

ABSTRACTS OF RECENT LITERATURE

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

Acta Orthopaedica Scandinavica

American Journal of Occupational Therapy

Archives of Surgery

Clinical Prosthetics and Orthotics

Engineering in Medicine

Ergonomics

Hearing Journal

Hearing Rehabilitation Quarterly

Journal of Bone and Joint Surgery

Journal of Speech and Hearing Research

Journal of Visual Impairment and Blindness

Language, Speech and Hearing Services in Schools

Orthotics and Prosthetics

Paraplegia

Physiotherapy

Prosthetics and Orthotics International

Scandinavian Journal of Rehabilitation Medicine

PROSTHETICS, ORTHOTICS, AND RELATED TOPICS

Andersen JA, Klaborg KE (Department of Orthopedics, University Hospital, Odense, Denmark). Forefoot Amputation in Rheumatoid Arthritis. *Acta Orthop Scand* 58:394-397, 1987.

During a 20-year period, nine patients with rheumatoid arthritis had a total of fourteen transtatarsal amputations. They had severe preoperative pain when walking and painful callosities not amenable to padded insoles and orthopedic footwear. They also had severe hallux valgus, marked toe clawing, and forefoot ulcers.

Amputation was performed just proximal to the metatarsal heads using a long plantar flap. There was full foot use after 14 days and sutures were removed after 21 days when normal shoes were worn; the empty space was filled with insoles or cotton. The median hospitalization was 29 days.

All obtained primary healing and most achieved complete relief of pain at rest and when walking, as well as increased walking distance. Patients achieved an almost normal heel-toe gait. Several disliked the cosmetic result.

Forefoot arthroplasty has been demonstrated to provide pain relief initially; subsequently, many patients experience pain. In addition, the toes will have no function and deformity increases because arthroplasty weakens the lateral portion of the foot, increasing hallux valgus. Although arthroplasty seems to be the established treatment, no significant difference in long-term results between conservative treatment and arthroplasty has been demonstrated. Consequently, for those few patients for whom footwear modification proves inadequate, forefoot amputation should be considered as an alternative to resection arthroplasty. [JEE]

Beckman J (St. Vincent's Orthopaedic Hospital, Eastcote, Middlesex, England). The Louisiana State University Reciprocating Gait Orthosis. *Physiotherapy* 73:386-392, 1987.

The reciprocating gait orthosis is an aluminum and polypropylene thoracohip-knee-ankle-foot orthosis weighing 2.5 to 7 pounds. It is suitable for children and adults with paraplegia, muscular dystrophy, cerebral palsy, multiple sclerosis, and sacral agenesis. At St. Vincent's Hospital, four paraplegics have been fitted with the orthosis and a functional

electrical stimulation system and show lower oxygen use when walking. The orthosis consists of 5 mm polypropylene ankle-foot orthoses with carbon fiber inserts. Knees have bale locks and patella straps. Uprights are of titanium and aluminum. Polypropylene thigh pieces are secured with Velcro straps. Hip joints lock in the upright position, and can be unlocked for sitting and forward bending. Two Bowden cables connect the hip joints. The anterior cable controls bilateral extension at the hips; the posterior one controls flexion. Cables assist gait when the patient shifts weight onto the forward stance leg and extends the hip; this action transmits flexion to the contralateral side to swing it forward. A metal pelvic band or a molded pelvic girdle supports the trunk for those with high-level lesions. The trunk is supported by an anterior pad, side struts, and Velcro straps. Walking action is activated by the upper body and arms.

Contraindications include hip contracture, protruding abdomen, inability to tolerate rigorous exercise, poor motivation, and poor triceps strength. Children under 18 months of age are fitted first with a parapodium. Patients with Friedreich's ataxia, patients with multiple sclerosis (who use a wheelchair), and patients with hemiplegia are unsuccessful with the orthosis. The prefitting exercise program includes activities to strengthen the arms and increase hip flexibility. Medical evaluation aims to record the specific problems and arrange for clinical investigations, such as blood tests, and electrocardiograms; tendon releases may be needed. The physical therapy assessment includes planning the exercise program and a 2- to 3-month standing program. Training with the orthosis averages 2 to 4 weeks of intensive exercise. Some users can walk for several miles without fatigue. Close liaison between therapist and orthotist, as well as other team members is essential. [JEE]

Butler PB, Major R (The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Shropshire SY10 7AG, UK). The ParaWalker: A Rational Approach to the Provision of Reciprocal Ambulation for Paraplegic Patients. *Physiotherapy* 73:393-397, 1987.

The ParaWalker consists of a snug, rigid body brace to which are attached through special hip joints, steel uprights which stabilize the knees and

ankles with fixed ankle plates aligned in approximately 6 degrees dorsiflexion to aid standing stability and foot clearance during swing phase. Bale knee joints are locked during standing and walking, and the hip joints provide a limited range of flexion and extension, adjusted by altering stops in the joint. Footplates have a convex plantar contour. Crutches are needed to inject energy into the system and increase stability by means of a larger support area. Stance hip extension is achieved by pressing on the crutches and tilting the trunk toward the stance (flexed) hip and simultaneously extending the shoulder with latissimus dorsi action. The patient reacts against the orthosis to produce movement. Swing hip flexion is achieved simultaneously as the opposite hip extends. As soon as the swing leg clears the ground, gravity causes it to swing forward to the midline, then inertia continues the swing.

Donning is eased with toggle clamps at the foot and knee bands and a seat belt clip at the thoracic band. No anterior thigh band is required. Patients wear normal unadapted footwear; shoes may be interchanged if they have the same heel heights. Garments have been designed with reinforcement over the hips and knees and double-ended zippers for wear over the ParaWalker. Steel contributes to rigidity and support afforded by the ParaWalker; greater weight hampers performance of swing-through gait used for greater speed and stair ascent.

Prescription requires that the patient have latissimus dorsi function and good arm and shoulder use. The highest level commonly prescribed is T4. Hips must be mobile, with less than 15 degree contracture. Mild equinus or calcaneus can be compensated at the foot plate, as can leg length discrepancy. Scoliosis can be controlled with a rigid spinal orthosis. Patients should weigh less than 75 kg. Three weeks of training is sufficient. Energy costs are lower than those published by other researchers who have assessed paraplegics; self-selected walking speeds are faster, regardless of lesion level or length of use of the orthosis. Research is proceeding with functional electrical stimulation combined with the ParaWalker. [JEE]

Ellis M, Howe A (Rheumatism Research Unit, University of Leeds, Leeds, England). A Clinical Gait Analysis System. *Eng Med* 16:217-220, 1987.

A new gait analysis system uses electrogonio-

meters and heel and toe switches, with transducers monitored by a microcomputer using a portable telemetry system. Hip and knee motion are evaluated. Data are displayed in four sections, including demographic details; a graph of the gait pattern showing the temporal performance of both legs; Grieve diagrams for both legs, plotting hip angle against knee angle; and numerical values of various gait parameters, including average stride cycle time. Normally the system consumes about ten minutes from the time of applying transducers to the patient to the printing of results. The system is suitable for recording performance as the subject climbs stairs, as well as walks on level surfaces or runs. There are no trailing wires, special walkway, or gait analysis laboratory with cinematography, video systems or polarized light goniometric systems. It requires no special expertise to operate, but does not provide detailed biomechanical gait analysis.

