

2007 ANNUAL MEETING
Thursday, April 12, 2007

Session I – Physical and Mental Well-Being

7:45 am / Paper #1

**FROM BEAST TO BEAUTY:
EFFECTS OF PHYSICAL ACTIVITY ON THE AMPUTEE'S BODY IMAGE**

Kimberly Kathleen Hill
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Introduction: Previous research has indicated significant positive correlations between poor body image and mental illnesses such as depression and anxiety in the amputee population. Additionally, research has demonstrated a positive relationship between physical activity and self-esteem/body image in the non-amputated population. Thus, the primary purpose of this study was to examine the effect of physical activity on amputee body image; the secondary objective was to investigate the relationship between physical activity level and amputee body image.

Hypotheses: Physically active amputees will have a significantly lower (better) amputee body image score (ABIS) than non-physically active amputees. There will be a significant negative correlation between physical activity and ABIS score.

Methods: A non-randomized survey was given to a convenience volunteer sample comprised of 53 male and female amputees, ages 25-56. Participants were lower extremity amputees with at least 18 months experience with his/her prosthesis. Each subject completed a 10-item demographic profile, a 20 item amputee body image scale survey (ABIS) and a variable item physical activity and disability scale (PADS).

Results: A comparison of means using an unpaired T-test showed a significant difference between physically active and non-physically active ABIS ($p < .01$). The Pearson correlation test demonstrated a significant negative correlation between exercise and body image ($r = -0.681$, $p < 0.01$), total activity and body image ($r = -0.681$, $p < 0.01$) and physical activity and body image ($r = -0.616$, $p < 0.01$).

Conclusions: There is a significant relationship between physical activity and body image in the amputee population.

8:00 am / Paper #2

**THE PREVALENCE OF OBESITY IN A PEDIATRIC LOWER EXTREMITY AMPUTEE
POPULATION**

*Edward Skewes CPO, David E. Westberry MD, Linda Pugh BS
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Childhood obesity is rising at an alarming rate in the United States and other parts of the world. In some cases this scenario has been referred to as an obesity epidemic. When consumption of calories exceeds energy expenditure the excess is stored as fat in the body, yet why this increasing trend of childhood obesity is occurring in our youth has multiple aspects.

Genetics, environmental and behavior characteristics can be significant causative factors. The combination of sedentary life styles, unregulated dietary patterns, poor cardiovascular fitness, and parental obesity can have a detrimental effect upon our youth.

This presentation will review the prevalence of childhood obesity in the general population and its relationship to our pediatric lower extremity amputee population of 230 patients. It will also suggest the obligation of an institution to trend and identify existing and potential obese pediatric patients and offer education, counseling, and recommended life style changes for these patients and families.

The causes, multiple risks, and complications associated with childhood obesity will be reviewed along with the questionable paradigm of fitting some individuals within this population who have weight levels beyond the range of the available prosthetic components.

8:15 am / Creative Solution #1

**INSTILLING CONFIDENCE IN PARENTS OF CHILDREN WITH LIMB LOSS
THROUGH A NETWORK OF TRAINED PEERS**

Charlene J. Whelan, LCSW, MBA, Health Educator

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Whatever the cause, and however the news is received, parents are universally devastated to learn their child is faced with limb loss. As they scramble to arm themselves with sometimes overwhelming amounts of information, massive doubts often arise about their ability to become the parents their child needs. Although support groups for parents of children with limb loss are a significant potential resource, there is typically not enough critical mass in a given locale to make a face-to-face group happen. Furthermore, facing such a group isn't necessarily therapeutic at certain stages in dealing with trauma.

To address these issues, the Amputee Coalition of America (ACA) is working to expand its highly successful National Peer Network (NPN) for adults with limb loss by creating a unique communication and outreach resource for parents of children with limb loss, the Parent Support Network (PSN). To this end, ACA has revised its *Peer Visitor Training Manual* to include information targeted to parental support needs, derived from interviews with current ACA members who are parents of children with limb loss. The next step in developing the PSN program has been to identify and retrain select trainers from its active pool of certified peer trainers specifically to meet the needs of this unique group. A minimum of five PSN peer visitor trainings are planned in the program's first year, with a goal of certifying 50 PSN peer visitors.

Prospective PSN peer visitors are drawn from parents who have demonstrated their ability to shepherd their child along a path for living a full and productive life, adjusted to, but not restricted by, the child's limb loss. These parents are typically eager to share their success stories with other parents, and by doing so — being able to “give back” — are propelled even further along their own path of reconciliation and recovery.

At the PSN peer visitor trainings, parents of children with limb loss learn what it means to be a genuinely positive force as a peer visitor, what the role encompasses and what the inherent limitations are. The training provides the necessary tools, information and confidence to enable a certified PSN peer visitor to seamlessly move into this new role and to screen out those who might not be ready or appropriate for it.

Parents who could benefit from a PSN peer visit will be connected with a family that is matched as closely as possible to their child's age and the cause and type of limb loss. This presentation will offer ACPOC professionals some tips on communication and methods for facilitating the

referral process with parents in order to maximize the chances for successful follow-through on behalf of their child patients with limb loss.

8:30 am / Creative Case Presentation

**FAMILY PSYCHOLOGICAL AND LEGAL PROBLEMS DISRUPTING TREATMENT
OF A CHILD AMPUTEE: A CLINICAL CASE REPORT**

Robin C Crandall, MD

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

The challenging case presented involves a 16 -year-old female with congenital anomalies including a severe form of longitudinal deficiency of the tibia. Over the past 16 years the family has been unable/unwilling to abide by surgical recommendations involving numerous orthopedic surgeons. Much legal involvement occurred including a court order that only one of the parents decide on medical decisions. In spite of that court order, no surgery was done and the patient continues to ambulate on a significantly deformed residual limb. This challenging case will be discussed and audience comments solicited.

9:05 am / Paper #3

**THE FINANCIAL IMPACT OF NON-SPECIFIC PRESCRIPTION CRITERION FOR
PEDIATRIC LOWER EXTREMITY PROSTHETIC DEVICES.**

Edward A Skewes, CPO; Ronald Gingras, CPO; David E Westberry, MD; Ralph Lewkowicz, RPh, MS

The lack of specificity in lower extremity prosthetic prescription may create uncontrolled scenarios that provide high end (expensive) devices to pediatric patients regardless of their activity level, internal drive, or ability. This ultimately results in elevated (and perhaps unjustified) expenses for services provided within or for a hospital organization. Without appropriate pre-approval for L code procedures and specific guidelines established and imposed, there exists great potential for inconsistent provision of prosthetic devices among patients with similar etiologies and activity levels.

