group **

Temperament refers to stylistic features of behavior and underlying motivation rather than performance. The Dimensions of Temperament – Revised (DOTS-R) is a 54-item, factor-analytically developed self-report instrument that measures nine temperament dimensions including Activity-General, Activity-Sleep, Approach-Withdrawal, Flexibility-Rigidity, Mood, Task Orientation, Rhythm-Sleep, Rhythm-Eating and Rhythm-Daily habits.

There is no published literature looking at the temperament of children with unilateral congenital below elbow deficiencies (UCBED). The purpose of this study is to examine the relationship between temperament of children with an UCBED and wearing patterns, quality of life, and functional use of the prosthesis. The temperament of a parent of each child was also assessed and examined in relation to the above factors. In this cross-sectional, multi-Shriners Hospital study, 276 prosthetic wearing and non-wearing children were completed questionnaires regarding prosthetic use (PUFI), quality of life (PedsQL), temperament (DOTS-R) and a test of bimanual function (U-BET); prosthesis wearers performed the test both with and without their prosthesis as well as completed a prosthetic satisfaction questionnaire. In addition 480 parents completed the DOT-R in relation to their temperament and 210 parents reported their child's behavior. The statistical analysis of the data will be presented.

*Participants from 10 Shriners Hospitals for Children: Erie (Katherine Brasington OTR, Sharon McConnell MS), Greenville (Lisa V. Wagner OTR), Houston (Joanne Libertore OTR, Becky Ligon OTR, Elroy Sullivan PhD), Los Angeles (Joanna Patton OTR, Joanne Shida OTR), Montreal (Kathleen Montpetit BScOT), Northern California (Leslie Clawson MSW, Cheryl Hanley OTR, Carrie Risi-Hart OTR), Philadelphia (Susan Duff OTR, Cheryl S. Lutz OTR), Springfield (Elaine Charest OTR), St. Louis (Loray A. Dailey, OTR), and Twin Cities (Wendy A. Tomhave OTR) under the direction of Anta M. Bagley PhD and Michelle A. James MD

7:45 am / Paper #8

THE VALIDITY OF THORACIC-LUMBAR-SACRAL ORTHOSIS COMPLIANCE IN CHILDREN WITH SPINAL CORD INJURY

*Mitell Sison¹; Louis Hunter²; Melissa Mendoza³; Anita Bagley¹; M J Mulcahey²; Randal Betz²;
Lawrence Vogel³; Caroline Anderson³; Craig McDonald¹
Shriners Hospitals for Children, Sacramento, CA¹; Shriners Hospitals for Children,
Philadelphia, PA²; Shriners Hospitals for Children, Chicago, IL³*

Paralytic spine deformity is a significant clinical problem in children with spinal cord injury (SCI). 98% of children injured prior to skeletal maturity will develop scoliosis and two thirds of these children will require a spinal fusion for correction of the scoliosis^{1,2}. The majority of the literature suggests that the use of a thoracic-lumbar-sacral orthosis (TLSO) is ineffective in the prevention of paralytic spine deformity. Mehta et al³, however, found that prophylactic bracing may prevent severe progression and therefore prevent surgery in children who begin wearing the TLSO before their scoliosis reaches 20 degrees. The inability to accurately monitor TLSO wearing time has lead to a lack of evidence for both positions. Therefore, the purpose of the present study is to determine the validity of compliance monitors to assess TLSO wearing time of children with SCI and to evaluate the accuracy of compliance monitors by comparing them to the gold standard (reported) assessment.

Fifteen children, 5 to 14 years of age, who were prescribed a TLSO for paralytic spine deformity participated in the present study. 12 children had thoracic paraplegia and 3 had mid-cervical tetraplegia. 12 children were ASIA A, two were ASIA C and one was ASIA D. Three brace compliance monitors (HOBO, TidBit, and IntelliBRACE) were mounted onto each TLSO. Wearing time was documented by parents and therapists on a daily log for 4 days. Each day consisted of 6 hours of alternating 1 ½ hour periods of brace wearing or not wearing. Data were downloaded from the compliance monitors to a personal computer using software individually designed for each monitor. Agreement between reported minutes of wear per day and the compliance monitors' data were analyzed statistically.

