

ABSTRACTS OF RECENT LITERATURE

By

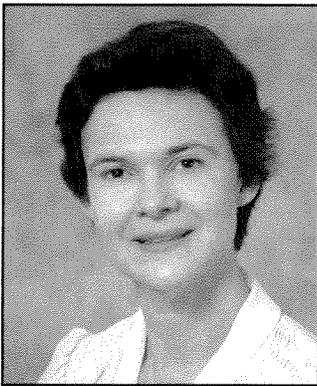
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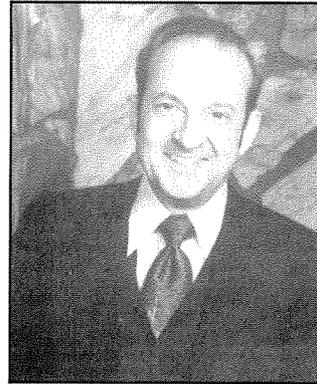


Joan E. Edelstein, P.T.

Joan E. Edelstein, the originator of the Abstracts section of the *Journal*, is a physical therapist who is a Senior Research Scientist at New York University Post-Graduate Medical School and School of Medicine. She is also Adjunct Professor of Prosthetics and Orthotics and of Physical Therapy, and Clinical Assistant Professor of Orthopedic Surgery.

A Fellow of the International Society for Prosthetics and Orthotics, she is Vice-Chairman of the United States National Member Society and Co-Editor of the International Newsletter. She edits the *Journal of the Association of Children's Prosthetic-Orthotic Clinics* and is a member of the editorial board of *Physical and Occupational Therapy in Geriatrics*. She participates in the Veterans Administration Scientific Review and Evaluation Board for Rehabilitation Research and Development.

Ms. Edelstein is a prolific author of monographs, book chapters, and journal articles. She has organized and presented lectures and courses in all phases of prosthetics and orthotics throughout North America, Europe, Australia, and Asia.



Jerome D. Schein, Ph.D.

From 1970 to 1986, Dr. Schein held appointments as Professor, and Director of the Deafness Research and Training Center at New York University. He became Emeritus Professor of Sensory Rehabilitation in September 1986. Prior to joining New York's University faculty, he was Dean of the University of Cincinnati's College of Education (1968-1970) and, earlier, a member of the faculties of the University of Wisconsin (1958-1959), Florida State University (1959-1960), and Gallaudet College (1960-1968). He presently is in private practice as Consultant on Sensory Rehabilitation, and is Co-Chair of the Veterans Administration Sensory Aids Study Section.

Dr. Schein's research has focused on the demography of sensory disabilities and on the effects of multiple disabilities on behavior. As a consultant to the National Health Survey, he developed techniques for surveying hearing-impaired persons that led to the National Census of the Deaf Population (1969-1973), which he conducted.

In the area of multiple disabilities, Dr. Schein's principal work has been with the deaf-blind and severely mentally retarded persons. He designed and analyzed the statistical plan for the National Survey of Needs of Deaf-Blind Persons, the first government-sponsored effort to determine the size and characteristics of the U.S. deaf-blind population. He has headed more than 30 other surveys and published over 180 papers and books. Among Dr. Schein's best known publications are *The Deaf Population of the United States*, *Model State Plan for Rehabilitation of Deaf Clients*, and *A Complete Guide to Communication with Deaf-Blind Persons*.

Abstracts are drawn primarily from the orthotics, prosthetics, and sensory aids literature. Selections of articles were made from these journals:

American Journal of Occupational Therapy
American Journal of Physical Medicine and Rehabilitation
Archives of Orthopaedic and Traumatic Surgery
Archives of Physical Medicine and Rehabilitation
ASHA (American Speech and Hearing Association)
Clinical Prosthetics and Orthotics
Ear and Hearing
Hearing Journal
Journal of the Acoustical Society of America
Journal of Bone and Joint Surgery
Journal of Speech and Hearing Research
Journal of Laryngology and Otology
Journal of Rehabilitation of the Deaf
Journal of Visual Impairment and Blindness
Paraplegia
Prosthetics and Orthotics International

PROSTHETICS, ORTHOTICS, AND RELATED TOPICS

Coombes AGA and MacCoughlan J (Bioengineering Centre, University College London SW15 5PR, United Kingdom). Development and Testing of Thermoplastic Structural Components for Modular Prostheses. *Prosthet Orthot Int* 12:19-40, 1988.

This experimental prosthesis features several thermoplastic components. It has a Rapidform polypropylene socket that provides impressive comfort and durability. The experimental uniaxial ankle unit was machined from Nylon 66. The four-jack alignment device at the socket and foot level is made of Nylon 66 and glass-filled nylon. The thermoplastic shank is rotationally molded in Nylon 11 with metal inserts at either end for single-bolt attachment of the socket and foot. Rotational molding is inexpensive, accommodates shank design changes, and permits varying wall thickness; the procedure takes approximately 30 minutes and can be used with a limited range of plastics. During molding, the shank mold containing thermoplastic powder is heated so that a layer of molten polymer forms at the mold wall. The mold is made of aluminum alloy segments enabling 1 mm

length increments. The Autoform rotational mold is heated in an electric oven which retracts so the mold can be cooled by an air blast. Rotation continues during the cooling phase. The minimum shank length produced was 70 mm. In the single-axis technique, the mold was inclined to coat the proximal end, then tilted to the same angle in the opposite direction to coat the distal end. The procedure is satisfactory for shanks from 78 to 220 mm long. Wall thickness tapers from 6 mm distally to 4 mm proximally. The shank may be conical or cylindrical with flared ankles.

Quality control required that nylon be stored in an oven at 30 degrees C to prevent moisture pick-up from the atmosphere, which would cause bubbles in the shank wall. Inspection with internal lights and ultrasound detected porosity. Wall thickness was measured with an ultrasonic thickness gauge. Static testing was conducted with an offset compressive loading arrangement to apply a bending moment. Static testing revealed a trend for shank deflection to increase with length. Brittle failure occurs between 3.1 and 4.6 kN, when insert pull-out is restricted by flanges; failure occurs sooner with conical inserts and in those shanks with powder remnants. The failure loads exceed the Philadelphia Static Load Levels but do not meet United Kingdom Department of Health requirements. Failure was assigned to either creep of the thermoplastic, resulting in early flexural fatigue failure of ankle bolts, insert shear, or shank buckling. Thus, ankle inserts should have a large diameter base flange and optimal design of the top anchoring flange which may have steel reinforcement. The wall should be at least 3 mm thick. Thermoplastic prostheses were fitted to 14 adults, 4 of whom experienced failure from 2 to 18 months after delivery. Longest use was 33 months. [JEE]

Gardner BP, Theocleous F, and Krishnan KR (Mersey Regional Spinal Injuries Centre, Promenade Hospital, Southport, Merseyside, PR9 0HY, United Kingdom). Outcome Following Acute Spinal Cord Injury: A Review of 198 Patients. *Paraplegia* 26:94-98, 1988.

Case histories of 198 consecutive acute traumatic spinal cord damaged patients were reviewed. Only 22 had spinal surgery in the acute stage. Five

patients with cervical lesions developed functional movement; 8 of those with thoracolumbar lesions developed movement. Treatment time averaged 29 weeks for those managed conservatively, and 31 weeks for those treated surgically. Forty-one percent of those treated surgically developed complications, as compared with 13 percent of the conservatively-treated group. Complications included symptomatic deformity, pain at the site of injury, radicular pain, infection, symptoms necessitating plate or wire removal, and symptomatic instability.

Duration of hospital stay, longer than reported elsewhere, is related to early mobilization employed elsewhere, as well as more rapid achievement of suitable housing. It is unclear whether higher staff ratios or policies of early mobilization will be more economical or effective in achieving earlier discharge. With regard to anatomical reduction, the paramount consideration is whether there are clinical consequences for the patient. Surgical intervention to resolve minor malpositioning must hold definite potential advantages. Functional outcome must be viewed in association with patient expectations, state resources, and local considerations. [JEE]

Grace TG, Skipper BJ, Newberry JC, Nelson MA, Sweetser ER, and Rothman ML (Albuquerque, NM 87109). Prophylactic Knee Braces and Injury to the Lower Extremity. *J Bone Joint Surg* 70-A:422-427, 1988.