This presentation will provide an overview of L code billing practices (which include the basic charge and the additions) for some specific pediatric lower extremity prosthetic devices and will show the effect that allowable L code bundling has upon the final cost of a lower extremity prosthetic device. A financial comparison of conventional and “high technological” pediatric prosthetic devices will provide insight regarding the financial impact that these devices may have upon a system.

Establishing guidelines for lower extremity amputees based upon developed pediatric functional guidelines that correlate with patient etiology, patient activity level and patient age may provide the potential for improved continuity of patient care. Instituting a methodology that also establishes allowable L code charges for devices can reduce what may otherwise be excessive prosthetic charges and expenses to an organization.

Communication and collaboration are essential for the development, installation, and utilization of an adequate computer system which can continually monitor the financial aspects of prescribed lower extremity prosthetic devices. Careful assessment of the appropriate information affords the opportunity to determine the most cost efficient and consistent provision of care paradigm throughout a hospital system.

To provide greater consistency in the provision of pediatric lower extremity prosthetic devices for limb deficient patients, avoid potential conflicts of interest, and reduce unnecessary

expenditures, philanthropic organizations may desire to implement their own specific prescription criteria and guidelines for prescribing lower extremity prosthetic devices.

Session II – Challenging Pathologies

11:15 am / CCP #1

ORTHOTIC MANAGEMENT OF GORHAM-STOUT SYNDROME (VANISHING BONE DISEASE)

*Richard Welling MSPO, Ed Barber CO
Children's Healthcare of Atlanta, Atlanta, Georgia, USA*

Gorham-Stout syndrome is a rare disease, with less than 150 cases reported in the literature¹, which results in local osteolysis. The disease is better known as vanishing bone disease. Because of the small number of cases documented, the prognosis, etiology and treatment of this disease can vary widely².

This case study will review the timeline of surgical and orthotic interventions as well as complications that occurred during treatment of a 12 year old female patient diagnosed with Gorham-Stout syndrome. Due to the progressive nature of the disease, multiple cervical orthoses were required over a several month period to maintain the stability of the patient's spine. The day to day challenges of maintaining skin integrity, wound care techniques and patient positioning will also be reviewed. A multidisciplinary approach was essential for an immediate resolution of these challenges and insure quality patient care.

References:

- 1) Lee S, Finn L, Sze RW, Perkins JA, Sie KC, Gorham Stout syndrome (disappearing bone disease): two additional case reports and a review of the literature, Arch Otolaryngology Head Neck Surgery. 2003 Dec;129(12):1340-3.
- 2) Boyer P, Bourgeois, Boyer O, Catonne Y, Saillant G, Massive Gorham-Stout syndrome of the pelvis, Clinical Rheumatology, 2005 Sep;24(5):551-5. Epub 2005 Apr 13

11:35 am / CCP #2

A CASE PRESENTATION: HEMOPHILIA AND BILATERAL TRANSTIBIAL AMPUTATIONS WITH CONVERSION TO TRANSFEMORAL LEVEL

Ann C. Modrcin, MD; Loren J. Decker, M. A.; Prosthetist**; Nathan D. Apple, PT*
*Children's Mercy Hospitals & Clinics, Kansas City, MO; **Capital Orthopedics, Lenexa, KS;*

The Problem: A 19-year-old male patient from Cambodia presented with bilateral below the knee amputations resulting from complications of hemophilia. His knees auto-fused in a flexed position as a result of the combination of bleeding into his joints, and immobility. He presented with a desire to ambulate, many years following his amputations. Other complicating issues include chronic pain and overuse in his left shoulder.

Issues for Discussion: The case study will review this patient's anatomy both clinically and radiographically. A review of the literature will be included, relating to the pathophysiology of untreated hemophilia and joint pathology.

The decision making process related to his prosthetic interventions initially included custom weight bearing orthoses with a stubby design, followed by bilateral prostheses with modified bent knee socket design and subsequent conversion to transfemoral levels bilaterally for more conventional prosthetic fitting.

Discussion of this case will include a review of the pathophysiology of hemophilia with regard to joint destruction, in addition to reviewing the decision making process regarding prosthetic intervention, custom wheelchair design, and the resultant functional gains achieved. Videos are also available for review.

11:55 am / CCP #3

PFFD CASE STUDY

*Harold J P Van Bosse, MD; William L Goldberg, CP; Timothy T Evans, CP; Katie Buker, CP
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Daniel* presented in clinic with bilateral proximal femoral focal deficiency (PFFD). His right limb had no hip joint, while his femur was 80% developed. He had a 60-degree knee flexion contracture along with clubfoot deformity. His hindfoot varus and forefoot supination caused the plantar surface of his right foot to be confluent with his medial leg skin. His first metatarsal had a bracket epiphysis with a duplicate great toe. His left limb was significantly less developed, its total length reaching mid thigh level of the contralateral limb. Both his left femur and tibia were vestigial. He could move his left foot spontaneously; it was of nearly normal size but had seven toes. Along with his limb deficiencies the patient also has sacral agenesis, lumbar spine abnormalities and Pierre-Robin deformities. The challenges we faced were how to enable Daniel to become weight bearing, ambulatory and non-wheelchair dependent. In order to achieve this goal we decided upon a combination of surgical procedures and rehabilitative efforts using both orthotic and prosthetic devices.

At 3 ½ years old Daniel began the surgical interventions necessary to become ambulatory. He had tissue expanders placed on the medial aspect of his right leg and ankle in order to stretch the skin prior to correcting the foot deformity. The expanders were removed after four months and an Ilizarov frame was placed on his right tibia and foot. This allowed us to gradually correct the ankle equinus, hindfoot varus, forefoot adductus and supination, by gradual soft tissue distraction. The foot deformity was corrected in four months at which time his knee flexion contracture was addressed. A posterior release of the knee was performed, the Ilizarov frame was extended above the knee, and the flexion contracture was gradually distracted. The Ilizarov frame was removed after three months, at which time the bracket epiphysis was osteotomized and his accessory great toe removed. He was then casted for four weeks while his Knee Ankle Foot Orthosis (KAFO) was fabricated.