Correlation coefficients demonstrated the HOBO to have the highest correlation (0.55) with the reported log and the IntelliBrace demonstrated the lowest correlation (0.38). Bland-Altman⁴ plots showed the IntelliBRACE to have poor equivalence between the daily log and the monitor; the monitor tended to underestimate wear time by an average of 68 minutes. Neither the HOBO nor the TidbiT had this result; these monitors tended to overestimate wear time by an average of 1.5 and 7.5 minutes, respectively. Variances were calculated for each of the three monitors versus the reported log values. The HOBO demonstrated the least amount of variance and the IntelliBRACE demonstrated the greatest variance. Comparisons between variance values demonstrated no significant difference between the HOBO and the TidbiT ($p>0.05$). Both the HOBO and TidbiT variance values were statistically less than the IntelliBRACE variance ($p<0.05$).

Based on this study, the HOBO and TidbiT can be used as effective monitors for documenting brace compliance, however the TidbiT was chosen to document brace compliance at home in a future prospective, randomized clinical trial on the effectiveness of TLSO bracing. It was chosen because its variance was not significantly different from the Hobo, and it is much smaller and less intrusive to the child's activities. Also, its sensor can not be removed from the unit.

Brace Compliance Monitor	Correlation Coefficient	Variance
Hobo	0.55	916.8
TidBit	0.46	1180.5
IntelliBRACE	0.38	2529.6

References: 1) Dearolf, et., al (1990). J Ped Orthopedics; 2) Mayfield, et .,al (1981). JBJS; 3) Metah, et., al (2004). J Spinal Cord Med; 4) Bland and Altman (1986). The Lancet

8:00 am / Paper #9

BENEFICIAL EFFECTS OF ORTHOTIST TRAINING ON BRACING SUCCESS FOR ADOLESCENT IDIOPATHIC SCOLIOSIS

Wendy Moon, CNP; William Shaughnessy, MD; Anthony Stans, MD; Mark Dekutoski, MD; Stacey Stoll, CO

Work performed at the Mayo Clinic, 200 1st St, SW, Rochester, MN 55905

Purpose: Despite a preponderance of literature concerning the success of various scoliosis braces, there is little information concerning the effects of orthotist training and education on bracing success. We examined bracing success prior to and following such training utilizing a custom molded TLSO.

Methods: All braced patients with adolescent idiopathic scoliosis were reviewed before and after orthotic bracing methods were updated. 30 braced patients completing treatment prior to orthotist retraining were compared to 42 patients completing bracing after retraining. Non-idiopathic scoliosis was excluded. Demographic data, follow-up, brace treatment, reported brace compliance and radiographs were reviewed. Brace success was defined as less than 10 degrees of progression at final follow up. Failure was defined as progression 10 degrees or more, or the need for surgery.

Results: The two groups were similar in age (13+2 vs.13+6), gender (83% vs. 80% female), and Cobb measurement at brace initiation (29 vs. 26 degrees). All measured outcomes improved following orthotist retraining, with statistically significant ($p = 0.0001$) differences in measurement. Cobb angle on first in-brace x-ray improved (5.9 vs. 11.9 degrees) as did Cobb progression, pre-brace to final follow up (9.36 vs. 1.5 degrees). Bracing success was 12/30 (40%) prior to orthotist retraining and 34/42 (81%) after retraining. Compliance decreased with age, time in brace and the presence of psychological co-morbidity (ADHD, depression). Surgery was required for 12/30 (40%) prior to orthotist retraining and only 4/42 (9.5%) after retraining. The only patients requiring surgery following orthotist retraining had Cobb measurements greater than 43 degrees at brace initiation or were being treated for attention deficit and depression.

Conclusion: Bracing can successfully treat adolescent idiopathic scoliosis. Success is dependent upon brace compliance and orthotic skills.

Significance: A trained, skilled orthotist is essential to successful scoliosis bracing. Among compliant patients, brace failure is unusual.