High school football players participated in a matched study in which 247 subjects wore a single-upright, single-hinged knee orthosis on each knee, 83 wore a single-upright double-hinged brace on each knee, and 250 wore no braces. Players were matched according to height, weight, and playing position in the 2-year prospective study. Parents decided whether or not the athlete used the brace. Injuries were documented and categorized, with particular reference to time lost from practice and competition. Fifty-three knee injuries occurred, including 34 ligamentous, 15 hyperextension sprains, and several meniscal tears and patellar derangements. Eleven injuries were Grade III, the most severe. Four of the 6 injuries treated surgically were in the single-hinged brace group and 2 were in the unbraced group. Knee injury occurred in 15 percent

of those who wore the single-hinged orthosis; 6 percent of those with the double-hinged device; and 4 percent of the unbraced controls. In 202 athlete pairs, neither the braced nor the unbraced partner was injured. Athletes wearing the single-hinged brace sustained knee injury 3.7 times more often than the matched partner who did not wear an orthosis.

Brace use remains controversial, with conflicting reports regarding whether prophylactic braces prevent knee injury. Conclusions from studies of collegiate and professional athletes may not be valid for younger players, the largest group of potential brace wearers. Athletes who wore single-hinged braces consistently had more injuries than non-braced controls, with an increased overall rate of injury, more severe injuries, more surgery, and generally more injuries in each diagnostic category. Injury also increased in joints adjacent to the braced knee, particularly the ankle. [JEE]

Hanse ES, Wethelund JO, and Skajaa K (Department of Orthopedic Surgery E, Municipal Hospital, DK-8200 Aarhus N, Denmark). Hemoglobin and Hematocrit as Risk Factors in Below-the-Knee Amputation for Incipient Gangrene. *Arch Orthop Trauma Surg* 107:92-95, 1988.

One hundred and eighty-six patients discharged after below-knee amputation for diabetic or arteriosclerotic gangrene were studied. Hemoglobin, hematocrit, serum protein, and serum carbamide were determined one day before surgery. Selection of amputation level was guided by skin perfusion pressure greater than 40 mmHg.

Of the 104 with arteriosclerotic gangrene, 43.3 percent had uneventful healing and 14.4 percent had secondary healing. Reamputation, primarily above-knee was performed on 38 patients. Mean preoperative hemoglobin and hematocrit readings were significantly higher in the complicated cases. The frequency of wound complications increased significantly with increasing preoperative hemoglobin and hematocrit levels. Complications were not influenced by age, sex failed reconstructive or ablative surgery, preoperative infection, critical illness, or serum protein or serum carbamide.

Of the diabetics, 57.3 percent healed primarily, 13.5 percent had secondary healing, and 24.4 per-

cent had reamputation, generally above-knee. Pre-operative hemoglobin and hematocrit readings were identical among healing and complicated diabetic amputations. Other factors did not appear to influence the outcome.

Prophylactic antibiotics have been shown to reduce complication rates substantially. Nevertheless, complications still occur in about a quarter of patients. High hemoglobin and hematocrit levels may indicate compromised microcirculation secondary to increased whole blood viscosity or dehydration with decreased tissue perfusion, although the lack of relationship between serum protein or serum carbamide and complication rates speaks against the role of dehydration. Hemodilution has a beneficial effect on wound healing, improving tissue oxygen tension in animal studies. Hemodilution has been applied successfully in treatment of tissue ischemia in peripheral arterial occlusive disease, chronic ischemic skin ulcers, cerebral infarction, and retinal vein thrombosis. Hemodilution decreases total peripheral resistance and increased venous return, stroke volume, cardiac output, and peripheral perfusion. The increase in cardiac output tends to overcompensate the loss of oxygen-carrying capacity of blood and improves oxygen delivery to tissues. [JEE]

Madorsky JGB and Madorsky AG (Casa Colina Hospital for Rehabilitative Medicine, Pomona, CA 91767). Scuba Diving: Taking The Wheelchair Out of Wheelchair Sports. *Arch Phys Med Rehabil* 69:215-218, 1988.

This case report of a 24-year-old who sustained traumatic T10 paraplegia traces his rehabilitation, commencing with a 10-week inpatient program. Ten days after admission he began instruction in table tennis, wheelchair racing, shotput, and discus while wearing a body jacket. He also learned to swim. Ambulation with knee-ankle-foot orthoses and a walker did not provide him with the freedom of mobility he sought. During two readmissions for treatment of decubitus ulcers, he engaged in counseling which included clarification of values regarding leisure interests and vocational goals. Subsequently, he completed a marathon road race in his wheelchair.

Five years after injury, he learned scuba diving, participating 4 hours weekly for 10 weeks in instruction consisting of classroom lectures, under-

water swimming in a pool, and open water dives in the ocean. Using standard scuba equipment, he omitted flippers, used 2-pound weights on his legs to keep them from floating excessively, and padded the inside of the wetsuit to prevent decubiti. He has become a fully certified Level A scuba diver and completed a 100-foot dive to explore a sunken ship with friends, spending 20 minutes underwater. Scuba diving enabled him to go wherever anyone else can go.

In 1986, the Handicapped Scuba Association published physical performance standards developed in conjunction with the Undersea Medical Society, the National Association of Underwater Instructors, and the Professional Association of Diving Instructors. Standards were tested with patients with paraplegia, quadriplegia, hemiplegia, bilateral below-knee amputation, cerebral palsy, blindness, and poliomyelitis. A training program was developed for individuals older than 12. Three levels of certification are based on the degree of dependency on one's buddy and ability to help a diver in distress. Divers use standard equipment, although optional new equipment can make diving easier. Absolute contraindications are: pulmonary disorders which might result in air-trapping; coronary artery disease; and convulsive disorders. Medical complications of diving can result from the toxicity of inhaled gas, from decompression sickness, and from pressure changes in the water and gas mixture. Precautions of special significance to the disabled are: allowing enough time for a decompression stop at 10 feet, protection against sunburn and chilling, and prevention of decubitus ulcers. Scuba diving offers recreational and vocational options to persons with disabilities. [JEE]

Marsolais EB and Edwards BG (Veterans Administration Medical Center, Cleveland, OH 44106). Energy Costs of Walking and Standing with Functional Neuromuscular Stimulation and Long Leg Braces. *Arch Phys Med Rehabil* 69:243-249, 1988.

Four subjects with complete spinal cord injuries ranging from T4 to T11 had percutaneous intramuscular electrodes implanted in the quadriceps, tensor fasciae latae, sartorius, gracilis, semimembranosus, adductor magnus, gluteus maximus and medius, soleus, and tibialis anterior. They had an outpatient program of electric stimulation exercise and gait

training from 15 to 20 hours per week, consisting of 1 hour daily muscle strengthening, standing in parallel bars, and isokinetic quadriceps exercise. Two subjects also had cardiovascular conditioning and gait training with orthoses concurrently. All walked with stimulation, using a reciprocal gait in the parallel bars and with a rolling walker. Orthoses were knee-ankle-foot with rigid ankles dorsiflexed 5 to 10 degrees. The individual with T4 lesion also had a pelvic band. The stimulator weighed 775 gm (1.7 lb) and had a switch enabling the user to initiate each step.

Mean energy cost during stimulation was 0.095 kcal/kg/min when the 2 subjects ambulated at a mean rate of 14.5 m/min, ranging from 0.13 to 0.56 m/sec, as compared with ambulation speed with orthoses of 0.19 to 0.22 m/sec. Stimulated walking had a 39 percent energy increase over orthotic ambulation; however, orthotic assisted drag-to or swing-to gait required subjects to lift much of their weight, while stimulated ambulation was performed with a reciprocal pattern which caused less arm fatigue. Higher heart rates with stimulation may be a reaction to the stimulation or the need to increase cardiac output to meet the oxygen requirements of the additional muscle mass augmented by increased cardiac preload. Much of the energy cost, 1.5 to 2.5 more than normal subjects, was due to stimulation itself which was intentionally set high to allow for muscle fatigue. Energy use with reduced stimulation level was the same as for orthotic standing and standing by a nondisabled individual.

Faster speeds resulted in less energy use with stimulation, whereas orthotic walking increased energy costs with increased speed. During stimulated walking, more time was spent in swing phase as speed increased; gait was more continuous than with orthotic walking which demands much energy in the swing phase. [JEE]

Meeks D and LeBlanc M (Rehabilitation Engineering Center, Children's Hospital at Stanford, Palo Alto, CA 94304). Preliminary Assessment of Three New Designs of Prosthetic Prehensors for Upper Limb Amputees. *Prosthet Orthot Int* 12:41-45, 1988.