Daniel is currently outfitted with a right KAFO and a left prosthesis. The KAFO has a solid ankle and ratchet lock knee hinges. The foot plate places his forefoot in neutral to prevent equinovarus. The locks allow for progressive stretching of his knee until full extension is achieved through a ratcheting system; thus preventing further contracture while continuing to work out his knee flexion contracture. The KAFO is both a functional and resting brace that Daniel wears essentially twenty-four hours a day.

On his left side he wears a hip disarticulation prosthesis with a Canadian style socket. The socket has a fenestration in order to accommodate his flail left limb. The components consist of a child's energy storing foot, pediatric 4-bar polycentric knee, and pediatric hip joint. Daniel is participating in physical therapy and ambulates independently with two lofstrand crutches.

*Name of patient has been changed to ensure privacy.

12:15 pm / CCP #4

RHETT REVISITED

*Sandra B Smith, MSPT; Eddie Rogowski, CPO; Janet Marshall, CPO; Natasha Casimir, MSPT;
Michelle Hiner, PT
Shriners Hospitals for Children, Tampa, Florida*

Rhett is a 10 year old male with a diagnosis of VATER syndrome resulting in multiple congenital anomalies including sacral agenesis and congenital scoliosis first treated at one year of age presented as a case study at ACPOC meeting in 1999. Initial surgical interventions included syndactyly release of the right hand and amniotic band release of the right arm. He also presented at birth with a congenital right knee disarticulation with a tibial remnant, and the left leg which was flexed and externally rotated at the hip and with a significant knee flexion contracture secondary to posterior webbing. After bilateral knee disarticulations at age 2, Rhett was initially fit with bilateral above knee prostheses without knees. At age 4, four bar knees were added to new prostheses. Despite therapy, he did not progress beyond physiological ambulation with a walker. For 6 years, he negotiated indoor environments with his stubbies and used a manual wheelchair for community mobility.

Rhett is now using bilateral above knee prostheses for independent ambulation. The factors which led to his request for “bendable” prostheses and interventions for successful integration with his daily activities will be shared.

Scientific Workshops

1:30 – 4:30 pm

Workshop B

THE MODIFIED BOSTON BRACE PROTOCOL

*Larry Mortensen, CO; Aaron Smith CO; Colleen Coulter-O’Berry PT, MS, PCS
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Much controversy surrounds the treatment of children with Idiopathic Scoliosis. None is more apparent than the conservative treatment of bracing, type of brace, number of hours recommended wearing the brace, and effectiveness of exercises, physical therapy.

The efficacy of orthotic treatment for idiopathic scoliosis has been debated in the literature for years. Researchers at the Mayo Clinic reviewed a single orthotic molding and implementation strategy and noted a significant improvement in outcome¹. This workshop will review the bracing strategy evaluated in the Mayo investigation.

Goals: The goal of the workshop is to define and demonstrate the casting, modification, and fitting stages of the Modified Boston Brace. The role of physical therapy treatment will also be discussed.

Objectives: Following the session the participants will:

1. Understand the different treatment philosophies between the Boston Brace module and Modified Boston Brace System.
2. Identify the necessary components of the radiological and clinical assessments of the patient.
3. Observe casting and measurement of a patient using the Risser Table
4. Understand modification techniques unique to the Modified Boston Brace

5. Understand the principles of initial fitting and final modifications using the Modified Boston Brace
6. Be aware of the physical therapist's role to assist the patient in positions for comfort, pain relief, tolerating movement in the brace, wearing schedules, and tips for clothing, sleeping, and activities.
7. Understand the treatment plan, including adjustments needed at follow-up, and physician follow-up.

References: Moon, W., Shaughnessy, W., Stans, A. Beneficial effects of orthotist training on bracing success for adolescent idiopathic scoliosis. Proceedings of the Scoliosis Research Society Meeting, 2005.

Friday, April 13, 2007

Session III – Spinal Management

8:00 am / Paper #4

ULTRA FLEXIBLE TLSO DESIGN FOR NEUROLOGIC SCOLIOSIS MANAGEMENT

Nancy Hylton, PT, LO

*Dynamic Orthotic Systems, a division of Children's Therapy Center of Kent,
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The Cheneau De-rotational TLSO has been used to treat idiopathic scoliosis successfully in Germany and other parts of Europe for more than 15 years. This design is constructed of 4 mm polyethylene in a highly contoured circumferential brace with anterior or posterior closure and posterior windows in the concavity of the curve. We have used an even more flexible modified version of this de-rotational TLSO system for children with neurologic curves ranging from 35 to 85 degrees Cobb angle with good success over the past 4 years in children ranging from 1 to 15 years. The extreme flexibility of the TLSO improves both comfort and compliance. We have used this system with a diverse group of motor impairments, including, Cerebral Palsy, Arthrogryposis, Spina Bifida and Spinal Muscular Atrophy type II.

Cast molding is done in maximum manual correction, either circular wrapped in supported sitting or in back and front component, both with some traction applied. The negative cast is modified further through wedging to open up the concavity of the curve and improve physiologic AP spinal curves toward more typical angles. Rectification of the positive cast deliberately de-rotates the pelvic, lumbo-thoracic and shoulder counter rotations toward neutral orientation, as much as possible.

Presentation will include testing for manual curve correction possibilities, comparison of different individuals in and out of bracing, data and x-ray records on curve containment and correction. It will also include important aspects of negative cast fabrication for optimal initial curve correction and further modifications typically made while rectifying the positive mold.

Session IV – Lower Limb Orthotic Management

3:45 pm / CCP #5

**SEVERE DEFORMITY AND LIMB LENGTH DIFFERENCE RESULTING FROM
OPERATIVE TREATMENT OF CLUBFOOT: AMPUTATION VS. RECONSTRUCTION**

Shawn R. Gilbert, MD, Division of Orthopedic Surgery
University of Alabama at Birmingham & Children's Hospital of Alabama, Birmingham, AL

The Problem: Two teenage boys present with complaints of foot deformity, limb length difference and pain with ambulation. Both had been treated with posterior medial release as infants (different surgeons) and subsequently developed partial growth arrest of the distal tibia.