Symposium IV

10:15 am – 11:30 am

TRANSITION OF CARE FOR LIMB DEFICIENT CHILDREN TO ADULTHOOD: DEVELOPMENT OF AN EDUCATIONAL EVENT FOR LIMB DEFICIENT PATIENTS AND THEIR FAMILIES

*Joel A Lerman, MD; Margaret Kugler MS; Janis Tokunaga LCSW; Catherine Curran
Shriners Hospitals for Children, Northern California, Sacramento, California*

The prosthetic and rehabilitative care of children and adolescents with limb deficiencies is frequently centered at pediatric specialty institutions. The transition of the care of our patients from this institution to other resources available in the community has been a topic of great interest to our staff. When patients transition out of care at our hospital at between the ages 18 and 21, it is desirable for patients to understand some critical personal, medical and professional issues facing them as adults. These issues include the importance of continuing their education so as to obtain viable employment in order to facilitate insurance coverage for continued prosthetic care. The importance of staying active in order to keep weight manageable and remain healthy is also imperative. Families can be intensely curious as to the long term outlook for individuals with limb deficiencies. Peer contacts can be very helpful in this regard, but exposure to young adults with conditions similar to their child's can be invaluable.

In an attempt to educate patients and families on these issues, a transition seminar was organized. Didactic sessions from our medical and allied health staff were presented. A panel discussion of former patients that have successfully transitioned to adulthood was of particular value, where these individuals shared their life experiences and answered questions from families. Our experience with orchestrating this event was interesting and will be shared.

Symposium V

1:00 pm – 1:45 pm

BRACHIAL PLEXUS BIRTH PALSY: A MULTI-DISCIPLINARY APPROACH

Michelle A James, MD; Dennis Hart, MD; Tiffany Terrell, OTR/L; Greg Aaron, BA, CO

About 1 in 1000 infants sustain a brachial plexus injury during birth. Many fully recover, but those who don't have persistent upper extremity weakness and may develop contractures. These problems may limit the child's function and participation in activities. Their treatment is the focus of the Shriners Hospital, Northern California Brachial Plexus Birth Palsy (BPBP) Clinic.

The BPBP Clinic is a multi-disciplinary clinic, staffed by an orthopaedic hand surgeon and a physical medicine and rehabilitation specialist, and supported by occupational therapists and orthotists. This presentation will focus on assessment, standard treatment and innovative treatment of infants and children with this condition, including assessment, botulinum toxin injections, tendon transfers and post-tendon transfer therapy, and orthotic treatment of the shoulder and elbow.

Challenging Case Presentations

3:15 pm – 4:15 pm

3:15 pm / CCP #5

DECISION MAKING IN CHILDREN WITH PFFD

*Matthew M Morel, CP; Kenneth J Guidera, MD; Robin C Crandall, MD
Shriners Hospital for Children Minneapolis, MN*

Three cases will be presented, two having class A PFFD and the third having bilateral PFFD. EB diagnosed with class A PFFD and type 1 fibular hemimelia at 6 months of age on her right side. She had a five toed foot and was projected to be between 25-40 cm short, and the majority of the shortness in the femur. She had a foot ablation at 9 years of age. She had been seen at Shriners Hospital for Children Twin Cities for almost 21 years. She was discharged from the system with a long BK type exoskeletal prosthesis. We will explore the decisions that were made.

KW is an 8yr old patient with class A PFFD and type 1 fibular hemimelia on the left side and a foot ablation at 11 months old. She has a projected LLD of 14cm with the majority of the discrepancy at the femur. Talk will be about lengthening vs AK vs nothing.

AR is a bilateral PFFD patient with multiple surgeries on her legs. She has had a Van Nes on left side as well as femoral lengthening. On the right side there is severe valgus of the hindfoot and shortening of the entire limb. There will be a discussion on what possibilities there are for future prosthetic care, as well as decisions that can be made with a bilateral PFFD patient.

