

Abstracts of Recent Articles

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Modular Seating for Paralytic Scoliosis; Design and Initial Experience: B. R. Seeger and A. D'A. Sutherland (Rehabilitation Engineering Department, Regency Park Centre for Physically Handicapped Children, South Australia) *Prosthetics and Orthotics International* 5:121-128, December 1981.

Once a child with muscular dystrophy becomes nonambulant, his spine often exhibits progressive scoliosis. The conventional wheelchair with its sling seat and back do not offer a firm and level pelvic position nor resistance to sideways curvature of the spine. A range of modular seats was developed to span the size range of school age children and to provide accurate fitting with four seats and four backs. The bases allow a 10-degree recline to resist forward sliding. Side supports encourage midline positioning of the pelvis and prevent excessive hip abduction. A lap belt holds the pelvis in the seat and a padded chest strap stops forward leaning. The base and back are molded from acrylonitrile butadiene styrene.

Most children preferred the new seats to the old ones, commenting that they could see more and could use their hands better; parents stated that the seats aided feeding and eye contact. Teachers and therapists also were pleased. X-rays revealed immediate improvement, averaging 11 degrees, in thoracolumbar curvature. The modular seats are less expensive than custom molded seats. The orthotist requires 30 hours to complete a custom seat, but only 17 hours to complete a modular one. Materials costs are similar.

An adjustable fitting chair allows various combinations of modules to be used to determine the best configuration. The modular seats are available in kit form. The kit is ordered using a measurement sheet.

Determining Amputation Levels in Peripheral Vascular Disease: Ernest Burgess and Frederick Matsen, III (Department of Orthopaedics, University of Washington, Seattle, Washington) *Journal of Bone and Joint Surgery* 63-A:1493-1497, December 1981.

More amputations are being performed because of the increase in the aging population, incidence of diabetes, air, water, and food contamination, physical inactivity, poor diet, tobacco smoking, and failed vascular reconstructions. Because the success of rehabilitation is directly related to lower limb loss, it is of utmost importance that the surgeon assess limb viability accurately. No single technique unfailingly predicts the outcome of amputation. Healing depends on post-operative circulation, whereas the level is selected on the basis of preoperative data. No measurement specifically

quantitates the ability of the limb to heal. In each patient, different demands are placed on the healing potential of tissues. Postoperative care alters skin circulation. Poor patient health compromises healing. The most essential factor in level selection is the surgeon's judgment which may produce healing rates of more than 90 percent. Limb viability may be assessed by means of extremity blood flow, arterial blood flow, muscle perfusion, skin blood flow, cutaneous oxygen delivery, segmental blood pressure, skin blood pressure, and skin function. Measurement of segmental blood pressure is most widely used, although there is no agreement on critical values, nor is it always possible to compress principal arteries near the cuff. Skin blood pressure, such as measured by xenon clearance, correlates with success of amputation somewhat. Skin blood flow as measured by xenon clearance is a selective test if multiple measurements were made at the same level. Transcutaneous oxygen tension is a noninvasive means of monitoring arterial oxygenation which assumes that oxygen tension reflects the healing potential of skin particularly in individuals with peripheral vascular disease. Data from several tests should be integrated with overall clinical assessment.

Skin Blood Flow in Seated Geriatric Patients: Leon Bennett and others (Veterans Administration Prosthetic Center, New York) *Archives of Physical Medicine and Rehabilitation* 62:392-398, August 1981.

Application of external body loads beyond some threshold causes pressure sores. Ischial sores are associated with many hours of sitting during which skin blood flow is occluded. Two groups of men, one normal and the other geriatric hospital patients, were compared in terms of tendency to experience occlusion when seated horizontally and at a tilt.