Case 1: A thirteen year old male presents with limb length difference and foot pain. He had posteromedial clubfoot release as an infant and subsequent distal tibia derotation osteotomy. He has limited ankle ROM with apparent dorsiflexion of 10 degrees occurring largely through the midfoot. The ankle and heel are in varus. He has intact motor and sensory function and 2+ DP and PT pulses. Total LLD is 7.2 cm, with 2cm of difference occurring below the ankle joint. He has a posterior distal tibia growth arrest and fibular overgrowth.

Case 2: A twelve year old boy presents with foot pain and deformity. He had posteromedial release of bilateral clubfeet as an infant. The left foot developed wound necrosis and some loss of correction. Additional procedures included revision release, calcaneo-cuboid fusion and first metatarsal osteotomy. His foot is in equinus and cavus with only a few degrees of ankle motion. No DP or PT pulse is palpable or dopplerable, but capillary refill is brisk. Radiographs and MRI confirm the deformities and reveal 3.4cm LLD and growth arrest of the distal tibia and first metatarsal.

Solutions: A similar presentation of options was made to both families. Complex reconstruction could be performed. Extra-articular angular correction would be achieved by osteotomy and gradual correction utilizing external fixation. Epiphyseodesis would be completed to prevent recurrent deformity. Lengthening would be performed concurrently to correct limb length difference. Despite realignment and equalization of limb lengths, persistent joint stiffness and some foot pain with activity would be expected. Alternately, amputation was offered as a simple, definitive procedure with low risk of complication and faster convalescence. Anticipated benefits would include relief of pain, excellent function and preservation of a distal, end-bearing level of amputation (Boyd or Symes). In case 1, reconstruction was chosen. Bifocal treatment with circular external fixation was performed. Problems, obstacles and complications were encountered. The patient is currently recovering from a fracture through the regenerate. In case 2, amputation was chosen. The initial Boyd amputation was complicated by skin flap necrosis and revised to a Symes amputation.

The ideal solution has yet to be identified.

4:05 pm / CCP #6

EFFECT OF ANKLE-FOOT ORTHOSES ON ANKLE AND KNEE KINEMATICS IN AN INDIVIDUAL WITH SPASTIC DIPLEGIA

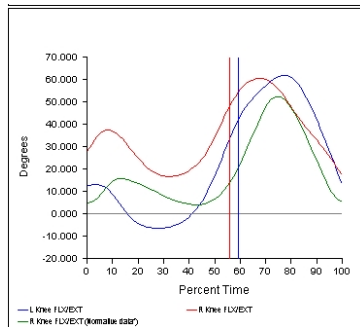
Mark D Geil, PhD

Georgia State University, Atlanta, Georgia

Cerebral Palsy affects the motor function of individuals in such a broad array of manifestations that it can sometimes be difficult to determine the cause of motor disorders. Clinical gait analysis is a useful tool for documentation of human movement, and in cases involving children with cerebral palsy, can be an effective component of treatment planning. The following details a case in which a child was evaluated to determine the cause of a multi-joint locomotor deficiency and assess the effectiveness of ankle-foot orthoses.

A six year old girl presented with bilateral lower extremity spasticity prior to Botox injections. She was fitted for bilateral ankle foot orthoses with plantarflexion stop, valgus control trimlines, and ankle cross-straps to prevent equinus, pes planovalgus, and spasticity.

Two analyses were used for kinematic assessment. Conventional analysis used an 8-camera 120 Hz Peak system and Motus 8.2 software. The Motus Kinematic software was used with human gait processing based on Vaughan et al. [1]. For comparison, a second assessment used a single sagittal-view Sony digital video camcorder and Dartfish DartTrainer v2.5.3 software. Dartfish enables digital separation of subject from background for the purpose of superimposing different conditions or producing cloned images of the subject at different portions of the gait cycle, as well as basic 2-D analysis of temporal and spatial parameters and joint angle. Walking trials were repeated for two conditions: barefoot, and shod with bilateral AFOs.



Results indicated involvement at the bilateral hip, knee, and ankle joints, abnormal pelvic motion which affected the trunk, and consequent changes in upper extremity excursion. In particular, at initial contact, the left knee in the barefoot condition was measured at 38.9° of flexion. In early stance the knee extended to 2.2° flexion, a range 36.7° for one particular trial.

The effect was recognized as a “Jump Knee” kinematic pattern. The AFOs were determined to attenuate but not reverse the pattern, with positive effects at other joints.

This case is an interesting example of the results of an intervention that produced both negative effects (e.g. reduced velocity) and positive effects (e.g. reduced recurvatum). Consequently, the case is a useful teaching tool to those assessing the potential for varied outcomes associated with orthotic intervention.

Reference

1. Vaughan CL, Davis BL, O'Connor JC. Dynamics of Human Gait. Champaign, Illinois: Human Kinetics Publishers; 1992

Session V – Lower Limb Prosthetic Management

4:45 pm / Paper #7

CAD SYSTEMS PRODUCE CONSISTENT AND ACCURATE MEASUREMENTS OF CLINICALLY USEFUL RESIDUAL LIMB ANTHROPOMETRIC MEASURES

Mark D. Geil, Ph.D.

Georgia State University, Atlanta, Georgia

For clinicians who work with individuals with limb loss, the measurement of residual limb anthropometrics and understanding of fluctuations in limb volume and shape may become increasingly important with the need for outcome measures in prosthetic rehabilitation [1]. Computer aided design and manufacturing (CAD/CAM) systems have been adapted for prosthetics for the primary function of socket design and fabrication. This study investigated an incremental step in that process: the capture and digitization of 3-D residual limb shape.

Previously published data [2] assessed the utility of different conventional calipers and tape measures in recording standard anthropometric measures from models of transtibial residual limbs. The present study used the same measurement locations and the same models with digital shape capture using two common CAD systems: an optical scanner (T-Ring 2) and an electromagnetic-field based contact scanner (Tracer Omega). Results were analyzed for accuracy and consistency and then compared to similar results from the conventional tool study.

Seven prosthetics students and four experienced practitioners participated in the study. The study was approved by the GSU IRB and each participant signed informed consent. All had CAD training specific to the systems used. Each participant captured the shape of three foam positive models of transtibial residual limbs using each of the two CAD systems in randomized order. The following anthropometric measurements were recorded from predefined landmarks on each model: AP and ML distance, Length (MPT-distal end), and circumferences at the MPT and at 2 and 4 inches distal. Two of the models were identical, permitting analysis of within-subject variability. Data were analyzed to assess consistency and accuracy and the role of experience (between groups) and device (between CAD systems).