4:00 pm / CCP #6

R CONGENITAL SHORT FEMUR, & CLUBFOOT; L PFFD, ABSENT TIBIA, & DUPLICATE GREAT TOES; UNUSUAL FACE

*Mary Williams Clark MD; Dana Yeomans PT; Joseph Springer CP; Jeff Purdy CP
Sparrow Regional Children's Center, Lansing Michigan*

The Challenge(s): Prenatal Diagnosis: What to say then?¹; Multiple congenital limb differences, and Fragility vs Energy²; and Does she fit one diagnosis?³

This family was referred when an intrauterine ultrasound demonstrated an absent left tibia. Mother was 18 yo with type 1 diabetes, poorly controlled especially during early pregnancy. (*¹Discussed absent tibias, possibilities of reconstruction vs. amputation, and usual independent abilities.)

Delivery occurred normally; child found to also have cardiac problems, unusual face, short right thigh, and very short left thigh and leg, with supinated, 6-toed foot.

Radiographs confirmed the left absent tibia, as well as no left acetabulum, proximal femoral focal deficiency, and duplicated left great toes. The right femur was short and bowed, with a shallow acetabulum; the right foot was in supination. (*¹More complicated discussions.)

At 5 weeks old the right femur broke at the bow, during diapering(*1more discussion); no signs of abuse. Healed well in a spiral spica splint (=*very useful solution).

At 13 months, left femur and fibula were surgically aligned and pinned; foot left temporarily to maintain control of the limb; spica cast. (Two months later the pin protruded, cultured Staph and Strep; treated with antibiotics. Two weeks later we excised the wound and distal pin track. No evidence of proximal infection, pin not grossly loose, but was shortened.)

She progressed well cognitively, mobilized by rolling, standing and hopping, even in casts or subsequent bivalved HKAFO.

Two months later she fell off a sofa arm, bending the pin at the femoral-fibular junction*2. 1 week later, had radiologic new bone at the bend; clinical alignment 'not bad'; we left bone crooked. Four weeks later did Syme amputation: into double spica, including the stump, in a sitting position. Cast off after 5 weeks [21 months old]. She immediately stood on the right foot, holding only one hand. 3 weeks later she was in a prosthesis with her hip flexed [contracted], and prosthesis extending underneath, articulated, with elastic knee-extension aid. (*Solution for mobility in eager child with irregular bone and contracture.)

After initial intense PT, in next 6 months she went from hopping in posterior walker to independently walking, pushing a play shopping cart.

At 2 1/2 years old had the bent rod removed, bowing of the femur and fibula corrected with Sofield-Millar osteotomies, re-rodming, and spica. Two months later cast off, pin pulled, and bones stable to gentle palpation; into single semi-rigid-fiberglass spica. New prosthesis made; 3 days before clinic visit she fell off grandmother's lap*2; fracturing distal 1/3 of fibula, transverse, nondisplaced. Another spiral spica; 6 weeks later into new prosthesis. Then PT, strengthening and stretching, etc. Now walking with plungers [see slides!], and short distances without.

Persisting challenges: Still energetic. Has lumbar lordosis, ? related to hip flexion contractures. The right hip's significant coxa vara will need an osteotomy. What now, and how? [& *3What is diagnosis: 'FHUF'? or 'Caudal Regression Syndrome'? Or ...?]

Saturday, May 20, 2006

Scientific Workshops

8:30 – 11:55 am

Workshop A

8:30 – 11:30 am

THE UNILATERAL BELOW ELBOW TEST (UBET)

*Lisa Wagner**, *OTR/L* and *Wendy Tomhave⁺*, *OTR/L*, and *Joanne Shida[^]* *OTR/L*

**Shriners Hospitals for Children, Greenville, SC; ⁺Shriners Hospitals for Children, Twin Cities, Minneapolis, MN; [^]Shriners Hospitals for Children, Los Angeles, CA*

The purpose of this workshop is to introduce the Unilateral Below Elbow Test (UBET). The UBET was developed to assess bimanual function in children with unilateral congenital below

elbow deficiency (UCBED) and was designed so children could be assessed both with and without a prosthesis.