Typical data for an osteoarthritic patient shows reduced heel and toe contact times for the affected limb, with reduced excursion of the hip and knee on that side. A rheumatoid patient shows almost simultaneous heel and toe contact times with reduced joint angles and erratic performance. Recording of a normal subject descending stairs shows that the toes contact before the heels, and the hip and knee angles are large. Data for an individual sitting and rising indicates that the subject leaned back at the hips once seated, then leaned forward when starting to rise. The diagram of a jogger shows occasional lack of foot contact and much greater hip and knee angles. [JEE]

Faso DR, Montgomery JB (3D Orthopedic Inc., Dallas TX 75220). The Dynamic Rotating Functional Knee Orthosis Concept. *Orthot Prosthet* 41:32-36, 1987.

The human knee is the largest, most complex, and most vulnerable joint. Motion occurs simultaneously in all planes, especially the sagittal plane. Knee orthoses are designed primarily to restrict motion. External hinges are simpler than the anatomic joint. Three types of orthotic joints are the fixed axis allowing a single axis of motion, the polycentric providing for the posterior femoral motion, and the "anatomical" systems which attempt to duplicate asymmetrical knee motion. Joints are combined with various cuff configurations. A mismatch be-

tween orthotic and anatomic knee motions restricts normal excursion and causes orthotic slippage and condylar separation.

In normal gait, the knee is extended with the tibia in external rotation at heel strike. Collateral ligaments inhibit excessive rotation. At foot flat, the knee flexes and rotates internally; collateral ligaments are lax while the cruciates tense. At midstance, the knee is in maximum internal rotation. At toe-off, the tibia externally rotates. The lateral femoral condyle moves two to three times more in the sagittal plane as compared with the medial condyle. The axis of rotation is medial to the medial tibial plateau. In the final 30 degrees of knee extension, the femur rotates internally, causing tibial external rotation. An orthosis must allow anatomic rotation to occur; the orthotic axis must be medial to the medial tibial plateau so that the lateral plateau can move in greater distance.

Most orthoses have rigid tibial and femoral components linked rigidly without any rotational mechanism. More flexible orthoses do not perform as well subjectively. Orthoses improve static stiffness at low loads, but at high static testing, they allow tibial subluxation. The major factor involved in successful orthotic care is maintenance of the proper tibia-femur relationship prior to loading the knee. The 3D orthosis dynamically produces an external rotation force that is greater as the knee extends, thus preventing tibial subluxation. [JEE]

Finsen V, Persen L, Lovlien M, et al. (Trondheim University Hospital, Trondheim, Norway). Transcutaneous Electrical Nerve Stimulation after Major Amputation. *J Bone Joint Surg* 70-B:109-112, 1988.

Fifty-one dysvascular patients with Syme's, below-knee, or through-knee amputation completed treatment with active transcutaneous electrical nerve stimulation only, sham stimulation only, or sham stimulation and chlorpromazine. Patients wore a plaster cast for the first 3 postoperative weeks. Low frequency stimulation was applied 30 minutes twice a day during the first 2 postoperative weeks. All patients were followed for at least a year or until reamputation or death. Reamputation rate was lower among diabetic than atherosclerotic patients; median time was 4 weeks. A third of the Syme's, and half of the knee disarticulations failed. Eighteen

percent of patients with below-knee amputation did not heal. After 6 and 9 weeks significantly, more healed among those who had active stimulation. The variations in analgesic consumption within each group were not statistically significant. During the first 4 weeks, approximately equal proportions of patients in each group complained of phantom pain. Sixteen weeks after operation, none of the stimulated patients complained, compared with more than a third of those receiving chlorpromazine and half having the placebo.

Stimulation had a definite effect on healing, and was associated with a smaller reamputation rate, probably due to the vasodilation resulting from stimulation. Neither stimulation nor chlorpromazine were superior to a placebo in reducing pain during the first 4 weeks after amputation. No long-term difference exists between stimulated and control groups; for those who did report phantom pain after a year, nearly all had very infrequent, mild pain, not requiring an analgesic. Stimulation produced a definite reduction in the prevalence of phantom pain in the middle term. [JEE]

Hale S, Wall JC (Department of Orthotics and Prosthetics, Royal Ottawa Regional Rehabilitation Centre, Ottawa, Ontario K1H 8M2, Canada). The Effects of Different Ankle-Foot Orthoses on the Kinematics of Hemiplegic Gait. *Orthot Prosthet* 41:40-49, 1987.

Many stroke patients exhibit dropfoot caused by calf spasticity and pretibial weakness. The most frequently prescribed orthoses for dropfoot are Klenzak, plastic shoehorn, and spring-wire ankle-foot orthoses (AFOs). They have similar biomechanical functions. Effect is usually assessed by subjective gait analysis which must be regarded as unreliable and does not detect subtle changes, nor allow for accurate comparison. Objective measurement of time and distance, such as stride time and step length, is useful in assessment of hemiplegic gait. Most studies that have compared various AFOs were performed with able-bodied subjects.

Seven hemiparetic subjects participated in the current study. All had had a stroke 18 months or more prior to the study, no contractures, gastrocnemius hypertonicity, and no aphasia or apraxia. Each had previously been prescribed a Klenzak, plastic shoehorn, or spring-wire AFO.

Subjects wore a footswitch and telemetry system as they walked 10 meters. Time and distance were recorded. Subjects walked at self-selected speed with and without the orthosis, whenever possible. All walked less than half the speed of able-bodied individuals. Only one subject showed a marked increase in speed with the orthosis. The most noticeable features are patient-to-patient variability and gait asymmetry. The orthosis eliminated toe scuffing during swing phase. Three subjects improved walking speed and single support time with the orthosis.

When the AFO was prescribed, the need may have been greater, but with improved motor recovery and constant use of the orthosis, the habituated gait pattern may have been maintained during the time the subject was tested without the orthosis. Fatigue and uneven terrain may increase the risk of tripping. [JEE]

Johansen PB, Breitholtz M, Cavrini R, et al. (Department of Rehabilitation Medicine, University Hospital Linköping, Sweden) Prosthetic Rehabilitation in Bilateral High Above Elbow Amputation. *Scand J Rehab Med* 19:85-87, 1986.

A 25-year-old man sustained electrical burns necessitating bilateral above-elbow amputation immediately; limbs were both 8 cm from the acromions. He was admitted to rehabilitation 6 months after injury. A pair of myoelectric prostheses manufactured in Bologna, Italy, were prescribed. The patient produced myoelectric signals from the upper trapezius, lateral deltoid, proximal biceps, and proximal triceps. After two weeks he could activate electrodes selectively. A single signal controlled two functions, such as hand opening and supination; control was possible because posterior straps were connected to switch controls. With the prostheses, the patient had 4 months of additional training conducted in the occupational therapy department and at home. Training began with single prosthetic functions and progressed to increasingly complex movement patterns. The patient now works at the state railways, having administrative responsibilities. He uses technical aids at home and at the office. He wears the prostheses more than 8 hours daily, principally at work. He liked eating with a knife and fork, and stated that the prostheses were comfortable. He was judged to perform at a Katz

Activities of Daily Living (ADL) Index of grade C. A pair of extra prostheses is now being fabricated.