A prehensor which is neither hook nor hand may satisfy the desires of upper-limb amputees. The first design is voluntary closing, using 3-jaw chuck grasp with curvatures for multipoint grasp of cylinders

and a cut-out for insertion of pencils. The second features a rotary thumb which, when positioned for fingertip grasp has voluntary opening, and when rotated for palmar grasp has voluntary closing. The third also provides voluntary opening for fingertip grasp and voluntary closing for palmar grasp, with a 4 cm (1.5 in) distal opening, suitable for 90 percent of activities. The designs were compared with a standard Hosmer-Dorrance 5X hook. The experimental models were made of hard plastic painted gray, with a gray fabric-covered forearm. Questionnaire assessment was obtained from 4 below-elbow amputees, 4 prosthetists, 5 occupational therapists and 5 lay persons.

The most popular design features the rotary thumb, and was judged to have nice contours (not weapon-looking), but provides awkward angles of grasp. Tied for second place were the standard hook and the voluntary-closing 3-jaw chuck design; the latter was deemed multifunctional, attractive, and simple, but too bulky.

This study indicates there are viable alternatives to the standard hooks and hands. [JEE]

Millstein SG, McCowan SA, and Hunter GA (Ontario Workers' Compensation Board, Toronto, Ontario M3L 1G8, Canada). Traumatic Partial Foot Amputations in Adults: A Long-term Review. *J Bone Joint Surg* 70-B:251-254, 1988.

Retrospective analysis of 277 patients with traumatic partial foot amputation indicated that 49 were later revised to Syme's or below-knee amputation. The 113 who retained their initial amputation were evaluated by a questionnaire, review of records, and clinical examination. All 113 were men whose mean age at amputation was 33; average follow-up was 16 years. Subjects had 118 amputations, of which 43 percent were rated good, indicating the subject was employed with no gait restriction, no ulceration, and minor pain. Rated fair were 38 percent who had sedentary jobs, moderate pain, recurrent callosities, shoe modifications, and functional restriction.

Of those who did not retain the initial amputation, the average time before revision was 1.4 years. Reamputation was caused by the severity of the initial injury, poor quality of final soft-tissue cover (especially the plantar and terminal grafts), infection, and late deformity due to fracture nonunion or malunion and arthritis. Those with toe or ray resection were usually revised to below-knee, while

transmetatarsal, Lisfranc and Chopart amputations were usually revised to a Syme's amputation. Functional success appeared unrelated to foot length; 28 percent of those with digital or transmetatarsal amputations had poor results, as compared with 4 percent of those with Lisfranc and Chopart who had severe functional limitation. Determining factors included fracture proximal to the amputation, skin grafts, multiple operations, and delayed amputation, all of which were associated with poorer results.

Chopart amputation failed in 61 percent of patients, although the others had a good result, using either a Chopart prosthesis or an acrylic ankle-foot orthosis or a custom-made boot with molded insole. They retained 25-degree-ankle motion; subtalar joints were fixed in neutral or varus with subsequent lateral callosities. A quarter of those with Lisfranc amputations failed. The others primarily used normal shoes with sole stiffeners, rocker bottoms, and reinforced uppers and toe fillers. Metatarsophalangeal and transmetatarsal amputations had the poorest results: 28 percent failed and 49 percent achieved poor results. Over 90 percent complained of footwear problems. Similarly, 44 percent of those with digital amputations did poorly, and 15 percent had reamputation. Thirty-nine percent of those with longitudinal amputation failed or had poor outcome. [JEE]

Peckam PH, Keith MW and Freehafer AA (Department of Orthopaedics, Cleveland Metropolitan General/Highland View Hospital, Cleveland, OH 44109). Restoration of Functional Control by Electrical Stimulation in the Upper Extremity of the Quadriplegic Patient. *J Bone Joint Surg* 70-A:144-148, 1988.

Restoration of functional grasp and release is a high priority in rehabilitation. Tendon transfers require at least one donor muscle under voluntary control, usually not available in patients with sixth cervical lesion or above. External orthoses have limited performance and low acceptance unless fitted soon after injury. Functional electrical stimulation restores voluntary control in those with central nervous system dysfunction, including patients with spinal cord injury, cerebrovascular accident, and cerebral palsy. Electrical stimuli introduced onto the peripheral nervous system generate

controlled skeletal muscle contraction. Candidates are those with: fifth or sixth cervical level injury with freedom from systemic infection; medical stability; pharmacologically-controlled spasticity; seated balance; minimum restriction of joint motion; as well as intact, electrically excitable lower motor neurons.

The system should restore prehension and sensation with minimal conscious effort of the patient. Individual muscles are selectively activated by intramuscular electrodes. Ten multifilament stainless-steel wires may be implanted in a 4 sq cm area, without percutaneous irritation. Electrode fracture occurs at approximately 0.005 percent per month; the deepest segment remains and the portion protruding through the skin is withdrawn. Few infections or other complications occur. Recently, implantable stimulators at the muscle epimysium have increased reliability. Muscle strength depends on intensity and duration of each stimulus pulse and the frequency of pulse delivery. Paralyzed muscles initially fatigue and have insufficient strength because of fiber atrophy and glycolytic metabolism. They respond to conditioning which also maintains joint flexibility and tendon gliding. Stimulation provides both palmar and lateral prehension, the former for holding large objects, the latter for small items. Two sites of implantation enable stimulating the primary flexors and extensors of the fingers and thumb. Arthrodesis, tenodesis, and tendon transfer may be used with stimulation to reduce the complexity of the stimulation system and improve reliability. The patient regulates grasp position and force through a control source, commonly contralateral shoulder positioning detected by a miniature two-axis joystick applied over the sternum. Thirty-three patients have been fitted with the portable neuro-prosthesis; all could use the system functionally. Some could even thread a needle and perform self-catheterization. The systems are reliable for more than 6 months. [JEE]

Rigas C and Xenakis T (School of Medicine, University of Ioannina, Greece). Pre- and Post-operative Gait Analysis of Hip Osteoarthritic Patients Fitted with Ceramic Autophor Total Hip Replacement. *Eng Med* 17(1):3-6, 1988.

Gait analysis was performed with 10 preoperative hip osteoarthritic patients who were compared with

10 who had total hip replacement following osteoarthritis, with fitting of a ceramic Autophor prosthesis. Seventeen subjects were women; average age in the preoperative group was 54, in the postoperative group 57. Subjects walked on a conductive walkway 22 m long, with electrodes on the soles of their shoes. In addition, 2 light beam/photocell units provided the mean speed of progression. They walked both at normal speed and at the fastest possible speed. The preoperative group had significantly shorter duration of single support on the affected leg as compared with the contralateral one. In contrast, the operated group demonstrated no significant difference between affected and non-affected sides; they had increased duration of single support on the affected side, and significant decrease of single support duration on the contralateral side, particularly when walking rapidly. Walking speed and step length were not significantly different between the two groups.

Preoperative gait asymmetry reflected the reduced ability of the affected leg to sustain load and the extended period of loading on the contralateral leg. Those fitted with an Autophor replacement had essentially identical duration of time in single support and heel to heel phases of gait on each limb. Group means, however, were slower than reported for the normal population. [JEE]

Schuch CM (University of Virginia Medical Center, Charlottesville, VA 22908). Report From: International Workshop on Above-Knee Fitting and Alignment Techniques. *Clin Prosthet Orthot* 12:81-98, 1988.

An International Workshop on Above-Knee Fitting and Alignment Techniques was held in Miami, Florida in May 1987, sponsored by the International Society for Prosthetics and Orthotics and the Veterans Administration. Approximately 50 invited participants attended, representing 8 countries. The history of modern sockets was reviewed, beginning with the suction socket which appeared in the United States after World War II, and proceeding to the total contact quadrilateral socket of the early 1960's. The newest ischial-containment socket designs are known by various names: Contoured Adducted Trochanteric-Controlled Alignment Method, Normal Shape-Normal Alignment, and Narrow Mediolateral. Review of the quadrilateral socket and

alignment theory indicated that the socket should not be described as a cross-sectional shape at ischial level, but rather a three-dimensional receptacle which demonstrates the same biomechanical requirements claimed by proponents of the ischial containment sockets, namely conformable weight-bearing, narrow walking base, and normal swing phase. Well-fitting quadrilateral sockets provide the same comfort and gait as do the newer sockets. Teaching principles pertinent to the newer designs were described, with particular reference to the manual written at University of California. New evaluations include the skeletal and soft tissue mediolateral dimensions, the iliofemoral angle measured on the patient, and the pubic arch angle and ischial inclination evaluated by palpation and captured in the wrap cast. Socket trimlines are specified, as are bench alignment reference points.