Noninvasive instrumentation is stiffer than cushion materials or flesh, and thus produces inaccurate results; however, the problem is reduced when the seat position monitored is lateral to the ischial tuberosities in an area of lower pressures. Pressure and shear sensors were mounted in a hard seat and appeared to the user to be surface-flush metal buttons. A blood flow photoplethysmograph measured cutaneous pulsatile flow. Each subject sat on the test wheelchair with his buttock bare. Data was gathered as the subject sat relaxed. Then the seat was rotated backwards 20 degrees and more data was collected. A final run occurred when the subject was returned to horizontal. Geriatric patients were more likely to experience skin blood flow occlusion at lower pressure values, higher shear values, major benefits from seat tipping, and larger variability in sitting pressure values. Ischemia is easier to induce in elderly ill men than in young

healthy men. The tendency of older subjects to exhibit larger pressure variation probably reflects lowered muscle tone with accompanying reduced flesh stiffness. Flesh distal to a load-bearing center displaces readily; the lack of distal support reduces the effective load-bearing area, necessitating higher local pressure to maintain equilibrium. Hospitalized geriatric patients generate three times as much shear as young persons. Consequently, cushion testing should employ elderly subjects for more valid results.

Biofeedback Devices as an Adjunct to Physiotherapy: David Caudrey and Barry Seeger (Rehabilitation Engineering Department, Regency Park Centre for Physically Handicapped Children, Crippled Children's Association, South Australia) *Physiotherapy* 67:371-376, December 1981.

Biofeedback refers to procedures whereby information about an aspect of bodily functioning is fed back by some visual or auditory signal. The specific biological information is normally inaccessible to the patient, and when displayed externally, gives him the means to gain control over aspects of bodily function that are normally independent of his direct control. Systematic biofeedback began in the 1960's with attempts to train heart rate and blood pressure. Biofeedback training is skill training, in which skeletal muscles are trained to correct action and improve skill. The intact sensory channel is used to calibrate the cerebral representation of skill when proprioception is impaired. Electromyography has been widely used to provide information to the patient whereby he could control muscle activity. Six categories of devices include those for a) muscle training and relaxation, b) posture control, c) lower limb training, d) upper limb training, e) oro-facial control, and f) toilet training.

The scoliosis orthosis is a device for informing the wearer when he leans against a thoracic pad. The limb load monitor is a shoe insole which senses the amount of weight applied to it, together with an auditory signal box. The amputee knee extension monitor is a switch at the prosthetic knee which causes a warning buzzer to sound whenever the knee is not fully extended. Step length, knee angle, and ankle angle monitors are also intended to aid gait. A hip disassociation monitor measures the extent to which the hips function independently during walking. A hip rotation monitor has proven of limited success in aiding correction of gait abnormalities.

Gait Analysis: Alterations in Support Phase Forces Using Supportive Devices: Pierce Scranton, Jr., Larry Pedegana, and James Whitesel (Orthopedics International, Ltd, Seattle, Washington) *American Journal of Sports Medicine* 10:6-11, 1982.

Five individuals with flexible flat feet were studied as they walked across a cholesterol crystal force plate when barefoot, walking with a plastic heel cup, a felt medial arch support, and when the foot was taped by low-dye technique. The technique involves shaving, cleaning, and drying the foot. Aerosol tape adherent was applied to the foot, then small strips of adhesive moleskin were taped to the medial and lateral aspects of the first and fifth metatarsal heads. Then a 2-inch-wide strip of moleskin was cut to the size of the

foot, from the fifth metatarsal head, around the heel, to the medial first metatarsal head. The hindfoot was kept neutral without pro- or supination, while the medial forefoot was passively plantarflexed and tape was applied to the longitudinal arch.

The medial arch support was similar to barefoot walking inasmuch as both concentrated forces under the midfoot longer than was the case with the heel cup or taping. Overuse syndromes such as plantar fasciitis, posterior tibial tendinitis, metatarsalgia, and metatarsal stress fractures are associated with the pronated foot. Taping medializes heel strike forces, diminishing the duration of forces under the midfoot, thus diminishing strain on medial plantar structures. The heel cup prevents collapse of the heel fat pad and elevates the heel, thus deepening the posterior support and raising the arch. Medial arch support shifts forces laterally, but does not diminish the duration of forces nor shift the anterior path of forces as far medially under the second metatarsal head as did the heel cup or taping.

Fractures in Lower Limbs with Prior Amputation: John Bowker and others (Department of Orthopaedic Surgery, University of Arkansas for Medical Sciences, Little Rock, Arkansas) *Journal of Bone and Joint Surgery* 63-A:915-920, July 1981.