More sophisticated approaches, such as electronic pattern recognition and adaptive grip might have been attempted, but these may not have met with patient acceptance, especially if skillful socket fabrication, comprehensive training, and an adequate service organization were lacking. Prosthetic acceptance is directly proportional to the increase in efficiency afforded the patient by the device. This fitting is a clinically advanced combination of conventional techniques. The most critical parts were signal training, socket fabrication, and training in daily activities. Development of comprehensive teamwork at specialized centers is important for a positive result. [JEE]

Jones RF, Snowdon E, Coan J, et al. (Spinal Injury Unit and Department of Rehabilitation, The Prince Henry Hospital, University of New South Wales, Sydney, Australia). Bracing of Thoracic and Lumbar Spine Fractures. *Paraplegia* 25:386-393, 1987.

Thirty-three consecutive patients with thoracic or lumbar fractures were treated with nonoperative fracture reduction and second hourly skin pressure relief by lifting, log-rolling, or turning with an Egerton Stoke-Mandeville bed, for 6 to 8 weeks. Patients performed isometric back exercises daily on their back. Fluoroscopic evidence of stability preceded fitting of a brace used for 16 weeks. Radiographic evidence of stability in flexion and extension without the brace permitted discarding the brace. A 6-month radiographic follow-up was also performed. The regimen was used for patients with and without neuropathy. Fractures were categorized as: 1) those with less than one-third vertebral compression and minimal displacement; 2) those with greater than one-third compression and more than 1 cm of anteroposterior displacement; and, 3) those with severe disruption of the vertebral body and posterior element damage, and gross displacement. Patients who showed neurological deterioration in an incomplete cord lesion or who had insufficient recovery from a cauda equina lesion had decompressive laminectomy. Any lacerated nerve roots were sutured.

Braces were originally made of Litecast, Hexalite, as well as the Taylor design and Plastzote-lined

polythene; however, fitting problems caused the elimination of the first two types. Polythene was restricted to patients with fractures at T4-5 or lower. Taylor braces were used without groin straps to minimize pressure necrosis in patients with neuropathy; patients changed to a waterproof brace for showering. Polythene braces took 3 hours to make and required 45 minutes of fitting by two people. Taylor braces required 15 minutes for measurement and 20 minutes for fitting by two people. Fourteen patients having the polythene braces showed 11 with excellent results and 3 with good results. Fifteen patients wearing Taylor braces recorded 7 with excellent results and 5 with good results, and complained less about restriction of movement and discomfort in the summer, but did not like the shoulder strap pressure. [JEE]

Koganezawa K, Fujimoto H, Kato I (Department of Mechanical Engineering, Iwaki Meisei University, Fukushima 970, Japan). Multifunctional Above-Knee Prosthesis for Stairs' Walking. *Prosthet Orthot Int.* 11:139-145, 1987.

A new hydraulic mechanism was assembled in the Waseda Leg Prosthesis-7 Refined. The mechanism allows gradual change from free swing to locking to intermediate rigidity which is necessary for gradual yielding during stair descent. The knee joint yields gradually while sustaining full body weight. Patients can ascend and descend without external power. The prosthesis has a knee joint cylinder hydraulically connected to the ankle joint. Structural material of the prosthesis is carbon fiber reinforced plastic and duralumin. The prosthesis weighs 2.4 kg below the knee joint, approximately the same as a conventional prosthesis. During level walking, ankle dorsiflexion hydraulically pushes a knee piston upward to prevent yielding of the knee. After dorsiflexion is terminated at the end of stance, the knee flexes gradually for smooth transition from stance to swing. Then the knee flexes and the knee piston lowers. The ankle piston rises, causing the knee to extend, ready for the next heel contact.

On stair descent, the ankle and knee mutually counterbalance, so that gradual yielding under full loading may occur. Automatic stability is mechanically provided by hydraulic interaction. Excessive knee flexion plantarflexes the ankle; the plantarflexion moment works to extend the knee, in

combination with hip extension activity, to prevent excessive knee flexion. After the sole lifts, the ankle plantarflexes by spring force, leading to knee flexion, so the foot can step over the edge of the stair. The knee extends actively thereafter. A young adult amputee walked on level surfaces and up and down stairs by reciprocal stepping with the prosthesis. Rate of knee-yielding during stair descent was regulated by a needle valve and a spring in the unit. On ascent, the needle valve was almost closed. Reciprocal ascent was achieved by mutual counterbalance between knee flexion and ankle dorsiflexion which almost prevented knee flexion during dorsiflexion. Further refinement and testing are planned so that the design may be introduced for practical use. [JEE]

Lamb DW, Dick TD, Douglas WB (Princess Margaret Rose Orthopaedic Hospital, Edinburgh, Scotland). A New Prosthesis for the Upper Limb. *J Bone Joint Surg* 70-B:140-144, 1988.

A body-powered above-elbow prosthesis includes a polypropylene adjustable socket. The socket was bivalved and secured with a Velcro strap which the amputee could tighten. The socket pivoted distally. The fifteen adults fitted with the prosthesis all found they perspired less. Endoskeletal construction with an aluminum tube covered by semi-rigid polyurethane foam enabled concealing the terminal device control cable in the tube. The polycentric elbow permits 180 degrees flexion and has a mechanism allowing for locking in seven positions by means of manual pull on the cable, cable-operated control from movement of the opposite shoulder, or by myoelectric control. The prosthesis passed mechanical testing including static loading of the elbow, tensile loading of the wrist adaptor plate and cyclic testing of the elbow. A new hand departs from the usual three-point pinch grip, which is difficult to use with small objects because of the awkward approach angle. The new hand has side pinch, allowing unobstructed approach; the index and long fingers move together around an axis corresponding to the index metacarpophalangeal joint. The thumb moves about an axis midway between the carpometacarpal and metacarpophalangeal joints. The hand is covered with a silicone rubber glove. Final tinting is done by spray-painting the interior. Reduction in operating

cable friction was achieved with the use of pulleys whenever the cable had to change direction and use of a centrally-operated push rod to eliminate need for an external cable and improve appearance.

All patients reacted positively to the prosthesis six months after fitting. They were scored on a 16-item bimanual activity test with regard to appearance and timing; nearly all scores were good or fair. Twelve subjects wore the prosthesis more than 4 hours daily; others wore it for social occasions. Few used the socket adjustment. Patients and their relatives stated that the hand looked better than the previously worn polyvinylchloride glove. Patients attempted tasks they had previously thought impossible. [JEE]

Lawton RL, DePinto V (Department of Surgery, University of Iowa College of Medicine, and Veterans Administration Medical Center, Des Moines, IA 50310). Bilateral Hip Disarticulation in Paraplegics with Decubitus Ulcers. *Arch Surg* 122:1040-1042, 1987.