The UBET consists of nine age-appropriate bimanual tasks for activities of daily living and play. Tasks are defined for each of four age groups: 2-4 years old, 5-7 years old, 8-10 years old, and 11-21 years old. Task performance is videotaped and then scored by the occupational therapist at a later time. Two scoring scales are used: Completion of Task which is a five point ordinal scale, and Method of Use which is a four category nominal scale. Completion of task scores range from a 4 for “completes the task with no difficulty” to a 0 for “unable to complete task”. Method of Use codes describe the patterns of grasp and stabilization used by the affected limb. Parallel coding for the prosthesis wearing and non-wearing conditions was developed.

Method of Use	Prosthesis On	Prosthesis Off
A	Active grasp of terminal device	Residual limb end manipulation and/or stabilization
P	Passive use of prosthetic forearm or terminal device	Forearm stabilization
E	Elbow or trunk grasp	Elbow or trunk grasp
N	No use of affected limb	No use of affected limb

Inter- and inter-observer reliability analyses for both UBET scoring scales have been performed. Completion of Task has good inter-observer globally. Method of Use has good inter- and intra-observer reliability for the prosthesis on condition and moderate inter- and intra-observer reliability for the prosthesis off condition.

Workshop B

9:00 – 10:25 am

MANAGEMENT OF THE PEDIATRIC SPINE.

Jeffrey A. Nemeth, CPO, FAAOP

Hanger Prosthetics and Orthotics, 1515 E. Florence Blvd., Casa Grande, AZ 85222

This symposium seeks to address and illuminate current issues in orthotic stabilization of the pediatric spine. Topics to be covered include unique anatomical considerations, particularly of the pediatric skull, stabilization of newborn injuries, appropriate options for critical immobilization, and proper airway alignment as it relates to pediatric cervical spine injuries.

Workshop C

10:30 – 11:55 am

MANAGEMENT OF THE PEDIATRIC HIP

Ms. Kaia Halvorson-Busch, CPO, LPO

SPS (Southern Prosthetic Supply), 6025 Shiloh Road; Suite A, Alpharetta, GA 30005

There are several pathologies that can adversely affect the structural integrity of the pediatric hip; cerebral palsy, tone or spasticity secondary to spinal cord injury, cerebral vascular accident, or traumatic brain injury, congenital and or developmental hip dysplasia, arthrogyrosis, and Legg Calve Perthes disease. Each presents with distinctive deficiencies due to ligament laxity, muscular imbalance, degenerative bony changes, and subluxation and or dislocation therefore management poses a unique challenge to every member of allied health team.

It is common to divide management into two categories, pre-operative and post-operative. Pre-operative intervention focuses on preservation of anatomical structures, reduction of contractures, ambulation, sitting balance and early integration of ADLs. To achieve these goals orthotic applications are designed to stabilize and protect soft tissue from contractures, align the hip to achieve maximum bony congruency aiding in proper development and reducing subluxation and or dislocation in addition to hopefully prolonging operative management allowing maximum bony growth to occur. These designs are often thought of as ambulatory however also provide significant stability in sitting and may have a positive effect on reducing upper extremity spasticity/tone.

The objective of post-operative orthotic intervention is to preserve stabilization techniques, range of motion and aid in rehabilitation, ambulation and to relative ADLs. Traditionally stabilization was done through the use of hip spica casts. These have been very successful in maintaining proper bony and soft tissue alignment however had significant drawbacks relative to skin care, wound site inspection, and toileting complications. To address these deficiencies orthoses were designed to be removable, washable, and provide adequate stabilization techniques. In addition these orthoses can also be adjusted to provide various range of motion allowing for safe and controlled ambulation during the rehabilitation process.

The introduction of these designs throughout the past 3 years has given way to many successes and reported failures. To address the discrepancy in results the presentation will explore the application of each style of orthoses, appropriate pre and post operative applications in addition to investigating perceived expectations and outcomes of the caregiver, therapists, and orthotist. (Orthoses to be included: Camp/Truelife – SWASH, Becker Orthopedic – Maple Leaf, Fillauer Inc. – Anti-adduction orthoses, Orthomerica – Newport Jr.)

POSTER ABSTRACTS

Poster #1

HOW DO WE AS PROFESSIONALS PROVIDE RESOURCES TO FAMILIES WITH CHILDREN WITH AMPUTATIONS OR LIMB DEFICIENCIES?