A retrospective study of 85 below- and above-knee amputees who had sustained 90 fractures was conducted. Eighty-one percent of the patients were men; most of the amputations were below-knee. Most patients sustained fracture in a fall, usually while wearing the prosthesis. Most of the below-knee amputees sustained femoral fracture; a third had fractures about the hip. Prosthesis type did not seem to correlate with fracture site, inasmuch as more than a third of patients with distal femoral fractures were wearing prostheses with thigh corsets at the time of injury. Approximately half of the below-knee amputees had their fractures treated nonoperatively, particularly fractures about the knee.

Among above-knee amputees, most wore a prosthesis with a metal hip joint and pelvic belt when they sustained fracture. Most above-knee amputees had their fractures treated nonoperatively, either by non-weight-bearing or with a lightweight cast.

Six of the 34 below-knee amputees who had fractures about the knee healed in malunion; three of these patients returned to use of the original prosthesis. Two had knee joints and thigh corsets added to the prosthesis, and one had a liner added to a new, realigned prosthesis. All but one below-knee amputee continued to use the prosthesis after fracture.

After fracture, 82 percent of the above-knee amputees continued to use a prosthesis, although no changes were required in the prostheses. The small mass of the residual limb and the shortened lever arm allowed nonoperative management of the femoral neck and intertrochanteric fractures. As much as 40 degrees of varus malunion did not interfere seriously with prosthetic function. For all amputees, the most important goal is restoration of normal angle of inclination to aid in restoring hip abductor function.

Modifications of the Switch Control for a Powered Hand on an Elbow Disarticulation Prosthesis: John Spaeth, Orthotics and Prosthetics 35:45-48, December 1981.

A 12-year-old girl was provided with a modified prosthesis. Functionally a congenital elbow disarticulate, she had three immobile distal digit remnants. She could operate the elbow of a conventional prosthesis, but could not use a conventional terminal device, and thus rejected the prosthesis. She had no usable myoelectric potential sites at the biceps or triceps, and electrode placement on the deltoid would necessitate a snugly fitting socket with high trimlines. Consequently, the definitive prescription was for a conventional elbow disarticulation socket, outside locking hinge, Variety Village pull switch and power supply, and Otto Bock externally powered hand and wrist disconnect.

The control cable was connected to the pull switch, rather than the usual connection to the terminal device. This allowed for full elbow flexion which would have interfered with elbow locking. Consequently, the pull switch was modified so it would provide enough opposition to the control cable force to allow forearm flexion, yet, once the elbow was locked, the opposition was small enough to allow activation of the switch. Details of switch modification are provided. Control movements were the same as for a conventional prosthesis. After 40 minutes of training the patient could operate the pull switch with complete accuracy. She has worn the prosthesis for a year without any mechanical failure.

The Berkeley Endoskeletal Below-Knee Modular System:

Timothy Staats, Orthotics and Prosthetics 35:37-44, December, 1981.

The Berkeley system is a vertical pylon alignment coupling and endoskeletal foundation for the below-knee prosthesis, suitable for use in temporary prostheses. It may also be used as a definitive prosthesis if the system is duplicated from an aligned socket on an adjustable leg in the standard procedure. The pylon weighs 18 ounces and consists of a socket cup, spherical alignment coupling, internal proximal clamping component, pylon tube, and internal foot clamping component. The socket cup is made of polyester resin in two sizes; it is heated and trimmed to receive the socket, then epoxied in place. The alignment coupling has a hexagonal bolt which allows angular adjustment and serrated edges which lock the alignment adjustments. A wooden keel SACH foot, with or without a rotator unit, can be attached to the clamping component. A minimum of 5 1/2 inches is required between the bottom of the socket and the top of the foot.

Initial assembly and alignment instructions begin with selection of the proper socket attachment cup, heating, trimming, and bonding to the socket. Static alignment depends on accurate casting and mold modification. Dynamic alignment is performed by loosening the alignment coupling retainer bolt and tilting the socket within a range of 10 degrees flexion, extension, adduction, and abduction tilt and unlimited rotation. Exaggerated sagittal and frontal adjustments affect foot action. Final assembly and finishing is similar to that used in other pylon systems. A prosthetic foam cover can be applied.

Pressure Applied by Elastic Prosthetic Bandages: A Comparative Study: George Varghese and others, Orthotics and Prosthetics 35:30-36, December 1981.