The first hip disarticulation was recorded in 1806, probably for osteomyelitis. During World War II, disarticulation was performed to rehabilitate paraplegics. This is the authors' report of their experience with three paraplegics. The nonanatomic operation is valuable to patients with decubitus ulcers, osteomyelitis, extensive involvement of the skin of the buttocks and thigh, and hip flexion contracture.

The anatomic operation is used with patients without sepsis; it involves disconnection of the thigh through tendinous and fascial structures with minimal bleeding. The nonanatomic approach is used when tissues are fused by infection. The part is filleted, removed in close proximity to bone. The techniques may be combined. Three types of incisions are the racquet, leading to vertical closure; posterior flap, producing a horizontal anterior scar; and a large anterior musculocutaneous flap. Surgical management of musculature, vessels, tendons, and ligaments are detailed.

The three patients were rehabilitated to the wheelchair; two have colostomies. Advantages of disarticulation include ease in transferring from bed to wheelchair with the use of an overhead bar; independent travel in the wheelchair; ability to maneuver with a wheeled platform, using the arms as motors; patients can negotiate stairs with a

handrail; option of rolling and ambulating by swinging the torso with the arms extended and the hands on the floor. Disadvantages of the procedure include the body image, although prosthetic legs can be appended to the wheelchair; and vertical instability, which can be reduced by fitting the patient with a sheath slipped over the pelvis and strapped over the abdomen. [JEE]

McFarland SR (National Rehabilitation Hospital, Washington, DC 20010). Mobility and Mobility Devices for the Spinal Cord Injured Person. *Clin Prosthet Orthot* 11:215-224, 1987.

The only successful technical solution to a mobility problem is one which integrates well with other rehabilitation interventions and withstands the test of time and use by the patient. Simplicity, cosmetic design, and reliability are essential to acceptance. The spinal cord injured patient must cope with impaired voluntary control of skeletal muscle; altered bowel, bladder, and sexual function; sweating; diminished bone strength; peripheral vascular disorder; muscle spasm; and sensory deficit which can lead to ulceration.

Transfer from reclining to sitting can be aided with an overhead handle, or a powered bed. Standing transfer is preferable to support by an attendant or device. If standing is impossible, a transfer board or fabric hammock used with an electrical or hydraulic jack may be used. Overhead track systems aid bathroom and car transfer. Passive and powered bath seats are available. The vertical shaft elevator or the less expensive stairway elevator or ramps aid travel between levels. Static standing aids bind the patient to a rigid upright structure. A mobile stander uses a power source to raise the person to standing. It is available in several forms of wheeled mobility. A very few adults use the swivel walker. Torso and leg braces, sometimes augmented by electrical muscle stimulation, aid standing and walking; temporary standing is useful to get through narrow entryways, such as toilet compartments. Torso stabilization is imperative for use of upper limb devices. Wheeled mobility should be provided by a prescription (not a commodity) wheelchair, with or without electric drive. Powered carts aid those who are limited in range and speed of ambulation. Adapted motor vehicles must be accessible; doorway size and shape can be controlled in a

personal vehicle. Access to mass transit has been developed for modern systems or by use of special buses. Mobility aids must be stowed in the vehicle, if the user transfers to the automobile or van seat. The passenger must be secured. Vehicle control may be achieved with hand controls of various designs. [JEE]

McGill SM, Norman RW (Department of Kinesiology, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada). Reassessment of the Role of Intra-Abdominal Pressure in Spinal Compression. *Ergonomics* 30:1565-1588, 1987.

Two biomechanical models were formulated to test the effects of intra-abdominal pressure (IAP) on low back loading. The first model was a dynamic-linked segment representation of the pelvis, thorax-abdomen, head-neck, upper arms, forearms, and hands to calculate a reaction moment about the L4-5 intervertebral disk. The second model partitioned the moment into muscular, discal, and ligamentous components used to calculate compression and shear forces at this level.

The latter model was obtained by using the force on the hands and the reaction forces and moments up the arm linkage and down the trunk. The vertebral unit model incorporated 48 muscles, 7 ligaments and a three-dimensional pelvis, rib cage, and 5 lumbar vertebrae scaled to a median North American male. Muscle geometry was derived from study of multiple tomographic scans of young working males of mean age 40.5 years, mean height of 173.8 cm and mean weight of 89.2 kg. Electromyograms were recorded from subjects to drive the model musculature coupled with cinefilm records of body kinematics. Although muscle force estimates were not validated from direct measurement, the sum of modeled muscle moments was scaled to match the reaction L4-5 moment. Thus phasic information and muscular cocontractions were monitored. Muscle force estimates were applied to the three-dimensional skeleton. A geometric model for each muscle incorporated the curving lines of pull of the abdominal obliques. Compression and shear components of each abdominal muscle were calculated. Intra-abdominal pressure (IAP) was estimated using a modification of Chaffin's equation. Three fit young men were examined lifting a heavy load with low acceleration

and a light load with high acceleration. During the heavy extension phase of the lift, abdominals showed low activity, with slight increase at the end of the lift as the subject cocontracted the trunk muscles to stabilize the trunk. Flexor moment generated by abdominals contributed no more than 5 percent to assist back extensors. The theory of IAP as a significant mechanism in disk loading has been greatly overemphasized. IAP may create a pressurized cavity with hydrostatic pressure to maintain the hoop-like geometry of the abdominals. IAP may act as a spinal stabilizer to hold the spine rigid against buckling, and may provide physiological benefits referable to circulation. [JEE]

McHugh B, Campbell J (University of Strathclyde, Glasgow G3 ONW, Scotland). Below-Knee Orthoses. *Physiotherapy* 73:380-385, 1987.

The below-knee orthosis controls the ankle joint and usually consists of two uprights connected proximally to a calf band and distally to a mechanical ankle joint. Most orthoses are attached to strong shoes with a stirrup or caliper. The stirrup may be employed with any ankle joint and allows accurate correspondence with the anatomical ankle. The caliper provides minimal weight, economy, and easy fitting and adjustment, but displaces the mechanical ankle joint. Single-axis ankles may assist, limit, or stop motion. Valgus or varus correction straps control frontal plane deviation. Thermoplastics, such as polyethylene, polypropylene, and acrylic, can be easily shaped with heat. Plastic orthoses generally do not have mechanical ankle joints. Simulated ankle motion can be achieved by flexing the orthosis. Trimline position determines the flexibility of the orthosis.