The approach at Northwestern University emphasizes the wrap cast, model modification, and alignment, all based on a straight line from the center of a narrow socket through the distal femur to the center of the heel. The procedure taught at New York University involves use of a casting brim, allowing evaluation of socket design under weight bearing conditions, and centralization of the femur to prevent a large mediolateral bulge. Critical measurements are the mediolateral dimension taken 1 to 2 inches distal to the ischial tuberosity, mediolateral dimension from the tuberosity to a point superior to the greater trochanter, and dimension from tuberosity to the subtrochanteric area of the femur. Trimlines of all 3 new sockets are similar, including a low anterior wall to clear the superior iliac spine, relatively horizontal posterior wall, lateral wall covering the trochanter, and medial wall sloping toward the anterior wall. Several speakers described versions of the flexible socket and frame configurations. No specific contraindications were noted for any socket design. [JEE]

Schuch CM (University of Virginia Medical Center, Charlottesville, VA 22908). Orthotic Management of the Arthritic Foot. *Clin Prosthet Orthot* 12:51-60, 1988.

The foot bones are arranged in medial, lateral and transverse arches. Each foot joint is lined with synovium which, when inflamed, shows dramatic clinical, radiographic, and pathologic changes. The

most debilitating form of arthritis is rheumatoid arthritis which primarily affects the synovial lining of joints, tendons, and bursae, and may destroy cartilage, bone, and ligaments. Early edema and decreased range of motion leads to bony erosion and cartilage destruction. Reactive hyperemia is associated with osteoporosis. Deformities become fixed as the weakened skeleton yields to normal mechanical stress. The most common deformity is pes plano-valgus. The midfoot loses pronation and supination, and the forefoot shows hallux valgus, claw toes, metatarsophalangeal depression, forefoot abduction, and splay foot. Osteoarthritis affects primarily the ankle and the first metatarsophalangeal joints. Other forms of arthritis affecting the foot include: ankylosing spondylitis, Reiter's syndrome, psoriatic arthritis, gout, and systemic lupus erythematosus.

Foot orthoses can maintain and support existing arches, reestablish fallen flexible arches, provide inversion-eversion stability, distribute weight bearing pressures, and supplement soft tissue. Patients often receive Plastazote inserts molded directly on the foot; these are not as durable as PVC-Pelite orthoses molded over models of the foot. Rigid foot orthoses fabricated of Nyloplex are unsuccessful, lacking flexibility and the soft tissue supplement needed by arthritic patients.

Ankle-foot orthoses are used infrequently, but may benefit patients who suffer ankle pain, swelling, decreased motion, severe pes planus, and subtalar erosion. One design is the rigid, molded plastic ankle-foot orthosis; the other is the bivalved, weight-bearing rigid molded plastic orthosis. When pain in the ankle or subtalar joint is caused by walking, the former suffices. For patients experiencing pain while standing and walking, the latter orthosis is needed to redistribute weight-bearing, and is effective when worn with shoes with soft soles. The solid-ankle cushion heel and rocker sole are unnecessary.

Suitable shoes include thermoadjustable ones which feature a thin outer fabric covering, crepe wedge soles, Velcro lap closure, and removable Plastazote insole. Application of heat causes the plastic to mold to the patient's foot to accommodate severe deformity. Extra-depth shoes are ideal to accommodate foot and ankle-foot orthoses; these shoes should have a very soft leather upper with generous forefoot width and height. Running shoes suit many patients because of their appearance,

removable insole, and light weight, but are not as adjustable as the other designs. [JEE]

Seale KS (Department of Orthopedics, University of Arkansas Medical School Center). Clinical Analysis of Foot Problems. *Clin Prosthet Orthot* 12:44-50, 1988.

Clinical analysis consists of obtaining a pertinent history of the pain, problem, or deformity, as well as performing examination involving inspection, palpation, and manipulation. The patient should be seen standing and walking with and without shoes. Heel pain may be caused by fat pad atrophy, plantar fasciitis, or neuritis. The condition should be treated by padding the heel, modifying the shoe with a soft sole, relieving the center of the heel, and fitting a soft arch support. For those with neuritis, an orthosis limiting pronation is useful.

Pes planus may be caused by posterior tibial tendon rupture, Charcot joint degeneration, arthritis, and ligamentous laxity. The patient often has excessive eversion, greater than the normal 10-degree excursion, as well as forefoot varus. Management includes correcting the valgus tilt of the calcaneus, providing a medial arch support, and controlling hyperpronation of the first ray. Metatarsalgia may be caused by fat pad atrophy, requiring soft-soled shoes; sesamoiditis, requiring low-heeled shoes with padding to relieve weight-bearing under the first metatarsal head; disorders of the lesser metatarsal joints; interdigital neuroma, aided by a metatarsal support proximal to the heads and eliminating snug, high-heeled shoes; rheumatoid arthritis, requiring a soft, total contact insert with padding proximal to the heads; or pes cavus, aided by a soft arch support.

Ankle instability may result from lateral ligamentous laxity demonstrated by the lateral talar tilt test, or a varus heel or a varus angulated tibia. A lateral heel and sole wedge tilts the hindfoot into slight valgus to prevent recurrent instability. [JEE]

Simon MA (University of Chicago Medical Center, Chicago, IL 60637). Limb Salvage for Osteosarcoma. *J Bone Joint Surg* 70-A:307-310, 1988.

Four concerns must be addressed when limb salvage is considered for the patient with osteosarcoma in an extremity: 1) Is survival rate decreased? 2) How does immediate and delayed morbidity compare? 3) How

good is limb function likely to be? 4) Are there psychosocial benefits? Limb salvage has no adverse impact on long-term survival when adjuvant or neoadjuvant chemotherapy and wide surgical margins were employed. Local recurrences arise almost exclusively from femoral lesions, 5 to 10 percent. Long-term survival after salvage or amputation for osteosarcoma range from 40 to 70 percent. Patients who had hip disarticulation did not have local recurrence. For those with local recurrence, amputation is indicated if metastases are absent, but survival is still unlikely. Candidates for limb salvage are those in whom wide surgical margins can be achieved (excluding extensive tumor), no technical problems exist (excluding distal tibial tumor), and no unstable pathological fracture exists.

Immediate complications of salvage relate to soft tissues; late complications relate to skeletal reconstruction. The most frequent complication is skin necrosis secondary to fashioning the large cutaneous flaps needed. Deep infection is usually associated with skin necrosis. One quarter of patients with salvage required amputation because of immediate complications. Long-term complications include pressure sores from the prosthesis, and phantom limb pain. Knee arthrodesis or rotationplasty are durable, but problems accompanying knee reconstruction are unknown. Function of extra-articular resection of the proximal humerus is superior to that after forequarter amputation. Local pelvic resection with or without the acetabulum and proximal femur is more functional than hemipelvectomy. In contrast, distal tibial or foot tumors are better treated by below-knee amputation. After resection about the knee, the most common site of osteosarcoma, amputation, arthrodesis, rotationplasty, or a mobile knee may be considered. Patients with resection and endoprosthetic replacement had lower energy expenditure than did those with above-knee amputation. Energy expended by those with below-knee amputation was less than by those with a prosthetic knee replacement. Reconstruction with mobile components was superior to arthrodesis which was superior to above-knee amputation. Rotationplasty is also superior to above-knee amputation. However, no reconstruction will enable the patient to have a functionally normal limb.

No significant differences in measures of psychological outcome exist for those with salvage and

those with lower-limb amputation. [JEE]

Stills ML (University of Texas Health Science Center, Dallas, TX 75235). Partial Foot Prostheses/Orthoses. *Clin Prosthet Orthot* 12:14-18, 1988.

Designs for partial foot amputation may terminate above or below the ankle. Prostheses for the former may be fabricated from polypropylene, polyester or acrylic with graphite to reduce weight and increase strength, or may have metal and leather components. The distal portion contacts the foot totally and is lined with a soft interfacing material. The foot buildup of foam extends the foot lever arm and fills the shoe. The shoe may require a full length spring-steel cushion heel and rocker sole to provide smooth transition from foot flat to heel-off. A solid ankle device has an anterior section extending to the dorsum of the remaining foot, locking the foot into the device, eliminating ankle motion, and providing better retention. The proximal region may be a patellar tendon-bearing socket or may terminate lower. Designs which limit ankle motion require shoe modifications to improve gait, such as a cushion heel.