Elastic bandages are the most common method of reducing edema of the amputation limb, rather than elastic shrinkers, pneumatic shrinkers, or rigid postoperative dressings. The ideal pressure range for edema reduction is 20 to 25 millimeters of mercury, although a range of 15 to 30 mmHg is probably acceptable. Forty-one amputees, both above- and below-knee, participated in a study comparing elastic wrap, elastic shrinker, and a new elastic shrinker modified by the manufacturer depending on the efficacy of the compression. Skin pressure was measured with a pressure switch, a solid state transducer which provided a liquid crystal read-out. Four switches were used, placed anteriorly and posteriorly, proximally and distally. Pressure was measured after application by patient and staff. Seven patients using elastic wrap had unacceptably high pressure, with a large difference in pressure depending on who applied the wrap. Single layer shrinkers resulted in unacceptably low pressure, but double layering achieved acceptable pressure which was maintained after repeated washing of the shrinker.

External compression raises the extra-vascular hydrostatic pressure, decreasing exudation of fluid at the arterial end of the capillary while increasing resorption at the venous end and increasing venous return. Elastic compression increases venous return, especially if pressure can be sustained and graded so that it is greater at the distal end of the limb. The shrinker developed by the investigators, Compresogrip, maintained pressure longer and like all shrinkers was easier to apply and more consistently compressive than were elastic bandages.

The Chicago Insert: An Approach to Wheelchair Seating for the Maintenance of Spinal Posture in Duchenne Muscular Dystrophy:

Irwin Siegel, Oscar Silverman, and Michael Silverman (North Shore Orthopedics, Highland Park, Illinois) Orthotics and Prosthetics 35:27-29, December 1981.

Scoliosis is common in advanced muscular dystrophy. The convexity is toward the side of the dominant hand because the patient usually leans toward the nondominant side to support the dominant arm. Patients with hyperextended spines and rigid paraspinal contractures have less lateral curvature. Thus, orthotic management should keep the pelvis level and the spine extended, locking the vertebral facets to inhibit development of scoliosis. A firm wheelchair seat with either circumferential or three-point torso support, or a spinal containment orthosis in the form of a modified wheelchair seat, will accomplish this purpose.

The Chicago insert is modeled on the Toronto spinal support system. It can be fitted to any standard wheelchair. Fabrication begins with measurements of the width of the wheelchair, vertical height at the waist with the patient seated, and a snug waist measurement. Wide bands of rubber are then stretched over a hinged spring steel frame. Closed-cell polyurethane foam is cut to give a 15 degree posterior pelvic tilt. The foam is covered with 1-inch Temper foam, and the entire insert is upholstered in nylon tricotee. The back of the insert is angled 15 degrees above the waist to provide

thoracolumbar hyperextension. Lateral control pads at the hinge of the seat flare upward to waist level. Lateral control pads must be fitted so they do not impinge on the arms; the superior border is at the 11th or 12th ribs. Because no plaster cast is required, the Chicago insert is less expensive than alternative custom seating.

The Use of Shortened Periods of Rigid Postoperative Immobilization in the Surgical Treatment of Idiopathic Scoliosis: Vernon Tolo and Robert Gillespie (Department of Orthopaedic Surgery, The Hospital for Sick Children, Toronto), *Journal of Bone and Joint Surgery* 63-A:1137-1145, September 1981.

Seventy-eight consecutive adolescents treated by Harrington instrumentation and fusion were analyzed. All had idiopathic scoliosis, and were allowed to walk after application of an underarm plaster body jacket, 10 to 14 days postoperatively. For patients with high curves, a Milwaukee-brace neck ring was attached to the cast. Ten weeks later, the cast was removed and a spinal orthosis having a Rohadur or Lexan back and a canvas front was constructed, using the plaster cast as a model. The orthosis was worn for 3 months while the patient was ambulatory. All external support was discontinued 6 months after surgery, when swimming, tennis, and other non-contact, non-stressful sports were permitted. Football and high-diving were permitted 1 year after fusion.