Prescription criteria are derived from systematic physical examination and gait observation of the patient, as well as consideration of appearance, ease of use, and ease of manufacture. Success depends on whether the expected outcome has been achieved with optimum comfort, mobility, appearance, and patient acceptance. For dorsiflexor insufficiency with good to fair mediolateral stability and no spasticity, the biomechanical requirements are dorsiflexion assistance in swing phase and resistance to plantarflexion in early stance. A conventional ankle-foot orthosis with a tension spring anterior or compression spring posterior, or a plastic posterior

leaf-spring orthosis will suffice. Most patients prefer the latter. A solid plantarflexion stop at 90 degrees is not indicated. For plantarflexor insufficiency, the orthosis should prevent passive dorsiflexion and induce active plantarflexion. A plastic orthosis should have an anterior trimline or a conventional orthosis with an anterior stop at the ankle. Patients with plantar and dorsiflexor insufficiency require a dorsiflexion stop and a plantar flexion resistance spring. Orthotic management of ankle joint deformities and weight relief are presented. The ankle-foot orthosis may have desirable or undesirable effects on knee function. [JEE]

Messenger N, Bowker P (Department of Orthopaedic Mechanics, University of Salford, England). The Role of Gait Analysis in Clinical Medicine: A Survey of UK Centres. *Eng Med* 16:221-227, 1987.

Thirty-five centers with substantial facilities for the study of gait were sent a questionnaire inquiring about equipment, research projects, clinical service commitments, and the opinions of the staff regarding gait analysis. The survey was designed to resolve the contradiction between the claims for the clinical value of quantitative gait analysis and the doubts expressed by some clinicians that specific measurement techniques are not needed for assessment of pathological gait. Twenty-five centers responded, but nine were eliminated from the data analysis because these centers had not yet begun to use their equipment or were no longer performing gait analysis. Of the remaining 16 centers, 12 had both kinetic and kinematic data collection equipment. Only 8 had electromyographic instruments, and 7 had energy-physiology cost devices; 7 centers had neither appliance. The force platform was the most popular means of obtaining kinetic data, closely followed by the pedobarograph; many centers had several types of kinetic data systems. Other devices were a Romberg balance plate, load cell matrix, pressure sensitive film, and limb segment accelerometers. Video techniques were the most common kinematic approach; opto-electronic and cine devices were used in four centers. Temporal/distance data was obtained by an instrumented walkway, measurement of footprints, or further analysis of kinematic data obtained by previously-mentioned means. Energy cost was usually obtained with the heart-rate method

rather than oxygen uptake or modeling techniques. Centers were divided regarding clinical service, many noting that the procedure was too time-consuming and the general clinician did not understand the techniques. Many centers are investigating visual means of presenting data to facilitate interpretation and clinical value. Only a third of centers saw 5 or more clinical referrals per month. Many respondents commented on the need for biomechanical education of prospective clients. [JEE]

Nene AV, Major RE (Orthotic Research and Locomotor Assessment Unit, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Shropshire SY10 7AG, UK) Dynamics of Reciprocal Gait of Adult Paraplegics Using the ParaWalker (Hip Guidance Orthosis) *Prosthet Orthot Int* 11:124-127, 1987.

Nine adult traumatic paraplegic young adults with lesions between T4 and T9. All were experienced users of the ParaWalker, aided by elbow crutches. Each walked in a gait laboratory equipped with two orthogonally-placed video cameras and a 6-channel force platform. Because a single force platform is designed to record data from only one contact point, the investigators considered a complete picture to have been obtained with a minimum of 4 walks to record both legs and both crutches. At right heel strike, the left foot force begins to decline to approximately 0.9 body weight, and left crutch-load is minimal, as is the right crutch force. At right crutch strike, load on the right leg peaks at about 0.86 body weight and both crutches increase load to 0.35 body weight to get the left foot off the ground. At left early swing and lateral tilt to the right, vertical load on the crutches peaks, while the right foot force is at the lowest point, 0.35 body weight. During later swing, the crutches unload and the right foot force increases. Finally, at left heel strike, right foot force declines, right crutch force is at a minimum, and left crutch force also rapidly decreases. During most of the stance period, the horizontal force is posterior, while crutch force begins anteriorly, then changes to a posterior direction to produce forward propulsion. Crutches always show laterally-directed force. Unlike juvenile users of the ParaWalker, adults are less confident, and experience pain in the hands. This may be

because the adult orthosis is subject to more bending deformation, especially at the hip joint, which can lead to loss of extrinsic stability. Large forces applied through the crutches overcomes the problem, although alternative compensations for lack of rigidity may eventuate in a hybrid mechanical and electrical stimulation system. [JEE]

Rosen WR, McColey JJ, Bowker JH (University of Miami/Jackson Memorial Rehabilitation Center, Miami, FL 33136). The Team Approach to Orthotic Management in Quadriplegia. *Clin Prosthet Orthot* 11:201-209, 1987.

Prompt management of the upper limbs avoids joint stiffness. The approach involves frequent joint range of motion, positioning with and without devices, temporary and permanent dynamic orthoses, and externally powered orthoses. Patients are initially placed on Roto-Rest bends which have a positive effect on respiratory, renal, and circulatory systems by their continuous side-to-side motion, but jeopardize glenohumeral and scapular mobility. Shoulders are positioned in abduction and external rotation to reduce pain and stiffness. The elbow is extended and the forearm pronated and may be held with thermoplastic splints, bivalved casts, or serial casting. Functional hand position is maintained with a resting hand splint or a functional long opponens splint with C-bar and lumbrical bar. Once the patient is medically stable, he can use functional orthoses. Success depends on early experiences of sitting, trunk balancing, and functional arm placement. The patient may be provided with adaptive devices for specific functions, such as feeding or oral-facial hygiene. He should also have multipurpose temporary functional orthoses to prepare for future acceptance of definitive ones. Therapists should fabricate a training orthosis. The patient should reside close to a facility that can adjust the orthosis and is accessible to transportation. Funds must be allocated for the initial cost, maintenance, and replacement of the orthosis. Function has to exceed the perceived inconvenience of the orthosis which must be easy to don. The dominant hand should be fitted initially. Vocation and avocational needs determine materials and design. Psychological intervention is necessary to assist the patient through denial, anger, and depression to adaptation. Team members may need help in dealing with their value

systems regarding quality of life. Therapists and orthotists, in particular, must exude confidence when dealing with upper limb orthoses. Clear instructions should be given to the patient and family. Most upper limb orthoses are fabricated in an institutional setting. Candidates for wrist-driven prehension orthoses are initially fitted with a temporary version; the definite Engen orthosis is preferred and can be used for self-catheterization. Two-thirds of externally powered orthoses have not been used long-term because patients prefer adaptive aids. A training version needs to be developed. [JEE]

Samuelson B, Wangenheim M, Wos H (Department of Clinical Physiology, Uppsala University, S-751 85 Uppsala, Sweden). A Device for Three-Dimensional Registration of Human Movement *Ergonomics* 30:1655-1670, 1987.

A special garment in the form of overalls made of elastic polyester fabric was equipped with 43 light-emitting diodes of the 7 type. Wiring was run through channels on the surface of the garment, so the outside was smooth and the subject was not disturbed by loose wires. Elastic bands attached diodes to the head, hands, and feet. Two Selspot II cameras were used with a general purpose motion analysis software and with software, Robot Check, developed for control measuring of robot kinematics (the latter is more accurate when measuring postures). A third software is being developed to yield faster calculations.