Anthropometric measurements taken from CAD models were accurate and consistent on the order of 1 mm. The optical and contact scanners tested produced similar results for the same measurement, and both students and practitioners were able to use the devices consistently. Results were also very similar to those obtained from hand calipers and tape measures. For example, the AP distance for identical models A and C was measured as 13.41cm and 13.40cm by the digital systems; these data compared to measurements of 13.19cm for each model by hand calipers, averaged across all subjects in each study.

These results have established the capability of two CAD systems to produce consistent and accurate measurements of clinically useful residual limb anthropometric measures, at least within the scope of the study (foam models with gel liner coverings as opposed to *in vivo* limbs, no model modifications). The results also established surprising agreement between CAD measures and hand measures. Because CAD systems collected more information in less time than conventional methods, prosthetists should consider CAD as an efficient means to record residual limb anthropometrics and 3-D shape information, even in cases when conventional techniques will be used for socket design and fabrication.

References

1. Convery P, et al. Measurement of the consistency of patellar-tendon-bearing cast rectification. *Prosth Orth Int* 2003;27:207-213.
2. Geil MD. Consistency and accuracy of measurement of lower extremity amputee anthropometrics. *J Rehab Res Dev* 2005;42(2):131-140

5:00 pm / Paper #8

THE EFFECT OF PEDIATRIC PROSTHESIS MADE FROM COLOURED STAKINET ON THE CHILD AMPUTEES' PARENTS' SATISFACTION

Ö Ülger PT, PhD; S Topuz PT, Msc; K Bayramlar, PT, PhD, Assoc Prof; G ener; PT, PhD, Prof; F Erbahçeci, PT, PhD, Prof

*Hacettepe University School of Physical Therapy and Rehabilitation
Prosthetics & Orthotics Biomechanic Department*

Introduction: Early prosthetic fitting is very important in child amputees for regaining body image, balance and stability. Regardless of the functional benefits of early fitting, the cosmetic appearance is also very important for their parents.

Purpose: The purpose of this study is to determine the effect of the pediatric prosthesis made from coloured stockinet on the child amputees' parents satisfaction.

Methods: The participants used their prosthesis before they participated in this study. Their prosthetics were applied in the Prosthetics Orthotics and Biomechanics Department of our school. Parents of child amputees using prosthesis coloured stockinet were interviewed. Evaluations included demographic characteristics, level of amputation, cause of amputation,

date of amputation, duration of prosthetic use, prosthetic comfort, function, cosmesis and price of the application, reasons for changing prosthesis, game activities such as ball game and cycling. In addition, satisfaction with prosthetic use was evaluated as “very satisfied or dissatisfied”. Assessments were done for old prosthesis and also for new prosthesis.

Results: The 10 amputees (6 congenital, 4 acquired) with ages ranging from 0-4 years were the subjects of the study. It was determined that 5 of the patients were amputated from below knee, 3 from above knee and 2 from hip disarticulation level. When we asked the parents how the child functions, their comfort and cosmesis, their participation in activities of child games, 80% parents explained that their prosthesis were good and 75% of the parents explained that their children were successful participants in activities of child games. Reasons for changing prosthesis originated from the insufficiency of stump socket fitting (70%), deformation of prosthetic knee and foot (20%). The old prosthesis satisfaction was found to be about 85%. In the assessments with new prosthesis it was shown that the patients were not satisfied with the cosmesis of the prosthesis.

Discussion: The result of this study has reported that the child amputees’ parents want their children to participate in social activities. On the other hand, they want the prosthesis to be cosmetic. Although parents were “very satisfied” with the new prosthesis in comfort and function, they felt uncomfortable about the appearance of the coloured prosthesis, because it was different from the natural appearance.

Saturday, April 14, 2007

Symposium III

7:30 – 8:30 am

MEASUREMENT AND OUTCOMES: PRACTICAL TOOLS FOR ANALYSIS OF MOTION AND EVIDENCE-BASED PRACTICE

Mark D Geil, PhD

Georgia State University, Atlanta, Georgia State University

The growing movement toward evidence based practice is causing clinicians to consider opportunities and methods for collecting and documenting information about the movement patterns of their patients, as well as ways to record changes in movement patterns following treatment.

This symposium will explore methods to analyze and quantify motion, including outcome instruments and surveys and fundamental principles of *observational* and *instrumented* motion analysis for prosthetists, orthotists, and physical therapists.

Prosthetics, orthotics, and rehabilitation involve and depend on observation of motion. Observational analysis is taught through various methods and with various levels of depth, but it is rarely researched. On the other hand, fewer students are exposed to instrumented gait analysis, which is a widely used tool for research.

There is evidence to suggest that some gait variables are more reliable to observe than others, but not enough to generalize recommendations. In this context, the course will explore what we have learned about observation of motion and forge the best possible strategies from those knowns, including planes of observation and “pathology based” learning. A unique aspect of the session will be consideration of situations beyond level straight-line walking.

The session will feature live real-time observational analysis of an individual with a movement disorder, observation of videotape of that individual, and demonstration of basic quantification of motion that can be done in any clinical office. Software will be introduced that allows clinicians to effectively document temporal and spatial parameters of gait and basic kinematics.

Goals and objectives of the symposium:

- To understand various methods to analyze motion
- To discuss their use in evidence-based practice
- To develop practical strategies to quantify motion in clinical offices

Session VI – Motion Analysis

8:30 am / Paper #9

COMPARISON OF MOBILITY IN BILATERAL BELOW KNEE AND UNILATERAL BELOW KNEE CHILD AMPUTEES

Semra Topuz, PT, MSc; Özlem Ülger, PT, PhD; Kezban Bayramlar, PT, PhD, Assoc Prof; Fatih Erbahçeci, PT, PhD, Prof; Gül Pener, PT, PhD, Prof
Hacettepe University School of Physical Therapy and Rehabilitation
Prosthetics & Orthotics Biomechanic Department

Purpose: This study was performed to determine of mobility in lower limb child amputees.

Method: The 10 unilateral below-knee, 10 bilateral below knee child amputees used prosthesis before participated in this study. First of all general physiotherapy and prosthetic evaluations were done. Then mobility was assessed by Amputee Mobility Predictor Questionnaire(AMPQ).