Sixty-four patients were followed for 2 years or more. Sixteen had unsuccessful preoperative experience with a Milwaukee brace, and the 14 who had Cotrel traction preoperatively did not benefit from it. Eighteen had preoperative reduction in pulmonary function. The overall final curve correction was approximately 45 percent. Little loss in correction occurred after the first 6 months, and was attributed to penetration of the Harrington hooks into the lamina and to less-rigid support afforded by the brace. Five rods fractured, but only one patient had pseudoarthrosis. The postoperative results compare favorably with other series of patients, with better initial postoperative correction appearing to be the major determinant. The shortened period of recumbency engenders fewer psychological, medical and socioeconomic problems than does the traditional 3 months of recumbency in a plaster cast. The current orthosis protects the spine from extreme movements, while allowing muscle strengthening activity and beneficial limited stress on the fusion mass.

Splinting in Rheumatoid Arthritis: I. Factors Affecting Patient Compliance: John Nicholas, and others (Presbyterian-University Hospital, Pittsburgh, Pennsylvania) *Archives of Physical Medicine and Rehabilitation* 63:92-94, February 1982.

A questionnaire investigation of rheumatoid arthritis revealed that 29 of the 36 patients queried wore hand splints some part of each day. The wearers included 13 fitted bilaterally. Those who did not wear splints had all been provided with unilateral devices. Most responded that the splints were worn to relieve pain and give good wrist support. With regard to daily activities, most patients wore splints for activities requiring more strength, rather than for activities,

such as brushing hair, which required more dexterity. A larger number who could perform heavy tasks wore splints while performing them. Four patients with unilateral splints and one with bilateral devices reported that the splints reduced their ability to perform tasks. Three patients had difficulty donning the splints.

A considerable educational effort should be mounted to impress patients and their families that splinting is a successful method for treating inflamed joints. Painful hands and wrists will benefit most from wearing splints while the patients perform heavy tasks.

Splinting in Rheumatoid Arthritis: II. Evaluation of Lightcast II Fiberglass Polymer Splints: John Nicholas and others (Presbyterian-University Hospital, Pittsburgh, Pennsylvania) *Archives of Physical Medicine and Rehabilitation* 63:95-96, February 1982.

Lightcast II is a new polymer, developed by Merck Sharp and Dohme Orthopedic Co., suitable for custom fitted, lightweight, and durable hand and wrist splints fitted at one clinic visit. Such splints were provided to 54 outpatients with rheumatoid arthritis who complained of hand or wrist pain, or pain when using the hands, inability to perform activities, or whose hands appeared to interfere with function. Splints were fabricated by overlaying four strips of Lightcast II over the supine hand and wrist, and bonding them with silicone cream. The forearm was covered with stockinette. The material was cut with scissors. The fiberglass was held against the forearm and exposed to the Lightcast light source for 3 minutes. After curing, the fiberglass was removed, edges trimmed with a hand grinder, and Velcro straps affixed by rivets. A complete splint was fabricated in 45 minutes. The static wrist supports allowed free use of the fingers. Patients were evaluated periodically and were seen for a final time 9 months after receiving the splints.

Twenty-nine of the original 54 recipients reported wearing the splints. Five disliked the appearance, finding it rough, did not breathe properly, stretched when wet, or broke easily. Twelve stated the splints were uncomfortable. Although therapists complained during fabrication process, patients did not remark on the odor or stickiness of the material.

Body Build and Its Relationship to Pressure Distribution in the Seated Wheelchair Patient: Susan Garber and Thomas Krouskop (Texas Rehabilitation Engineering Center, Baylor College of Medicine, Houston, Texas) *Archives of Physical Medicine and Rehabilitation* 63:17-20, January 1982.

Seventy patients with a prior history of decubitus ulcers were evaluated; most had severe spinal-cord injury. They were divided into three groups: thin, average, and obese. Patients sat on a pressure evaluation pad, consisting of a pad containing a 12 by 12 matrix of pneumatically controlled contact switches. Investigators varied the air pressure and photographed changes on an illuminated readout board to obtain a pressure contour map of the buttocks and upper thighs. Bony and soft tissue distribution were ascertained by the pattern of lights on the display console. Four cushions

studied were the E & J Polyurethane Foam, Bye-Bye Decubiti, Aqua Seat, and 3 inch T-41 Temper Foam.

Although men have more clinical tissue breakdown, they do not have significantly higher bony or soft tissue pressure. Obese body build, however, is a significant factor relating to pressure distribution; maximum pressure occurred more frequently in a soft tissue area. Variation of more than 50 percent in peak pressure and in pressure distribution occurs with each of the cushions studied. Consequently, no cushion is optimal for any of the patient subpopulations tested. Thin patients tend to have maximum pressure in bony areas and show significantly higher pressures over bony prominences than did average or obese patients. The topography of the patient interface between patient and cushion is important. Greater surface area and increased thickness of soft tissue over a bony prominence suggests greater ability to diffuse pressure away from a bone and to diffuse it over a larger area.