Cameras placed at fixed points observed the diodes. Cameras had two-dimensional electronic linear position sensors to determine the position of the diodes. Automatic calibration was achieved by using a frame fitted with at least four diodes at fixed distances. Because cameras could only measure one point at a time, diodes were lit in 100 ms sequence. Software provided data collection, processing, and reporting. Accuracy was better than 0.1 percent of measured volume under optimal conditions. The system worked satisfactorily, and all equipment could be transported in an ordinary car. One day of supervised practice was needed to make full use of the programs and device. Very rapid sequences could be recorded; processing time amounted to 5 times the recording time. Experiments with a pendulum determined that the system could follow movement even if partially obstructed, and demonstrated

the reliability of the system. It was possible to follow rotating movement. Speed and acceleration can be obtained with the system. Geometric error, which can be compensated for by optimizing camera arrangement, is a limitation; better software will also reduce error. Reflections are another problem which may be lessened with the use of infra-red light or material. [JEE]

Stallard J (The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, Shropshire SY10 7AG, UK). Assessment of the Mechanical Function of Orthoses by Force Vector Visualisation. *Physiotherapy* 73:398-402, 1987.

The Dicon ORLAU vector generator was developed to display the effects of ground reaction forces in a clinical context. In contrast, force platforms are too expensive for every physical therapy department, even though the platforms measure the rapid fluctuations in magnitude and direction of the ground reaction force as the center of body continuously oscillates in all 3 planes during walking. The separate components of force, as conventionally presented from force platform instrumentation, do not provide information of great clinical significance. The effects of ground reaction force relative to each joint should be shown immediately, as by combining data in a single plane to provide a vector superimposed on the visual image of the patient in that plane. The Dicon generator combines outputs from force platform instrumentation with positional information, computes the vector magnitude and position, and presents a real-time vector display in either the sagittal or coronal plane.

The line of ground reaction force passes closely to the centers of the knee and hip during normal walking, minimizing the turning effect, thus muscle action. Except for the initial and final stages of stance, the vector is in almost perfect alignment with the hip and knee joints. In the coronal plane, the vector passes just lateral to the medial condyle of the knee. The generator is used to assess patients for whom surgery or bracing is considered. Cases have been seen in which stresses acting on a joint differed from those predicted by visual inspection, suggesting that surgery would be inappropriate. The generator enables the definition of orthotic problems to be more precise, including the magnitude of stabilizing forces needed. Adjustment of a plastic ankle foot

orthosis for children with cerebral palsy is aided by noting when the vector aligns closer to the hips and knees at midstance by the addition of suitable shoe modifications. Knee-ankle-foot and knee orthoses can also be assessed, showing whether required control is to be achieved. Patients with problems difficult to analyze locally may be referred to centers equipped with the generator. [JEE]

Taylor SJ (Rehabilitation Engineering Program, University of Tennessee, College of Medicine, Memphis, TN 38163). Evaluating the Client with Physical Disabilities for Wheelchair Seating. *Am J Occup Ther* 41:711-716, 1987.

Proper positioning, usually seated, is a prerequisite for functional use of most technical aids. The combination of seating with technical aids forms a system. A neuromotor summary includes evaluation of tone and postural reflexes. The orthopedic summary involves determining which deformities are correctable and which must be accommodated. Sensation status includes areas of impaired sensation, especially over the ischial tuberosities, as well as how long the client sits during the day. Independence in daily activities is evaluated so that seating will not hinder the client, for example, in transfers. The education and work history provides an indication of any need for special trays for communication or for a need to access a computer; the type of school or college van influences the type of wheeled base on the seating system; work space height must be considered in relation to wheelchair height. Psychosocial evaluation includes the extent of complexity the client is likely to tolerate as well as cosmetic considerations.

Positioning goals are established, beginning with pelvic support. The general goals of seating are to minimize the effects of abnormal tone, accommodate, delay, or prevent deformities, increase functional skills, accommodate for impaired sensation, and provide comfort. The pelvis should be held in midline and may be held with a lap belt. Hips should be in neutral rotation and flexed 90 degrees. Knees and ankles should also be flexed 90 degrees, except for those with knee flexion tightness, in which case less flexion allows the client a more neutral pelvic position. Adduction contracture of one hip and abduction of the opposite hip are accommodated so that the trunk and head face

forward. Those with bilateral hip adduction may need a pommel placed distally. Foot position can be maintained with straps or orthoses. Trunk support may be required. Shoulder and head position may be aided by slightly reclining the chair. A seating simulator assists in determining the most functional position. Devices are then matched to the client's need, depending on the extent of involvement. [JEE]

Wytch R, Mitchell CB, Wardlaw D, et al. (Department of Bio-Medical Physics and Bio-Engineering, University of Aberdeen, Aberdeen AB9 2 ZD, Scotland). Mechanical Assessment of Polyurethane Impregnated Fibreglass Bandages for Splinting. *Prosthet Orthot Int* 11:128-134, 1987.

Composite materials improve the strength-to-weight ratio and design flexibility. Continuous filament fiberglass fabric strength and flexibility depends on fiber diameter and knit pattern. Urethane pre-polymer resin contributes to strength. Bandages are activated by water immersion and wrapped similar to a plaster bandage. Fiberglass bandages are stronger, lighter, have better X-ray transmission, cleaner application, and faster curing than plaster. They are more expensive and do not store well, nor do they rival the molding properties of plaster. Eight mechanical tests were performed on five fiberglass bandages and plaster. An Instron 1195 materials testing frame was used for all tests, except the wear tests. Samples were made of 100mm (4 in.) bandage. Bandage tension was controlled with a purpose-built test jig. All tests were conducted on a minimum of 6 samples of each material. On cylinder compression testing, plaster cylinders were insufficiently rigid to maintain their shape after 60 minutes of testing. Fiberglass reached a third of their final strength within 30 minutes and 90 percent of strength in 24 hours. After 72 hours, they were more than 3 times stronger than plaster. Zimcast was the strongest. All materials reduced strength after water immersion, but recovered after 24 hours. Delta-lite was least affected, Scotchcast 2 the most. All materials built strength sufficiently to allow weight-bearing within 30 minutes. Working time ranged between 2.92 and 3.83 minutes. All fiberglass bandages reached satisfactory lamination strength within 11 minutes, especially Scotchcast 2 which reached strength of 200N.

The elastic modulus in flexure and the flexural stress at maximum load were obtained from a three-point bending test. Fiberglass is stiffer in the transverse direction, plaster was stiffer longitudinally. Fiberglass fractured at stresses up to 5 times greater than plaster in the longitudinal direction, and up to 20 times greater in the transverse direction. Duraset-lite was strongest transversely and Zimcast longitudinally. All were more wear-resistant than plaster, especially Delta-lite which was more than twice as hard wearing. [JEE]

Yaramenko DA, Sytenko AN, Bazhina EN, et al. (Ukrainian Research Institute of Prosthetics, Kharkov, USSR). Prosthetic Sockets of Polymerized Metal: Materials, Design, Technology. *Prosthet Orthot Int* 11:135-136, 1987.