Below-ankle, slipper-type designs may be rigid, semirigid, semiflexible, or flexible. All are fabricated on a model of the amputation limb. Rigid and semirigid versions have a laminated or thermoformed socket with foam lining. The distal plantar surface of the foot is apt to ulcerate if motion occurs inside the socket. Semiflexible designs have a urethane elastomer base which may be combined with a University of California-Berkeley shoe insert; the system does not interfere with ankle motion. Another semiflexible design is made entirely of urethane elastomer molded in a custom-made mold of the foot. The flexible cosmetic prosthetic foot uses only reinforced silicone. It is based on a negative weight-bearing alginate impression of the contralateral foot. A mirror image model of the sound foot is sculpted from wax, then a negative model of the sculpted foot is made and combined with the rectified model of the amputation limb to produce the prosthesis. Silicone is precolored to match the patient's skin color.

Although mechanical and kinesiological comparisons of the various designs are not available, it appears that above-ankle designs should be limited to those patients with very short amputations. [JEE]

Sturup J, Thyregod HC, Jensen JS, Retpen JB, Boberg G, Rasmussen E and Jensen S (Department of Orthopaedic Surgery, Rigshospitalet, Copenhagen, Denmark). Traumatic Amputation of the Upper Limb: The User of Body-Powered Prostheses and Employment Consequences. *Prosthet Orthot Int* 12:50-52, 1988.

Six women and 37 men presenting unilateral traumatic amputation, including 19 below the elbow, were fitted with body-powered prostheses. Eleven were younger than 18. Mean follow-up was 7.4 years, when patients were interviewed.

Only one patient was unemployed, although another received a pension and 10 were school age or younger at the time of amputation. At follow-up, 4 were unemployed, and for 6, rehabilitation was tried, but had failed. Fourteen never used their prostheses. Fifteen used prostheses all day. Users and nonusers were not distinguished by age, sex, pain, time between amputation and fitting, or follow-up. Eighty-nine percent of below-elbow amputees became users, as compared with 50 percent of above-elbow amputees. Those with above-elbow amputation of the nondominant arm had the lowest proportion of users, 46 percent; all below-elbow dominant arm amputees used prostheses. Higher employment was found among nonusers who were generally skilled workers or in non-strenuous jobs, although the difference was not statistically significant. [JEE]

Summer BN, McClelland MR, and El Masri WS (The Robert Jones & Agnes Hunt Orthopaedic Hospital, Oswestry, Shropshire SY10 7AG, United Kingdom). A Clinical Review of the Adult Hip Guidance Orthosis (ParaWalker) in Traumatic Paraplegics. *Paraplegia* 26:19-26, 1988.

The ParaWalker is an adult version of the Hip Guidance Orthosis designed for children with low-thoracic level spina bifida. The ParaWalker consists of rigid leg braces articulating with a rigid body brace via ball bearing hinges. The wearer positions the hip ahead of the foot by hip flexion or hyperextension, enabling the leg to swing forward. Orthotic rigidity allows guidance of the swinging hip in relative abducting, preventing it from colliding with the stance leg. Energy for forward movement comes from the upper limb musculature-manipulating crutches; the patient pushes down on the ipsilateral crutch.

Twenty men with complete lesion between C8 and T12 used the ParaWalker for at least 6 months. Most had lesions between T4 and T9. Subjects were interviewed with regard to: ability to doff, don and transfer; value of the orthosis to the patient; and distance and environment where the patient could walk. Average follow-up was 20 months; average time from injury to fitting of the ParaWalker was 41 months. Eleven had used leg braces prior to using the ParaWalker and all found walking tiring and unstable; 10 had abandoned braces. At follow-up, 12 were in full or part-time employment. Three abandoned the ParaWalker, finding it too tiring, although one had injured his arm and hoped to return to the ParaWalker. All 3 had been dependent indoor walkers. The 17 who persisted with the ParaWalker were able to doff and don it independently, and could stand and sit unaided. With the ParaWalker, few household activities were possible because of the necessity of using crutches for walking and standing. The bulkiness of the device interferes with operating a car. The principal benefit was the physical and mental well-being associated with being able to ambulate without undue effort in the reciprocal manner, and especially with being able to stand and talk to a friend at eye level. Patients could walk on gravel paths, lawns and pavements and negotiate gentle inclines and small steps. They could generally walk several hundred yards. Although the ParaWalker is worn outside clothes, only two found it unattractive.

The ParaWalker is unsuitable for the elderly, the excessively tall or obese, and persons with significant cardiac or respiratory disease. Motivation is a key factor. [JEE]

Want GH, Moskal JT, Albert T, Pritts C, Schuch CM, and Stamp WG (University of Virginia Medical Center, Charlottesville, VA 22908). The Effect of Halo-Vest Length on Stability of the Cervical Spine: A Study in Normal Subjects. *J Bone Joint Surg* 70-A:357-360, 1988.

The halo is the preferred method of treating unstable spinal injuries, cervical lesions, and spinal deformities. Rigid immobilization facilitates early walking. Slight motion in the neck occurs. Force vectors on the head and neck are greatest in vertical compression and distraction, and least medially and laterally when the patient sits. Twenty healthy young men were fitted with a halo fitted over a thin rubber

pad wrapped snugly around the subject's forehead. A commercially available vest was fitted with two vertical bars that permitted shortening and lengthening. Rotational control was confirmed as the subject attempted to rotate the neck while photographs were taken, enabling comparison of halo position with chest and nose markers. A total of 11 radiographs were taken with the head neutral and in flexion, extension, and lateral bending, and with the vest adjusted to full, short, and half-lengths. The X-ray films were measured by two independent examiners who were unaware of the vest adjustment.

Spine rotation did not occur in any subject, and was unaffected by vest length. No difference in flexion or extension above C5 was noted, regardless of vest length. Significant increase of motion occurred below C5 when the full vest was compared with the half one. Insignificant differences in the small amount of lateral motion were found. Thus, range of motion varies at different cervical levels, increasing slightly below C5. This study demonstrates that a support extending to the iliac crests does not add stability. Therefore, patients with lesions between C1 and 4 can be treated adequately in a halo with a short, half-vest. For those with lesions at C5 and below, additional vest length to the level of the twelfth ribs provides additional stability; the full iliac crest length vest, however, does not provide any better support. Because of slight motion in the lower neck, an extension bar is recommended (especially for tall patients). [JEE]

Weaver SA, Lange LR, and Vogts VM (Shriners Hospital, Philadelphia, PA 19152). Comparison of Myoelectric and Conventional Prostheses for Adolescent Amputees. *Amer J Occup Ther* 42:87-91, 1988.

Ten adolescents with congenital unilateral below-elbow amputation were evaluated with their body-powered hook prostheses regarding their ability to open the hook in various positions and to perform bimanual activities. Grasp force was measured and the growth of the forearm was assessed. Prosthetic history was evaluated and a social worker interviewed candidates and families to assess psychosocial attitudes. School performance, peer interaction, appearance, and level of psychosocial development were observed. Subjects were fitted with a myoelectric prosthesis with a flexible self-suspending socket, and Otto Bock hand; 9 received two dual-

site electrodes. All subjects were admitted for 10 days of training. Reevaluation at 6 months included the Bimanual Functional Assessment, consisting of 38 bimanual activities that subjects rated for both body-powered and myoelectric prosthesis.

With myoelectric prostheses, the snug socket resulted in decreased elbow flexion for 4 subjects and loss of supination for 2; and some active pronation gain for one. After 6 months, the sound side increased in girth while the amputation limb increased at most, 43 percent of the rate of the sound side at midlimb. The amputation limb reduced at the proximal circumference. Grasp force increased with myoelectric fitting providing an average of 7.5 kg pinch compared with the body-powered pinch of 1.06 kg. Wearing time increased from 9.5 hours daily with the body-powered to 10.4 hours on average. Subjects reported a two-thirds increase in the number of bimanual functional activities performed after being fitted with the myoelectric prosthesis. Some tasks, such as cutting meat and doffing a shirt, were more difficult with the myoelectric prosthesis. Eight subjects liked the appearance of the myoelectric prosthesis. Those who disliked it objected to the glove color or were pressured by their families to participate in the project. Gloves were the most frequently replaced item. All required at least one glove change in the 6-month study period; 8 required more than one. Rubber retainer-rings from floating electrodes and batteries were frequent problems. In 7 instances, the socket did not fit properly and required adjustment. Myoelectric prostheses produced an intimate fit, freedom from harnessing, and increased pinch force. Body-powered prostheses allowed more active range of motion and were lighter. The myoelectric prosthesis provides an increase in functional use in bimanual tasks without a large increase in wearing time. The substantially greater cost of the myoelectric prosthesis is justified for carefully selected candidates. [JEE]

Wyss CR, Harrington RM, Burgess EM, and Matsen FA III (Department of Orthopaedics, University of Washington, Seattle, WA 98195). Transcutaneous Oxygen Tension as a Predictor of Success after an Amputation. *J Bone Joint Surg* 70-A:203-207, 1988.