A Method for Custom Seating of the Severely Disabled:

Charles Pritham and Carol Leiper (Moss Rehabilitation Hospital, Philadelphia, Pennsylvania) *Orthotics and Prosthetics* 35:19-26, December 1981.

Individuals who need specialized seating are dependent in transfers, severely contracted in many joints and have significant fixed rotary and lateral spinal deformity. Often one hip is dislocated. Patients usually have sparse soft tissue. The more desirable features of the molded plastic insert, foam-in-place flexible foam cushion, casting on an "A" frame and with a vacuum dilatency bag were combined. An adjustable fitting chair was used with vacuum dilatency bags. The base of the chair was the same as used in the foam-in-place process. The chair allows the patient to recline and the angle of the seat can be changed related to the back. One bag was used for the pelvis and thighs and a second for the trunk. Polystyrene beads were contained in two sacks of thin double-knit material.

The chair is adjusted to suit the patient and the bags are individually exhausted. An impression is then taken of the bags using plaster splints.

The plaster model is the basis for fabricating a triple layered seat, the innermost layer being of foam-backed Naugahyde, a vacuum-formable version of Naugahyde. The second layer is of one inch closed cell foam padding vacuum formed over the first layer. The third layer is of Kydex, a copolymer of acrylic and PVC. The Kydex layer was fastened to the middle layer with Velcro patches to allow dismantling the seat. An interface on which to mount the seat on a wheeled base was the universal telescoping interface which is part of the molded plastic insert system, or a wheelchair, buggy or stroller. The method, a synthesis of various methods, is complex, expensive, and lengthy, and has little padding which may be inadvisable for individuals liable to develop decubitus ulcers.

Limb Load Monitor: Evaluation of a Sensory Feedback Device for Controlled Weight Bearing: John Gapsis and others (Departments of Physical Medicine and Rehabilitation, Baylor College of Medicine, Houston, Texas) *Archives of Physical Medicine and Rehabilitation* 63:38-41, January 1982.

The Limb Load Monitor, an auditory feedback device, is the most refined, compact biofeedback tool for controlled weightbearing which is commercially available. The device consists of a control box connected by a 5-foot cable to a load-sensitive transducer placed in the shoe. The control box is small, and is powered by a 9-volt transistor-radio battery. One can set it so that a tone is emitted when precalibrated loading is achieved. Alternatively, the tone can be set to decrease with increased loading, or can be set to increase sound when loading is increased beyond a set point.

Ten middle-age to older patients used the monitor; their performance was compared with 10 similar patients who did not use the device. Both groups included individuals with femoral and hip fractures, amputations, total hip replacement, and chronic pain. Patients had no history of auditory defects. The monitor was calibrated as the patient loaded the limb on a bathroom scale. The initial setting was 10 percent of body weight and was increased every second to third day until full weightbearing was reached. Both groups reached their therapy goals. The groups with the monitor reached the goals in almost half the time of the control group. The monitor was believed to allay fears and decrease reluctance to proceed with weightbearing.

Several suggestions for improving the practicality of the monitor include improving durability and ease of repair.

Prosthetic Management of Adult Hemicorporectomy and Bilateral Hip Disarticulation Amputees:

Charles Dankmeyer, Jr., and R. Doshi (Baltimore, Maryland) *Orthotics and Prosthetics* 35:11-18, December 1981.

Three case reports demonstrate the development of management systems for high-level amputees. The first case is that of L-4 traumatic hemicorporectomy. The distal spine was so sharp and sensitive that the patient had not been upright since the accident. He could tolerate support under the ribs, but not distal bearing. A trunk mold was modified so that the underside of the thorax is fully supported. A base equal to the size of the transverse dimension of the thorax would hinder transfer from floor to wheelchair. A distal extension was intended to substitute for lost trunk height. The extension housed iliostomy and colostomy containers. The base of the extension was 40 percent of the width of the rib cage on each side of the center. The socket was laminated and trimmed one inch below the inferior scapular angles, and was suspended by shoulder straps. The patient moved about the house with the aid of hand-held blocks enabling him to clear the floor while wearing the socket. He drove a car with the socket. Otto Bock free motion modular hip joints, safety knees, and SACH feet were added 6 months later. Subsequently, the leg segments were made removable from the socket to aid transfer, yet allow swing-through walking.