Sockets are the most important element of lower-limb prostheses. Physiologically and biomechanically acceptable conditions for amputation limb environment and function are ensured by accurate fitting and making use of the flexible, thermal, and hygienic properties of materials. Technological feasibility determines the fitting accuracy, cost, complexity of maintaining equipment, and personnel skill and time. Homogenous materials, such as wood, leather, plastic, and metal alloys do not meet the complexity of current requirements. Composite systems, consisting mainly of polymers, have drawbacks in continuous manufacturing time and loss of material strength as a result of aging.

The new approach involves an aluminum alloy former in the basic socket design, which is shaped individually and then coated with polymeric composite. The receptacle socket is fabricated by pulse stamping of metal blanks over a matrix. Coating is done with vibro-vortex spraying. The below-knee amputation limb is covered with socks to provide for the required thickness of the metal blank and the coating. The covered limb is then casted with plaster. The negative mold is placed in a steel box and the space between the mold and box filled with a solution of plaster or wax. A cylindrical or conical blank is placed in the cavity of the matrix, which is then filled with water. The blank is stamped with a special pulse-stamping device which operates by means of explosion of propane or butane and oxygen. This produces hydraulic flow which provides slow deformation of the metal by metal

expansion and drawing off the excess into the area of plastic deformation, thus avoiding breakage and thinning. Overall stamping time does not exceed 6 minutes. The socket is trimmed, and fitted to the patient. Any corrections are easily done by shaping the aluminum. A 0.8 to 6.5 mm polyethylene coating is sprayed onto the metal. Coating can be burnt off to enable adjustment of the socket following limb shrinkage. Forming frames for above-knee sockets are in 20 standard sizes of aluminum blanks, and technology is being developed for stamping sockets individually. Since 1978, more than 500 patients have been supplied successfully. The below-knee socket weighs 250 g, the above-knee 400 g. [JEE]

SENSORY AIDS/REHABILITATION

Hoit JD, Hixon TJ (University of Arizona, Tempe, AZ). Age and Speech Breathing. *J Speech Hear Res* 30:351-366, 1987.

An extensive battery of respiratory measurements were made of 10 healthy males in each age group of 25, 50, and 75 years. Among respiratory differences found, vital capacity and residual lung volume altered most with age. Speech breathing generally changed with age, showing differences, for example, in lung-volume excursion, syllables per breath, and lung volume per syllable. Results are discussed in terms of the underlying mechanisms and their implications for the evaluation and management of patients with breathing disorders. [JDS]

Hoover J, Reichle J, Van Tassell D, Cole D (Cerebral Palsy, Inc., Green Bay, WI). The Intelligibility of Synthesized Speech: ECHO II versus VOTRAX. *J Speech Hear Res* 30:425-431, 1987.

Speech samples generated by ECHO II, VOTRAX, and a male speaker were presented to 16 females and 16 males with normal hearing. The stimulus material consisted of 27 CVC words singly and at the end of low-probability and high-probability sentences. Probability that the final word could be guessed was empirically determined. Results showed natural speech was greatly more intelligible than either synthetic, and VOTRAX was

significantly more intelligible than ECHO in both sentence conditions. Only ECHO showed a positive practice effect and only in the high-probability condition. Researchers urge that results not be generalized to other commercially available speech synthesizers. [JDS]

Humes LE, Boney S, Loven F (Indiana University, Bloomington, IN). Further Validation of the Speech Transmission Index (STI). *J Speech Hear Res* 30:403-410, 1987.

Modified Speech-Transmission Indexes (MSTI) for seven normal-hearing subjects under a variety of conditions—background noise levels, speech levels, reverberations times, and filter passbands—were monotonically related to scores on the Nonsense Syllables Test (NST). A version of STI in a sound field similarly was monotonically related to speech-recognition scores. [JDS]

Keller E (Université du Québec a Montréal, Centre Hospitalier Cote-des-Neiges, Canada). Factors Underlying Tongue Articulation in Speech. *J Speech Hear Res* 30:223-229, 1987.

Based on the factor analysis of 11 measures of tongue activity in producing /ka/, 3 factors were found that account for three-fourths of the variance: (a) displacement and velocity; (b) durational measures; and, (c) midsyllable durational and distance measures. Theoretical implications of these findings are discussed. [JDS]

Kempler D, Curtiss S, Jackson C (University of California at Los Angeles). Syntactic Preservation in Alzheimer's Disease. *J Speech Hear Res* 30:343-350, 1987.

Analysis of 20 Alzheimer's disease patients' spontaneous speech and writing revealed syntactic ability significantly more intact than semantic. Investigators relate these results to a modular theory of grammar in neurolinguistics. [JDS]

Kimelman MDZ, McNeil MR (Louisiana State University Medical Center, New Orleans, LA). An Investigation of Emphatic Stress Comprehension in Adult Aphasia: A Replication. *J Speech Hear Res* 30:295-300, 1987.

Nine aphasic males and five controls answered questions after listening to paragraphs differentiated as to presence or absence of emphatic stress. Aphasics answered correctly significantly more frequently to material presented with emphatic stress. While the contribution of emphatic stress to aphasic's comprehension is positive, it is practically small. [JDS]

Ludlow CL, Connor NP (National Institute of Neurological and Communicative Disorders and Stroke, Bethesda, MD). Dynamic Aspects of Phonatory Control in Spasmodic Dysphonia. *J Speech Hear Res* 30:197-206, 1987.

Nine patients with spasmodic dysphonia were compared to 15 normal controls on tasks with different degrees of laryngeal motor control. Significant differences were found only for phonatory offtimes and for elapsed time between onset of laryngeal movement and phonatory onset. While patients had no difficulties with onset of laryngeal movements, they were slow to achieve phonation, suggesting their disorder involves motor control of vocal-fold adduction. [JDS]

McClellan MD, Beukelman DR, Yorkston KM (University of Toronto, Toronto, Canada). Speech-Muscle Visuomotor Tracking in Dysarthric and Nonimpaired Speakers. *J Speech Hear Res* 30:276-282, 1987.

The performances of 6 dysarthric and 10 nonimpaired adults were compared on their ability to visually track a 0.6 Hz sinusoidal target using four muscle groups: lower lip, jaw, and laryngeal and respiratory speech-muscle systems. Dysarthric patients varied widely in their performances, while controls showed consistently high cross-correlations with minimal phase shift. Authors conclude the approach is useful for clinical evaluation. [JDS]

Miller MH, Schein JD (Department of Communication Arts and Science, SEHNAP, New York University, New York, NY). Improving Consumer Acceptance of Hearing Aids. *Hear J* 40(10):25-30, 1987.

Presents data on hearing aid use in the United States based on a stratified national sample of

hearing-impaired persons, 3 years of age and older. Hearing aid use ranges from 4 percent to 37 percent. Rate of use increases with age and severity of impairment. Authors examine reasons for the relatively low acceptance of hearing aids and recommend that rehabilitators give as much attention to the psychological aspects of wearing this prosthesis as is presently given to its engineering. [JDS]

Moon JB, Weinberg B (Thames Valley Children's Centre, London, Ontario, Canada). Aerodynamic and Myoelastic Contributions to Tracheoesophageal Voice Production. *J Speech Hear Res* 30:387-395, 1987.