Review of 162 patients who had 206 amputations proximal to the forefoot in 181 limbs indicated good

correspondence between values for transcutaneous oxygen tension and clinical judgment regarding amputation site selection. Two weeks before amputation, patients had oxygen tension measurements at chest, above and below the knee, and at the midfoot. Doppler pressure at the ankle was also recorded. Few below-knee amputations were performed when tension distal to the knee was less than 20 mmHg. Failures were most often in limbs with low tension, although a few with zero readings healed. Below-knee amputations failed as systolic blood pressure at the ankle decreased, but the relationship was less consistent than that observed for oxygen tension. Results for foot amputations were similar. Diabetic and nondiabetic patients had increasing risk of healing failure at the below-knee and foot level with decreasing tension.

Tension measurements prior to above-knee amputation had little predictive value for healing potential. The results suggest that an objective threshold value that would predict healing potential does not exist, because risk of failure increases with degree of ischemia. Thus, ischemia is a risk factor rather than the sole cause of failure. After amputation, limb circulation may change inasmuch as the available perfusion, especially for patients with above-knee amputation, may be adequate to supply the residual limb. Other factors contributing to healing are surgical technique, postoperative care, patient's overall health, and nutrition. Although transcutaneous oxygen tension is a reliable indicator of local ischemia and a good predictor for risk of failure, the measurement is localized and may not detect values elsewhere in the limb, and some nutritive blood flow to the skin may be present even with zero measurements. Prospective measurement of ischemia furnishes the surgeon with the risk of performing amputation at the level where the measurement was made. Once the risk is known, the surgical decision can be made on the basis of other criteria based on clinical judgment and assessment of physical findings. [JEE]

Yarkony GM, Roth EJ, Heinemann AW, Lovel L, and Wu Y (Rehabilitation Institute of Chicago, Chicago, IL 60611). Functional Skills after Spinal Cord Injury Rehabilitation: Three-Year Longitudinal Follow-up. *Arch Phys Med Rehabil* 69:111-114, 1988.

Follow-up of 236 individuals with traumatic spinal cord injury included administration of the Modified Barthel Index, a 100-point scale of ability to perform 14 self-care and mobility skills. Subjects averaged 27.0 years of age; 83 percent were male; 128 had quadriplegia.

Individuals with complete quadriplegia had mean scores of 30.3 at discharge and 37.8 at the third follow-up. Those with incomplete quadriplegia were discharged with a mean score of 53.8 and returned with an average 68.3 score 3 years later. Individuals with complete paraplegia scored 72.0 at discharge and 75.6 later, while those with incomplete paraplegia scored 77.0 at discharge and 86.1, 3 years later. At least 86 percent of patients maintained or improved functional independence levels. None of those with complete paraplegia could walk independently at follow-up, although 39 percent could walk with assistance and 11 percent could climb stairs with assistance.

The rate of improvement is greater for those with incomplete injuries, especially quadriplegia. Most of the subjects used wheelchairs as their primary means of mobility, but they maintained or improved self-care and transfer skills. The study population excluded those with greater function at discharge who apparently tended not to need comprehensive follow-up services or who found services in the community. Those with less discharge function continued to improve, possibly because of fewer family or social resources, increased severity of medical complications, or more difficulty adapting to their disability. Skill improvement was greater during inpatient stay than following discharge. [JEE]

Yarkony GM, Roth E, Lovell L, Heinemann A, Katz RT, and Wu Y (Rehabilitation Institute of Chicago, Chicago, IL 60611). Rehabilitation Outcomes in Complete C5 Quadriplegia. *Amer J Phys Med Rehabil* 67:73-76, 1988.

Sixty-three individuals with traumatic C5 quadriplegia were compared with regard to function at admission to the rehabilitation center and at discharge. Function was documented with the Modified Barthel Index, a 15 item inventory of functional skills, related to self-care and mobility. Eight-seven percent of the patients were male, with an average age at onset of 25.1 years. Motor vehicle accidents

were the leading cause of injury. The average rehabilitation stay was 140 days; 50.2 days, on average, elapsed between injury and rehabilitation admission.

The functional score increased significantly from 7.1 on admission to 28.9 on discharge. Self-care increased from 6.5 to 20.0, while mobility rose from 0.5 on admission to 8.9 on discharge.

The typical patient with complete C5 quadriplegia learns to eat and drink from a prepared meal tray, and to dress the upper body. One can expect the patient to perform grooming activities and propel a manual wheelchair, but to need assistance in bathing, transferring, and bowel and bladder activities. Rehabilitation outcome is also affected by motivation, cognition, physique, medical conditions, and endurance. The total program for patients and their families includes prevention and treatment of medical and psychiatric complications, vocational rehabilitation, driver education, recreation, psychology, and social work. Families and attendants are trained in care for activities the patient cannot perform, with the patient directing their care. Electronic environmental control equipment and communication aids augment the patient's ability to control the environment. [JEE]

SENSORY AIDS/REHABILITATION

Barber PO, Lederman SJ (Department of Psychology, Queen's University, Kingston, Ontario K7L 3N6, Canada). Encoding Direction in Manipulatory Space and the Role of Visual Experience. *J Visual Impairm Blindn* 82:99-106, 1988.

An empirical study of the ways in which individuals construct cognitive maps of *movement space*, defined as space whose dimensions are derived entirely from haptic information and further defined as *manipulatory space*, if data is derived from the upper limbs, and *ambulatory space*, if derived from the lower limbs.

Three groups of 12 adults each—normally sighted, congenitally blind (before 6 months of age), and adventitiously blind (mean age at onset 16.8 years)—participated in two series of experiments. In the first, after training, one of their hands was guided to 1 of 7 target objects easily differentiated tactually and given simple names (“ramp,”

“circle,” etc.) and they were asked to indicate the locations of the other 6 objects. In the second, they pretended to be at one location and pointed in the direction of the other objects. Among the results, group and gender differences in direction errors and in median reaction times were not significant. No speed-accuracy trade-off was observed. Accuracy, not speed, differentiated the first from the second task. Interviews with participants revealed that each developed some mapping strategy to manage the tasks. The authors regard their data as revealing a fundamental difference between manipulatory and ambulatory spaces. [JDS]

Bentler RA, Tyler RS (University of Iowa, Iowa City, IA). Tinnitus Management. *ASHA* 29(5):27-32, 1987.

Reviews 71 references to the evaluation and management of tinnitus. Practitioners do not agree on treatment approaches: results of clinical trials are either poorly reported or conflicting. The tendency is, therefore, for clinicians to adopt a trial-and-error strategy in the treatment of this highly prevalent condition. [JDS]

Bishop VE (No. 206, 4312 Duval, Austin, TX 78751). Making Choices in Functional Vision Evaluations: “Noodles, Needles, and Haystacks.” *J Visual Impairm Blindn* 82:94-98, 1988.

Offers a theoretical approach to the assessment of functional vision in able-bodied individuals and individuals with multiple disabilities that emphasizes observational data. The evaluation model takes into account environments (“haystacks”), visual abilities (“needles”), and individual differences in related abilities (“noodles”). It leads to choices of procedures for able-bodied children and children with disabilities and to a reporting format that conveys the essence of the examination to practitioners. [JDS]

Campbell KCM, Abbas PJ (University of Iowa, Iowa City, IA). The Effect of Stimulus Repetition Rate on the Auditory Brainstem Response in Tumor and Nontumor Patients. *J Speech Hear Res* 30:494-502, 1987.

Auditory brainstem responses were obtained from 28 adult patients with asymmetrical hearing impair-

ments, 8 having surgically-confirmed acoustic neuromas (Tumor Group) and 20 having only cochlear impairments (Nontumor Group). The one significant difference between the two groups was in Wave V latency shift: greater for the Nontumor Group as repetition rate increased from 9.7 to 49.7 per second. Investigators did not find a correction factor for hearing loss that would improve interpretation of Wave V latency shifts. [JDS]

Dent LJ, Simmons FB, White RL, Roberts LA (Stanford University, CA). Speech Perception by Four Single-Channel Cochlear Implant Users. *J Speech Hear Res* 30:480-493, 1987.