Jamee Riggio Heelan, OTR/L

Rehabilitation Institute of Chicago, 345 East Superior Street, 1st floor, Chicago, Illinois 60611

The Rehabilitation Institute of Chicago (RIC) is a world leader in rehabilitation, patient care, research, professional training, and advocacy. To extend its reach to people with disabilities across the globe, RIC created the LIFE Center, a resource center that focuses on: Learning, Innovation, Family, Empowerment.

The Center and its web site link you to a growing collection of books, videos, magazines, and multimedia materials. Information about community resources, such as support groups, disability-specific organizations, and classes, are also provided to help people with disabilities lead more fulfilling lives.

This poster will provide the professionals attending ACPOC with ways to connect to our web site, reaching our center by phone and ways to expand their knowledge base of finding the best resources for themselves as professionals and the families they serve.

Poster #2

FEMUR FRACTURE ORTHOSIS FROM NEPAL

Gyanendra Chandra Shrestha; Gregory Aaron, CO

Shriners Hospitals for Children No. California, 2425 Stockton Blvd, Sacramento, CA 95817

This orthosis was developed by Gayendra Shrestha (orthotist/ prosthetics) at his facility, Orthopedica, in Katmandu, Nepal. The challenge presented was one of efficient use of available bed space at the main hospital in Katmandu. Children would present with displaced femur fractures. The normal treatment would consist of 6 to 8 weeks of traction in bed at the hospital. Bed space being a premium, an orthosis that would maintain traction and proper alignment of the femur and allow the child to heal at home, freeing bed space was desired.

The orthosis is a HKAFO with a telescoping or adjustable femur section. Longitudinal alignment of the femur section is maintained by raised channels, which are vacuumed formed in the overlapping femur section. Traction is maintained by the ischeal brim and by gripping the medial and lateral condyles of the femur. Rivets or screws in the femur section maintain length. Rotational misalignment is eliminated by the vacuumed formed pelvic girdle, which is attached to the KAFO section by a free ROM hip joint.

A standard cast mold is taken of the affected lower extremity and pelvic section with appropriate landmarks noted. Length and dimensions of the unaffected side are recorded for comparison and proper fit. Modifications to the plaster model areas follows: a ischeal brim in formed in the

proximal margin of the KAFO section, gouging in at the medial and lateral condyles, and waist grooves are incorporated in the pelvic section. Standard modifications are done to the foot section. The thigh section may have to be modified to a more cylindrical shape if muscle development is of the more mature tapered shape. However, young children typically don't have the more mature tapered muscle mass.

Copolymer or polypropylene plastic is used with a soft thermo-moldable liner. Usual vacuumed forming techniques are used. Two straight raised forms are attached to the femur section prior to molding the plastic. It is important that they be parallel to each other and in longitudinal alignment to the axis of the femur to achieve the desired telescoping effect for traction. A "double pull" of the femur section provides for the overlapping and telescoping feature of the femur section

The orthosis is assembled following the recorded measurements with proper strapping to secure the orthosis to the patient. The orthosis is tried on the patient and any adjustments are done as necessary.

This orthosis has been used on three children. In one case the child resulted in a one-cm. leg length shortening because the parents did not control the child's activity level. The other two maintained equal leg lengths because the parents limited activity. In all three cases rotational and angular deformities were eliminated.

This orthosis is unique in several ways. It shows how, "necessity is truly the mother of invention", how the proper application of basic orthotic principles can bring about excellent results especially in a region of the world where a surgical intervention is not an option, and how creativity can benefit people. It is Mr. Shrestha's wish to share his idea for the betterment of the children of the world.

Poster #3

IF YOU HAVE TO HAVE A CAST, IT MIGHT AS WELL LOOK GOOD

Wendy Moon, CNP

Mayo Clinic, 200 1st St, SW, Rochester, MN 55905

An innovative technique for individualizing fiberglass casts is being utilized at the St. Marys Hospital Cast room. This technique is inexpensive, easy to perform, and results in tremendous patient satisfaction.