Results: In this study mean age of children with unilateral below knee amputees was 9.9 ± 2.01 and children with bilateral below knee amputees was 10.35 ± 2.04 . Amputation cause of all subjects were acquired such as trauma, cancer and various disease.

All of them were student and dating from amputation they have used prosthesis. Amputation age was found mean 5.04 ± 1.05 in unilateral below knee amputees and 6.07 ± 2.00 bilateral below knee amputees.

Every each amputee group wore second or third prosthesis. Time of prosthesis use was determined mean 2 years in unilateral below knee amputees and 2,5 years in bilateral below knee amputees. Every each group of amputee were evaluated AMPQ. Bilateral below knee amputee group took more less score than unilateral below knee amputee group.

Discussion: Although each amputee group demography, amputation year and amputation cause were similar, bilateral below knee amputees took more less AMPQ score than unilateral below knee amputees.

We conclude that number of extremity joined amputation effects on determined of mobility status lower limb amputations.

8:45 am / Paper #10

THE EFFECT OF PROSTHETIC REHABILITATION ON GAIT PATTERNS OF CHILDREN WITH ACQUIRED AMPUTATIONS

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Purpose: The study is planned to investigate the effects of prosthetic rehabilitation on gait patterns in children who had traumatic amputations.

Methods: 20 children whose ages varied between 8-17 were assessed to determine the time-distance characteristics of gait after 3 weeks of prosthetic training (first) and 6 months after their discharge (second) from the prosthetics department. Foot-print analysis were carried out to achieve data.

Results: Statistically important differences were found in foot angle step and stride lengths velocity and cadence data when the results of the first and second assessments were compared ($p < 0.05$). It was also determined that the children walked in a pattern closer to normal gait after 6 months of their discharge.

Discussion: Consequently it can be said that the children presented improved gait patterns and foot-print data closer to normal values after 6 months period of their discharge. It can be stated that the prosthetic use in social environment and the increase in prosthetic use time led the children to gain experience and confidence in daily activities.

9:00 am / Paper #11

A FUNCTIONAL COMPARISON OF SOLID AND ARTICULATED AFO'S DURING WALKING AND RUNNING IN CHILDREN WITH SPASTIC HEMIPLEGIC CEREBRAL PALSY

*Bridget M Lawler, Board Eligible Orthotist; Jason Wening, MS; Michael Oros, CPO
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While previous research with Cerebral Palsy has focused on hemiplegia and diplegia, Botox injections, and gait patterns with and without ankle foot orthoses in standing, walking, and stair climbing as compared to barefoot ambulation, none of this research has included AFOs' effects on running. The purpose of this study was to compare gait parameters of children with spastic hemiplegic cerebral palsy wearing solid and articulated AFOs during walking and running trials. It was hypothesized the articulated AFO significantly improves gait parameters during walking and running when compared to a solid AFO. Seven children aged 5-10 years with a diagnosis of spastic hemiplegia secondary to cerebral palsy participated. All subjects were current AFO users capable of walking and running without an assistive device, had no previous surgical intervention, and a passive dorsiflexion end range of 5 degrees. Subjects were fit with an articulated and solid AFO fabricated from the same positive model. Gait data for ten walking and ten running trials with subjects wearing each AFO were collected using the GaitRite system. No significant difference in the walking gait parameters was detected between the AFOs. A significant difference ($p < 0.05$) in favor of the articulated AFO was noted in the running trials for velocity, step length of the affected and non-affected sides, and stride length of the affected and non-affected sides. It is hoped that the results of this study will aid in the decision of functional orthotic management of children with spastic hemiplegia, especially those with the ability to run.

9:15 am / Paper #12

EVALUATION OF SHORT-TERM INTENSIVE ORTHOTIC GARMENT USE IN CHILDREN WITH CEREBRAL PALSY

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Purpose/Hypothesis: This study evaluated the effectiveness of an orthotic under garment with a strapping system on the gait pattern, postural stability, balance and life skills on children who have mild cerebral palsy (CP).

Number of Subjects: Five subjects (7-13 years) with diplegic CP participated. All subjects were classified at Gross Motor Classification Scale (GMFCS) level I. The subjects did not receive any ongoing physical therapy services during or before the study.

Materials/Methods: A TheraTog™ garment system was used for 12 weeks, 10-12 hours per day. The first 2 weeks, the vest and shorts were worn alone and then based on the findings from a musculoskeletal lower extremity assessment; a strapping system was individualized for each child and worn for the rest of the intervention phase. Baseline testing included Vicon® Motion Analysis of gait, Neurocom Equitest® for postural stability, Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) for balance and gross motor skills, and the Canadian Occupational Performance Measure (COPM) for functional skills/goals. Outcome measures repeated the baseline testing at the end of the intervention with the garment on and off and additionally 2 and 4 months after the intervention phase was completed. A parent diary of compliance and comments were kept and a parent satisfaction survey was completed at the end of the intervention period.

Results: Kinematic gait data indicated that peak hip extension at terminal stance increased during wear time and did not return to baseline by 4 month follow-up. Pelvic alignment in the sagittal plane was only impacted with the garment on, tilting the child's pelvis more posterior during gait trials. Neurocom results showed no significant changes on the motor control and adaptation tests, but the limits of stability test showed better directional control of their bodies during active weight shifts. The composite gross motor scores on the BOTMP improved with the garment on (31%) as well as with the garment off (27%) and the values continued to improve 2 and 4 months after the intervention. The performance score on the COPM improved 19% at the end of the intervention, 28% 2 months later and 20% at 4 months post. The satisfaction score on the COPM improved 24% at the end of the intervention, 23% 2 months later and 35% at 4 months post. Wearing compliance was 100% for 2 children and 75% for 3 of the children. The overall parent satisfaction was good, with primary complaints that the garment was too hot.

Conclusions: When used over a 2 month time frame, an individualized orthotic garment and strapping system can improve gait, postural stability, balance, and life skills in some children with CP, GMFCS level I. Further research is needed to determine if the same effect would be seen in a larger population and with those children who have greater disabilities. Optimum wear time and duration will require further study.

Clinical Relevance: Physical therapists may find these garments to be a useful tool to improve gait, posture, functional skills and balance in children who have CP.