Results of testing 4 profoundly deaf adults within 8 months after multiple (2 cases) and single (2 cases) scala-tympani implants found that the device failed as a sensory substitute, except for gains on the Everyday Sounds Subtest of the MAC. As a sensory aid (with a single-channel processor), 3 of the 4 found the implant provided valuable support, and 2 were enthusiastic about the gains provided in face-to-face communication. Speechreading scores of all 4 subjects improved significantly post-implant, as did connected-discourse tracking with stimulation. The fourth case, an excellent lipreader, regarded any benefit from the implant as not worth the bother of using it. The authors believe their findings are consistent with those already in the literature. [JDS]

De Witt JC, Schreier EM, Leventhal J (American Foundation for the Blind, 15 West 16th Street, New York, NY 10011). A Look at Closed Circuit Television Systems (CCTV) for Persons with Low Vision. *J Visual Impairm Blindn* 82:151-162, 1988.

Empirical evaluations of four CCTV systems and their in-house variations—Coburn Magnilink, Optelec, Telesensory Vantage, and VTEK Voyager—took into account magnification, contrast and brightness, glare reduction, user's physical comfort, monitor size and color, camera mounting, split screen, size and travel range of viewing table, and options. The evaluators recommend that purchasers concentrate their decisions on five features: image, reliability, portability, versatility, and cost. Manufacturers' replies to each evaluation are included in the report. [JDS]

Felps JN, Devlin RJ (Louisiana State School for the Blind, Baton Rouge, LA 70821). Modification of Stereotypic Rocking of a Blind Adult. *J Visual Impairm Blindn* 82:107-108, 1988.

A device ("Drive Alert") that slips behind the ear, and activates a buzzer when the head passes a preset position, was used to control the extreme rocking behavior of a 21-year-old, congenitally blind male, who claimed that the behavior was beyond his conscious control. In a matter of days, a dramatic reduction in rocking occurred in 3 settings (2 classroom and 1 while waiting for the bus). The reductions remained when follow-up observations were made 2 weeks after cessation of the intervention procedure. Both the student and his teachers expressed approval of the device. [JDS]

Frye GJ (Frye Electronics, PO Box 23391, Tigard, OR 97223). Crest Factor and Composite Signals for Hearing Aid Testing. *Hear J* 40(10):15-18, 1987.

Data are presented to support the use of low-to-moderate crest-factor composite signals in the saturation testing of hearing aids. The crest factor is defined as the ratio of a signal's peak amplitude to its overall power level. If the proper precautions are taken, all test methods produce essentially the same results. However, if an aid is overdriven by the peaks in the test signals, gain tests will yield erroneous results, and saturation testing by click-type signals can result in underestimation of the aid's power. [JDS]

Goldberg AM, Schreier E, Leventhal JD, De Witt JC (American Foundation for the Blind, 15 West 16th Street, New York, NY 10011). An Evaluation of Braille Translation Programs. *J Visual Impairm Blindn* 81:487-492, 1987.

Three computer programs to translate text into Grade 2 Braille—Duxbury Translator, PC Braille, Braille-Talk—were evaluated, using a scoring system developed by the Library of Congress for scoring brailled manuscripts. The article contains the reviews plus the vendor's replies. Braille-Talk was judged easy to use, but unreliable. PC Braille did a good job, but formatting took twice as much time as the other two programs. Duxbury provided a fast, accurate translation and easy formatting; however,

it did not translate certain symbols (like +), something the vendor states will be corrected in the next edition. Overall, the three programs are adequate, but they require considerable effort to fully master them. [JDS]

Grant KW. Frequency Modulation Detection by Normally Hearing and Profoundly Hearing-Impaired Listeners. *J Speech Hear Res* 30:558-563, 1987.

To determine the effects of hearing impairment on difference limens for frequency discrimination, 3 normally hearing and 3 hearing-impaired persons' thresholds for detection of frequency modulation were assessed by a two-choice procedure over a large number of trials and with either constant (C), sinusoidally-modulated (S), or randomly-modulated (R) stimuli. Limens were smallest for both normal and impaired persons for C stimuli, and greatest for R stimuli. Differences between performances with C and R stimuli were about 36 times larger for impaired persons. [JDS]

Hillenbrand J (Rochester Institute of Technology, Rochester, NY). A Methodological Study of Perturbation and Additive Noise in Synthetically-Generated Voice Signals. *J Speech Hear Res* 30:448-461, 1987.

Three sets of computer simulations studied pitch perturbation, amplitude perturbation, and additive noise as aids to diagnosis of voice-quality disorders, to identification of individual speakers, and to improving voice synthesis. The three measures interact strongly, making extremely difficult precise determination of aperiodicity sources in voice waveforms. Some measurement modifications that might overcome this difficulty are suggested, but their validity awaits empirical verification. [JDS]

Jones WP (No. 1270, 101 Convention Center Drive, Las Vegas, NV 89109). Computer-Simulated Research for Low-Incidence Handicaps. *J Visual Impairm Blindn* 82:113, 1988.

Describes a computer procedure to simulate various low-incidence combinations of physical conditions and behaviors, in order to test the probable results of intervention strategies. The Monte Carlo model rests on Gaussian probabilities. [JDS]

Kerr AG. Controversies in Otology (The First Sir Morrell Mackenzie Lecture). *J Laryngol Otol* 101:983-992, 1987.

Advances four principles of otological practice—pathology, prognosis, proficiency, and price—with particular reference to cochlear otosclerosis (the existence of which he doubts), and idiopathic sensorineural deafness (the treatment of which he considers in detail). [JDS]

LaGrow SJ, Kjeldstad A, Lewandowski E (Department of Psychology, Massey University, Palmerston North, New Zealand). The Effects of Cane-Tip Design on Three Aspects on Nonvisual Travel. *J Visual Impairm Blindn* 82:13-16, 1988.

Fifteen normally sighted adults (10 females and 5 males, ranging in age from 22 to 46 years) walked a specified route three times, using Equipose canes fitted with (a) cylindrical, (b) curved, and (c) round tips. No significant differences between tips occurred in sticking, curb detection, or continuous movement. However, most participants expressed a preference for the curved tip, though one-third rated it as poorest for curb detection. The authors reconcile contradictory results of Fisk's study by pointing out differences in age (young to middle-aged versus elderly), vision (blindfolded versus low-vision), and cane technique (touch versus continuous-contact). [JDS]

Larson CR, Kempster GB, Kistler MK (Northwestern University, Evanston, IL). Changes in Voice Fundamental Frequency Following Discharge of Single Motor Units in Cricothyroid and Thyroarytenoid Muscles. *J Speech Hear Res* 30:552-558, 1987.

Electromyograms of 3 men and 1 woman were made while they produced a prolonged vowel at modal pitch and loudness. The time between discharge of single-motor units and peak change in F_0 ranged from 5 to 20 ms for the thyroarytenoid, and 6 to 75 ms for the cricothyroid muscle. Distinct F_0 oscillations were present in all recordings of the female and of all men when they phonated above modal pitch levels. Results are discussed in relation to identifying the basis for vocal jitter. [JDS]

Leder SB, Spitzer JB, Flevaris-Phillips C, Richardson F, Milner P, Kirchner JC (Veterans Administration Medical Center, West Spring Street, West Haven, CT 06516). Innovative Approaches to Selection of Adult Cochlear Implant Candidates. *J Rehab Deaf* 21(2):27-33, 1987.

Describes the procedures developed for the communicative, medical, psychological, and social evaluation of cochlear-implant candidates. [JDS]

Mettler R (Division of Rehabilitation Services for the Visually Impaired, Department of Public Institutions, Lincoln, NE 68510). Blindness and Managing the Environment. *J Visual Impairm Blindn* 81:476-481, 1987.

By failing to recognize the basic competence of most blind persons, those who recommend environmental modifications often contribute to "neoinstitutionalization," that is, to less successful participation by the blind person in the community. [JDS]

Milenkovic P (University of Wisconsin, Madison, WI). Least Mean Square Measures of Voice Perturbation. *J Speech Hear Res* 30:529-538, 1987.