A second patient was provided with a comparable socket.

A third patient was fitted with the socket and removable cosmetic lower limbs.

Stride Kinematics and Knee Joint Kinetics of Child Amputee

Gait: Melissa Hoy, William Whiting, and Ronald Zernicke (Department of Kinesiology, University of California, Los Angeles, California) *Archives of Physical Medicine and Rehabilitation* 63:74-82, February 1982.

Ambulation patterns were analyzed as five juvenile unilateral amputees walked at three different speeds wearing a standard SACH foot, then an experimental prosthetic foot. Two were above-knee and three were knee-disarticulation amputees, all with at least 4 years of prosthetic experience. Motion pictures and footprints were obtained for each trial. The experimental foot was developed at UCLA Child Amputee Prosthetic Project and consists of a longitudinal strut at a 135 degree angle to the shank portion of the prosthesis; a flexible heel projection is attached to the rear of the strut and three flexible projections are located anteriorly. The projections allow limited foot rotation.

Although walking velocity was not different between the two foot types, the stride length was consistently longer with the SACH foot, as were step lengths and stride width. Foot angles were not affected by foot type. Unlike values reported for nonamputees, the subjects increased foot angles as they went from slow to normal speed, then (at fast speed) started to toe-in. At fast speeds, however, the subjects kept the prosthetic knee extended or hyperextended during early stance phase. Hip extension increased with faster gait, although maximum hip flexion was significantly less with the experimental foot than with the SACH assembly.

Videotape Recording—A Complementary Aid for the Walking Training of Lower Limb Amputees:

P. Netz, K. Wersén and M. Wetterberg (Department of Orthopaedic Surgery, Karolinska Hospital, Stockholm) *Prosthetics and Orthotics International* 5:147-150, December 1981.

Fifty lower-limb amputees, predominantly those with above-knee amputations, were videotaped during their regular walking training. They were photographed from the front, rear and side. Gait deviations and positive attributes were noted for the patient. Recordings were made several times during training. Forty-four subjects reported they noticed details of which they had not been aware before. All rated the experience as useful, particularly the sudden recognition of gait defects. Many reported that they walked better than they had thought. Recording helped them achieve a better gait than would have been possible with mirror only, because they could view themselves from different angles and did not have to divide their attention between walking and studying the mirror. None showed any depressive reactions to the recording.

Recording equipment is simple and each patient had an immediate playback after each session so he and the therapist could analyze movements. For poorly motivated patients, recordings act as a spur to make the patient aware of progress. Training with video-playback has motivated patients to pursue additional training. Therapists report that it is easier to teach patients correct techniques of weightbearing and stride length early.

The TC Double Socket Above-Knee Prosthesis: K. Koike and others (Tokyo Metropolitan Rehabilitation Center for the Physically and Mentally Handicapped, Tokyo, Japan) *Prosthetics and Orthotics International* 5:129-134, December 1981.

The current total contact suction socket has the disadvantages of difficulty in wearing the socket while sitting, in obtaining favorable disposition of soft tissues, in avoiding perspiration problems, in modifying socket shape, in obtaining comfortable fit, and weight. The new socket, TC-1, is a double socket composed of an external socket bolted to a metal plate over the knee unit and an internal socket with a metal screw valve. The two sockets are attached by Velcro straps. Polyethylene sheeting is used for the internal socket and polypropylene for the external one.

TC-1 offers reduced weight and easy handling, simplifying donning in the seated or standing position. Flexibility of the internal socket allows closer skin contact; the internal socket can be worn separately as a night shrinker. Perspiration drains through the valve in the internal socket. Contour changes are easily accommodated with heat, so that the same prosthesis can be used throughout training. Mass production of the sockets is possible.

A newer version, TC-2, substitutes a rubber sheet valve for the older metal one. The rubber valve is larger and softer. Since November 1978, 295 amputees, including nine bilateral above-knee amputees, have been fitted satisfactorily. None of the prostheses has broken.