Session VII – Upper Limb Prosthetic Management

10:15 am / Paper #13

EXAMINING THE PROSTHETIC FUNCTION AND BODY BEHAVIOR OF PROSTHETIC USERS PERFORMING ACTIVITIES OF DAILY LIVING

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This paper compares children using two different types of prosthetic wrist to an age matched group of normally limbed children. Prosthesis users enrolled in this study are between the ages of 4 and 13 years and use either a uni-axial friction wrist or an Omni-wrist on their below-elbow myoelectric prostheses.

To date, 13 prosthesis users have been recruited from among our clinical population. A group of 44, age matched, normally limbed controls have been recruited as a convenience sample from sports teams, schools etc. Testing is based on a set of three, large muscle, two handed tasks.

These are: zipping up a vest; riding a semi-stationary bike; and swinging on a playground type swing. These tasks have been chosen because they benefit from coordination of the actions of the sound hand and the prosthesis. The zipper task is one where the child can control the pace of the task. For the swing the timing is determined almost entirely by the physics of the system and the child must respond accordingly. The bike task falls somewhere between the other two in that the child rides a bicycle which has been mounted in a support which allows the child to pedal against resistance. The bike is supported so that as the child leans the bike will respond. The child has various commands projected on a screen in front of them and responds by pretending to turn, standing up to pedal, etc. These activities have a sufficient "fun factor" that children returning to the clinic are asking to take part again.

Data collection is done using a VICON Mcam motion capture system and a Noraxon electromyography system. These systems provide a means to examine the postures and movements of the children as well as their muscle activity during the activities. Preliminary analysis shows interesting results. During the zipper task, prosthesis users have more difficulty when the zipper is on the same side of the vest as the prosthesis. The majority of prosthesis users use their sound hand to control the zipper while they use their myoelectric hand to grasp and hold down the bottom of the vest regardless of which side the zipper is on. For the swing task, correlations between the angles of the dominant shoulder, elbow, and wrist show a trend for the normally limbed children which the Omni-wrist users fall directly into. The uni-axial friction wrist users fall away from the trend. The bike riding task has shown that prosthesis users appear quite similar to normally limbed children; their muscle activity however is very different. Prosthesis users depend on the sound arm for the majority of the stabilization while riding which not only affects the muscles in their dominant arm but in their body core as well.

10:30 am / Paper #14

MEASURING UPPER LIMB LOADS DURING ACTIVITIES OF DAILY LIVING

*Colleen Dewis; Benjamin MacPhee; Dr. Edmund Biden; Bertin Mallet; Michael Lamb; John Landry;
Greg Bush; Krista Fraser; Wendy Hill; John Hayden
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There is currently no quantitative method for analyzing the forces and moments that can lead to serious skin issues within the socket of a prosthetic arm. Over the past few years we have been piloting several potential methods to implant sensors into a prosthetic socket to get a map of the pressures occurring, however to date these efforts have not seen a great deal of success as a result of humidity issues within the socket. We are currently attacking the issue from the other end of the arm, and starting our analysis at the hands.

Work done at the University of New Brunswick has been using motion analysis to build a database of kinematic data for both upper limb prosthetic users and normally limbed children during play activities including swinging on a playground swing and riding a bicycle. This

work has been focused on comparing the postures of normally limbed children to those of prosthetic users with omni-wrist and uni-axial friction wrists.

The current study adds transducers that fit onto the chains which support the swing. The transducers have been custom designed and fabricated and are able to collect the grip and shear forces during the swinging phase of the testing. Similar transducers to measure forces during bicycling are in development.

The basic design of the transducers is relatively simple, while being highly effective. A semi-circular collar was manufactured out of aluminum. There is a gap down one side, which closes as the collar is gripped, which allows the semi-circle to bend as a curved beam, with this deflection recorded using strain gauges on the inner wall. The core of the device is comprised of a rectangular section of solid aluminum, which is then attached to the rear wall of the collar using pins. The pins are both outfitted with four strain gauges, two on top and two on the bottom, to measure the strain on the pins as the collar is loaded relative to the core. Shackles allow the transducer to replace a section of the chain at the point where the child swinging would hold on.

Strain gauges are used to measure how hard the child is gripping the transducer and how much they are tending to pull up or down on the chain. A small electronics package provides power to the strain gauges and basic signal conditioning. There are a total of 4 output channels, one shear and one grip for each hand. The data from the transducers is collected simultaneously with electromyography data and motion data using the Vicon MCam system's A-D boards external output channels.

Testing of the transducers has been promising, with outputs clearly illustrating when a user was squeezing, pushing or pulling on them. The transducers are able to measure a wide range of loadings.

The data collected from these transducers can then be used in a manner similar to the way force plate data are used in gait analysis. These forces, when combined with kinematic data from the VICON tracking system allow estimation of the forces and moments in the prosthesis and arm. Comparison with results from normally limbed children suggests that prosthesis users are significantly less symmetrical.

References

1. Lamb, Michael and Mallet, Bertin; "Inline Lad Cell For a Playground Swing", Senior Design Report, University of New Brunswick, April 2006.
2. Ross, Martha; "Development of a Quantitative Test for Prosthetic Function Using Motion Analysis and Activities of Daily Living"; University of New Brunswick, 2005.

10:45 am / Paper #15

PROSTHETIC USE IN PEDIATRIC UNILATERAL FUNCTIONAL FOREQUARTER AND SHOULDER DISARTICULATION LEVEL AMPUTEES: A RETROSPECTIVE STUDY OF SEVEN PATIENTS FOLLOWED LONG TERM

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Abstract: Seven functional forequarter and shoulder disarticulation level amputees were followed an average of 8.5 years from first clinic visit. Thirty different prosthetic devices were fabricated including passive, body powered, and myoelectric designs. The patients included five male and two female individuals. Diagnoses included three power take-off traumas, one lawn mower trauma, and three congenital amputees. In final follow-up four patients were considered full-time users by the prosthetic team, one patient half-time, and two patients rare or only occasional use. A combination of a locking shoulder and locking elbow with a myoelectric hand was the most common successful prosthetic option being worn in four patients, three full-time, one half-time. Lightweight locking shoulder, locking elbow and passive cosmetic hands were chosen in the female group. All seven patients will be presented with an emphasis on prosthetic fitting problems in this challenging group of patients.