The author describes a method of measuring jitter, shimmer, and signal-to-noise ratio of sustained vowels. Speech waveforms are digitized at a sampling rate of 8.3 kHz and fitted by a least-mean-square model with an interpolation to improve its temporal resolution. Empirical tests of the procedure were successfully performed. In the course of the validation studies, the author notes that jitter and shimmer are highly correlated and that correlations between voice perturbation measures depend upon the particular vowel being assessed, emphasizing the necessity for calibrating on vowel-like synthetic waveforms rather than on simpler test waveforms. [JDS]

Neuman AC, Levitt H, Mills R, Schwander T (Center for Research in Speech and Hearing Sciences, Graduate School and University Center, City University of New York, New York, NY 10036). An Evaluation of Three Adaptive Hearing Aid Selection Strategies. *J Acoust Soc Am* 82:1967-1976, 1987.

Eight hearing-impaired persons used three proce-

dures—iterative round robin, double-elimination tournament, and modified simplex—to compare hearing aids simulated by a digital master hearing aid that systematically varied low- and high-frequency gain in accordance with a 5-by-5 matrix. The three methods converged on the same or similar aids for most persons. The modified simplex procedure was the most efficient and the round robin procedure was the least efficient. [JDS]

Newman SE, Hall AD (Department of Psychology, North Carolina State University, Raleigh, NC 27695). Ease of Learning the Braille and Fishburne Alphabets. *J Visual Impairm Blindn* 82:148-149, 1988.

Data from 72 sighted, male college students who used vision to learn either the Braille or Fishburne tactual alphabets, significantly favored the latter in terms of the number of correct letters identified after an 8-minute study period. [JDS]

O'Donnell BA (Pennsylvania College of Optometry, 1200 West Godfrey Avenue, Philadelphia, PA 19141-3399). Stress and the Mobility Training Process: A Literature Review. *J Visual Impairm Blindn* 82:143-147, 1988.

Based on her reading of 75 citations, the author concludes that the role of stress in mobility training has not had, but much deserves, the attention of researchers and practitioners. [JDS]

Punch JL (Project Phoenix, Madison, WI). CROS Revisited. *ASHA* 30(2):35-37, 1988.

Reviews 17 articles about CROS and BICROS and concludes: These aids work best with persons who have unaidable hearing impairments in one ear, can verbalize their communication difficulties, can apprehend the operation of the equipment, and can appreciate its deficiencies. The author emphasizes the need for counseling in rehabilitation, using this type of hearing aid. [JDS]

Sakamoto I, Mehr EB (Western Blind Rehabilitation Center, Veterans Administration Medical Center, 3801 Miranda Avenue, Palo Alto, CA 94304). A New Method of Stair Markings for Visually Impaired People. *J Visual Impairm Blindn* 82:24-27, 1988.

Five adults with cataracts and healthy maculas (Group 1) and 10 with little or no cataract formation

but with macular degeneration (Group 2) walked up and down two identical sets of stairs, except one set had traditional horizontal markings and the other had Pastalan vertical stair markings. Group 1 expressed no preference for either stair marking, but Group 2 significantly preferred the Pastalan marking. The correlation between preference and time to traverse the stairs was not significant. Both groups preferred marked stairs to unmarked. [JDS]

Smith BL, Wasowicz J, Preston J (Northwestern University, Evanston, IL). Temporal Characteristics of the Speech of Normal Elderly Adults. *J Speech Hear Res* 30:522-529, 1987.

Recorded utterances of 10 adults, 24 to 27 years of age, were compared to 10 adults, 66 to 75 years of age. The older persons' segment, syllable, and sentence durations were 20 to 25 percent longer than the younger adults at both normal and fast rates of speech, suggesting to the investigators a tendency for most temporal characteristics of speech to become longer as age increases. [JDS]

Story SM, Kuyk TK Veterans Administration Medical Center, Southeastern Blind Rehabilitation Center, Birmingham, AL 35233). First Time Recognition of Synthesized Speech: A Comparison of Three Systems. *J Visual Impairm Blindn* 82:28-29, 1988.

Twenty sensorially-normal adults compared three speech synthesizers—Echo+, Slotbuster, and SynPhonix—under two conditions: preset and user-selected speech parameters. Though differences were small, number-correct scores were significantly greater for the user-selected condition. Significant interactions between user condition, type of task, and the synthesizers complicated the analysis. However, regardless of condition and task, recognition scores for all of the synthesizers were poor. The dramatic improvement of the Slotbuster, when users controlled speech, suggests that pause time between words is critical to intelligibility. [JDS]

Sullivan JA, Levitt H, Hwang J-Y, Hennessey A-M (Lexington Hearing and Speech Center, Jackson Heights, NY). An Experimental Comparison of Four Hearing Aid Prescription Methods. *Ear Hear* 9:22-32, 1988.

Using a digital master hearing aid, this study compared four methods of prescribing hearing aids: THRESH, SP-TH, SUPRA, and ADAPT. By themselves, the prescriptive methods did not yield significant results, but they did significantly interact with output level and subjects (with individual differences). The investigators speculate that ADAPT might prove superior when digital equipment becomes available. [JDS]

Terryberry E, Polk A (Red Acre Farm Hearing Dog Center, Box 278, Stow, MA 01775). Hearing Dogs: Another Alternative for the Hearing Impaired. *Hear J* 40(10):21-24, 1987.

Describes the functions of dogs trained to alert hearing-impaired persons to various auditory signals (alarm clocks, doorbells, etc.), and to provide companionship. Includes a directory of agencies that train dogs for these purposes. [JDS]

Trudeau MD, Crowe BJ (Ohio State University, Columbus, OH). Voice Disorders: Searching for Needles of Wisdom in a Haystack of Journals. *ASHA* 30(5):35-37, 1988.

Using Medline (a medically-oriented database), supplemented by direct searches of literature listed in *Index Medicus* and *dsh Abstracts* from 1980 through 1985, the authors identified 362 articles on voice disorders in 92 journals: 57 medical, 18 otolaryngology, 8 speech, and 9 other. *Laryngoscope* and *Folia Phonetica* each had 43 citations, the highest among sources. Diagnosis occupied 123 articles, treatment 110, diagnosis and treatment 46, and symptoms 83. By age of patient population, 53 articles concerned children, 158 adults, and 151 both children and adults. The authors criticize the lack of definitions and patient information in the literature they surveyed. [JDS]

Uslan MM, Russell L, Weiner C (American Foundation for the Blind, 15 West 16th Street, New York, NY 10011). A "Musical Pathway" for Spatially Disoriented Blind Residents of a Skilled Nursing Facility. *J Visual Impairm Blindn* 82:21-24, 1988.

The authors constructed and field-tested a system consisting of a compact-disc player, a computer that selects the musical signals, and groupings of speakers that form pathways between frequently-traveled points in a nursing home. Designed for use by one

person at a time, the system also includes a detection system that alerts the blind person when deviating from the pathway: a bank of infrared light-emitting diodes (LED) on the ceiling emit infrared light that is reflected back when the blind person (wearing a reflective tape) passes beneath a phototransistor also mounted on the ceiling. Additional features of the system include a hand-held volume control and a switchbox which the blind person must activate in order to use it. The music changes when the direction of the blind person changes. Results with 3 blind residents of the facility are discussed. The authors conclude that more study is needed; especially a market survey to determine the economic potential of the system. [JDS]

Watson BC, Alfonso PJ (University of Connecticut, Storrs). Physiological Bases of Acoustic LRT in Nonstutterers, Mild Stutterers and Severe Stutterers. *J Speech Hear Res* 30:434-447, 1987.

Laryngeal reaction time (LRT) of two normal speakers, 2 mild stutterers, and 2 severe stutterers was measured with and without fiberscope insertion. The LRT increased equally for all groups on an average of 26 ms when fiberscope inserted. Analysis

of a large number of measures led investigators to conclude: (a) acoustic data show LRT varies as a function of stuttering severity and foreperiod, which replicates their earlier findings, and (b) kinematic data indicate mild and severe stutterers both delay initiation of respiratory events, but (c) mild stutterers appropriately organize laryngeal and respiratory events while severe stutterers do not. The study supports multiple anatomical models of stuttering that can also account for degree of stuttering. [JDS]

Zimmerman G, Dalston RM, Brown C, Folkins JW, Linville RN, Seaver EJ (University of Iowa, Iowa City, IA). Comparison of Cineradiographic and Photodetection Techniques for Assessing Velopharyngeal Function During Speech. *J Speech Hear Res* 30:564-569, 1987.

Two normally speaking subject's velopharyngeal functions were observed, using an adaptation of Dalston's equipment and 100-frames-per-second cineradiographs. Correlations between the two measures ranged from 0.78 to 0.89. In an effort to account for the measurement discrepancies, the authors invoke two reasons: inherent differences in the procedures and measurement error. [JDS]