Fiberglass is the most common material used for casting following orthopedic trauma or surgery. Fiberglass casting tape is available in many colors, including "glow-in-the-dark" and even some patterns, however maintaining inventory in many colors as well as the patterns is cost prohibitive.

This technique utilizes plain printer paper, which can be printed with computer generated clip art, and the shapes are cut out. Patients may choose from a supply of clip art that is kept in a notebook. The printed pictures are applied to the top layer of fiberglass while it is still wet, and

overwrapped with a moistened ace wrap. In just a few minutes, the ace wrap is removed, and the picture is left adhered to the dried fiberglass.

Lack of control is a significant challenge for pediatric patients undergoing medical procedures. The cast room can be a frightening and overwhelming environment for the 200 children a month that are seen there. Providing children and adolescents an opportunity to personalize their cast and giving them some control over the situation is desirable for the patient and family. The children and adolescents are able to express their individuality, and the process of “designing” a cast offers an opportunity for distraction as well.

This technique is simple, easily replicated, cost-effective and demonstrates numerous benefits for both pediatric and adult patients. While having a cast is not entirely fun, and often has a negative impact on quality of life, the opportunity for self-expression and a beautiful, fun, or even wacky cast is one way of optimizing their experience.

Poster #4

LONG OPONENS ORTHOSIS FOR LONG-TERM INDEPENDENCE IN TETRAPLEGIA

*Mary Ann O'Dell, OTR/L; Sonny Alcairo, BOCO, CO
Shriners Hospital for Children Northern California, Sacramento, California*

Background: Hand and wrist paralysis in persons with tetraplegia interferes with functional independence in activities of daily living (ADL's). Occupational Therapists often fabricate long opponens splints of low-temperature thermoplastic for tetraplegic patients lacking wrist extension. This splint maintains wrist extension, preserves arches of the hand, and positions the thumb opposed to index and middle fingers which allows for grasp using passive tenodesis. Addition of a utensil slot allows use of a “right angle pocket” to hold items for functional use, such as a fork, toothbrush, or pen. These splints are effective but not extremely durable with everyday use. They require replacement when used regularly. Adding a metal support sandwiched between layers of thermoplastic reduces breakage but adds significant weight and bulk to the splint. Patients often require assistance to don and doff these splints. The need for a long-lasting brace is significant for patients transitioning out of pediatric services.

Purpose: To describe a durable, long-term alternative to standard low-temperature thermoplastic long opponens splints for patients with tetraplegia that maintains opponens position, includes a utensil slot for ADL's, and has customized straps allowing independent donning and doffing.

Methods: The Occupational Therapist for a 20 year old patient with tetraplegia consulted with the Certified Orthotist to fabricate a long opponens orthosis. Orthotist casted for splint with Occupational Therapist holding for positioning. Once cast modified, vacu-formed 3/16 polyethylene over cast which was lined with a foam liner. Immediately wrapped piece of 1 ½ x ¾ hot poly-ethylene around web to form thicker base. Slot made while plastic still hot. For custom strapping, used heat-molded 3/16 pelite and 3/16 thermo foam. Pelite heated over trim lines with ½ inch overlap on medial and lateral sides. Sewed a V strap decrone with a 1 inch tab for

grasping over the pelite and riveted the ulnar side. Hook Velcro glued to radial side of splint and pile Velcro sewn onto pelite for closure. Spring-loaded effect of pre-molded pelite was to increase ease of donning.

Results: Patient was fit with new long opponens orthosis with utensil slot. He independently donned and doffed the orthosis with customized straps. The contoured straps fastened easily with pressure from opposite forearm and unfastened with teeth by pulling perpendicular tabs. The utensil slot accommodated the “right angle pocket” for independent self-feeding. Patient was pleased with new orthosis and requested another for the contralateral hand.

Conclusion: The long opponens orthosis proved to be a durable alternative to previous splints made from low-temperature thermoplastic requiring frequent replacement. The strength of high-temperature thermoplastic allows it to be used indefinitely. Custom-molded straps allow independent donning and doffing. This intervention effectively increased independence and aided transition from pediatric services to adulthood. Further research, including long-term follow up with the long opponens orthosis, would provide more data on its use.