11:00 am / CS #6

“BACK IN ACTION”: ACCOMMODATING THE ACTIVE LIFESTYLE OF A 16 YEAR OLD MALE WITH A TRANSRADIAL AMPUTATION FOLLOWING A CRUSH INJURY

Robert Wagner, BOC

Wright and Filippis, Rochester Hills, MI

This 16 year old male presented with a left transradial amputation secondary to an auto accident in May of 2006. His residual limb was approximately 3.5' in length, with limited ROM, due to sensitivity of limb from crush injury. The patient was initially fit with a body powered prosthesis consisting of a muenster style socket, modified shoulder saddle harness, quick disconnect wrist, and #7 hook for a terminal device.

The patient also had an additional prescription consisting of transradial myoelectric prosthesis to aid in additional ADL's. This consisted of muenster style socket with flexible interface, supracondylar suspension, quick disconnect wrist, sensorhand speed hand and a griever for TD's. The patient utilized dual site myoelectric control that required customizing to enhance control of his terminal devices.

The patient leads an active lifestyle and enjoys ADL's including driving, playing football, weight training, and hunting. Included in the presentation is the adaptations used to accommodate his prosthetic needs.

Driving~ The patient is among many 16 year olds who are just learning how to drive. He is unique due to the fact that he is learning how to drive a stick shift while wearing a prosthesis. To do this activity, the patient will switch gears with his right hand, while operating the steering wheel with his left prosthesis. As an added modification to the steering wheel, a driving ring has been installed to assist in turning the steering wheel while wearing the prosthesis. He will wear his body powered prosthesis with his #7 hook that fits into the driving ring to aid in steering.

Weight Lifting~ The patient enjoys being in the gym and lifting weights. In order to lift weights bilaterally, his prosthesis must be able to suspend properly while withstanding an increased force and weight at the distal end of his prosthesis. To accommodate this prosthetically, his prosthesis will consist of the following: muenster style socket with gel liner to aid in reducing shear forces on limb, and suspend prosthesis with pin system, and quick disconnect wrist. An additional, supracondylar suspension will also be added due to the fact that the harness is eliminated for suspension and function of the terminal device. Instead, he will manually operate the terminal device, TRS's Black Iron Master, with his sound hand.

Football~ Like most 16 year old males, he loves to play football. In order to play football bilaterally, his prosthesis must be able to withstand impact, weight bearing, and aid in catching the football while having adequate suspension. To accommodate this prosthetically, his socket will consist of the same socket he wears while weight lifting, but by utilizing the quick disconnect wrist, he can change terminal devices. We will be using the Free Flex Passive Open Hand Mitt from TRS. This terminal device is strong enough to encounter impact, provide stability during a three point stance, and aid in receiving the ball with the open mitt. The gel liner will aid in suspension, provide comfort during impact, and reduce shear forces on skin.

POSTER PRESENTATIONS

Poster #1

IT TAKES A TEAM: PROMOTING SELF-ACCEPTANCE AND ADDRESSING FORMS OF TEASING

*Julie Honeycutt, PT; Beth Terborg, RN
Center for Limb Differences, Grand Rapids, MI*

The unique perspective and expertise of each professional of the clinic team contributes to multifaceted, dynamic means of promoting self-acceptance and to ways of dealing with forms of teasing. The clinic team collaborates to foster a positive framework of physical and psychosocial support starting early in the child's life and continuing throughout their adolescence. Adjustment to each developmental stage can be enhanced by the specific interventions of different team members. This poster provides tools for team members to use in helping the family and child with self-acceptance and to address teasing throughout their early and adolescent years.

Poster #2

EXTREME CONSTRAINT INDUCED THERAPY: A CASE REPORT OF CONTRALATERAL UPPER EXTREMITY AMPUTATION IN A PATIENT WITH HEMIPARESIS

*Shawn R Gilbert; Charles Law
University of Alabama at Birmingham, Childrens Hospital of Alabama. Birmingham, AL*

There is considerable enthusiasm for constraint induced therapy for neuromuscular disorders in children in certain centers. In this poster we present an extreme case of constraint due to contralateral amputation.

A three year old boy who was under our care for right hemiparesis secondary to an in utero stroke presented to an outside hospital in status epilepticus. He sustained a brachial artery injury from an injection of phosphophenytoin that ultimately resulted in a left elbow disarticulation, contralateral to his hemiparesis. Prior to the injury and amputation, the right upper extremity was maintained in a typical hemiparetic posture with elbow and wrist flexion with forearm pronation, cortical thumb and fist hand. Subsequent to his amputation, he demonstrated decreased posturing and increased function of the right upper extremity. Video of upper extremity function prior to and following amputation will be presented.

This case represents an extreme example of 'constraint' therapy in a hemiparetic cerebral palsy patient. Although it is a very unusual case, it serves to illustrate the principle and support the theory of constraint induced therapy.

Poster #3

"ONE STEP AT A TIME":

A CHILDREN'S BOOK WRITTEN TO ENHANCE LIMB LOSS AWARENESS

Susan Williams, BS, CP

Wright & Filippis, Rochester Hills, MI

Imagine a child who is eight years old and has an amputation of their right leg below the knee. He or she is about to start the third grade and is wearing a prosthesis. During the first day of school, what would one think the other children are thinking about when they see the eight year old child? Most likely the other children have not seen a child who is an amputee and currently wears a prosthesis; therefore they are not sure what to think. Their first instinct may include a negative attitude towards that child, because they are unsure of why that child is different. A children's book that relates to prosthetics and the limb deficient child is an important tool that can be used to educate other children about limb loss awareness.

The most significant background literature relating to the above issue is what factors contribute to successful classroom integration of children with special needs (1). This research indicates that normal children's attitudes are important to the success of mainstreaming. Furthermore, the research indicates that preparation of teachers may also be important, not only to facilitate positive attitudes, but also to facilitate an understanding of handicaps and their implications of the classroom (2). If an environment that encircles the child who is an amputee is surrounded with positive energy, then that child will have a greater chance to develop high self-esteem.

By teachers increasing able-bodied children's awareness about prosthetics and children who are limb deficient, it promotes a more positive environment for the children to develop. Teachers can do this by reading a book such as *One Step at a Time* to their classroom, and discuss the importance of disability awareness. By doing this, the limb deficient child is able to develop in a secure, positive environment, which will enable them to exhibit high self-esteem, along with a positive psychosocial being.

References

1. Allsop, J. (1980). Mainstreaming physically handicapped students. Journal of Research and Development in Education 13, 37-44.
2. Salend, S. J. (1984). Factors contributing to the development of successful mainstreaming programs. Exceptional Children, 50, 409-416.