Evaluations of five laryngectomized, tracheoesophageal speakers' phonation found that they were capable of adjusting their voice source on a myoelastic basis to vary F_0 change. Among other results, these speakers demonstrated increased trans-source air-flow rates, decreased airway resistances, and source driving pressures compared to standard esophageal speakers. [JDS]

Penner MJ (University of Maryland, College Park, MD). Masking of Tinnitus and Central Masking. *J Speech Hear Res* 30:147-152, 1987.

Three patients with sensorineural hearing impairments and tinnitus performed psychophysical tasks that established tuning curves and thresholds for external signals and for their own tinnitus frequencies. Results found were: (a) masking of tinnitus was dependent on masker intensity; and, (b) masking is independent of its frequency. In a follow-up experiment with three normal-hearing subjects, masking of a continuous tone was dependent on intensity of a contralateral masker, and masking was again independent of masker frequency. [JDS]

Penner MJ, Burns EM (University of Maryland, College Park, MD). The Dissociation of SOAEs and Tinnitus. *J Speech Hear Res* 30:396-403, 1987.

In 10 of 29 volunteers who reported tinnitus as a chronic problem, spontaneous oto-acoustic emissions (SOAE) were detected. Two experiments found that: (a) when volunteers reported tinnitus was masked by a high-frequency tone, SOAE remained

unchanged; and, (b) while SOAE was reported suppressed, tinnitus remained audible. In addition, data are presented that show frequency-specific suppression tuning curves for SOAE, while tinnitus can be masked by tones at any frequency. Hence, the independence of tinnitus and SOAE appears likely. [JDS]

Rastatter MP, Lawson-Brill C (Bowling Green State University, Bowling Green, OH). Reaction Times of Aging Subjects to Monaural Verbal Stimuli: Some Evidence for a Reduction in Right-Hemisphere Linguistic Processing Capacity. *J Speech Hear Res* 30:261-267, 1987.

In an effort to resolve ambiguous findings of prior research on lateral asymmetries for linguistic processes in elderly persons, 12 males and 12 females, averaging 72 years of age, in good health, and right-handed, were trained to select quickly a picture representing a word presented monaurally. Reaction times were lower when stimulus was presented to the right ear regardless of hand used in responding. Further analysis suggests that language-processing ability of the right hemisphere is inhibited in persons of advanced age. [JDS]

Riedel CL, Wiley TL, Block MG (Walter Reed Army Medical Center, Washington, DC). Tympanometric Measures of Eustachian Tube Function. *J Speech Hear Res* 30:207-214, 1987.

Twenty-four normal-hearing adults, 18 to 30 years of age participated in a preliminary study to develop instructions, procedures, and norms for four tympanometric tests of Eustachian-tube function: Valsalva, Toynbee, Inflation and Deflation. Statistically significant differences were found only in peak pressures for baseline and experimental tympanograms, with peak-pressure shifts greatest for Valsalva and Toynbee. [JDS]

Ross M (Department of Audiology, University of Connecticut, Storrs, CT). FM Auditory Training Systems as an Educational Tool. *Hear Rehab Quart* 12(4):4-6, 1987.

The advantages of the FM auditory trainer, most important of which is its excellent SNR, are discussed. While presented solely in terms of children,

the principles apply equally well to hearing-impaired adults. [JDS]

Rubinstein A, Boothroyd A (Brooklyn College, New York, NY). Effect of Two Approaches to Auditory Training on Speech Recognition by Hearing-Impaired Adults. *J Speech Hear Res* 30:153-160, 1987.

Three tests of speech recognition were administered 4 times to 20 mild-to-moderate hearing-impaired adults, 56 to 79 years of age: at beginning of research, after 1 month of no treatment, after 1 month of intensive treatment, and after another month of no treatment. Treatment for half of the adults concentrated exclusively on perceptual strategy and sentence perception, while the other half divided their time between those activities and consonant recognition. Performance improved significantly following training, but not after no treatment. Gains, though practically small (average 5 percent), persisted 1 month post-treatment. Training approach made no significant difference. [JDS]

Shirkey EA, Kelley RD (Department of Communicative Disorders, University of New Mexico, Albuquerque, NM). A Device to Mark Inaudible Behaviors on Audio Recordings. *Lang Speech Hear Serv Sch* 18:238-240, 1987.

By means of an auxiliary signal device (ASD), for which a wiring diagram is provided, clinicians and researchers can record instances of nonverbal or garbled speech behavior on two-track audiotapes. The ASD is an inconspicuous hand-held tone generator that produces an inaudible tone on one audio track, while the other records the patient's speech. When replayed together, the position of the marked behavior during speech production can be precisely determined. [JDS]

Taylor RG (Kansas State School for the Visually Impaired, Kansas City, KS). Teaching a Severely Handicapped Deaf-Blind Young Woman to Prepare Breakfast Foods. *J Vis Impair Blind* 81:67-69, 1987.

A 21-year-old, mentally retarded and deaf-blind woman was taught to prepare three different breakfast foods from tactile recipe cards, while using a

positional tray and prompt training. The single-subject design provided data showing the instructional program led to 100 percent independence in performing the three tasks in 28, 9, and 15 10-minute training sessions, respectively. [JDS]

Titze IR, Horii Y, Scherer RC (University of Iowa, Iowa City, IA). Some Technical Considerations in Voice Perturbation Measurements. *J Speech Hear Res* 30:252-260, 1987.

Independent studies of vocal perturbations (jitter and shimmer) in two separate laboratories are compared. Results suggest methodology plays a critical role in measurements. Investigators conclude that minimization of contaminating noise without interpolation between samples requires 9 bits of resolution and 500 samples per cycle. With interpolation, jitter can be reduced to 0.1 percent using fewer than 100 samples per cycle. While generally not harmful, low-pass filtering does affect results when peak-picking is used. A window of at least 20 cycles is recommended, along with multiple tokens of a given utterance, in order to obtain stable means of perturbation measures. [JDS]

Van Tassell DJ, Yanz JL (University of Minnesota, Minneapolis, MN). Speech Recognition Threshold in Noise: Effects of Hearing Loss, Frequency Response, and Speech Materials. *J Speech Hear Res* 30:377-386, 1987.

Four experiments with normal hearing and hearing-impaired (high-frequency, sensorineural) subjects examined speech-reception (speech-recognition) thresholds (SRT) under a variety of conditions. Plomp's model for impaired hearing predicted (fit) the obtained data fairly well. These results suggest SRT will be useful for hearing aid evaluation because of its speed, reliability, and sensitivity to frequency-response characteristics of speech in quiet and noise. [JDS]

Walden BE, Montgomery AA, Prosek RA (Army Audiology and Speech Center, Walter Reed Army Medical Center, Washington, DC). Perception of Synthetic Visual Consonant-Vowel Articulations. *J Speech Hear Res* 30:418-424, 1987.

Thirteen normal-hearing adults, 19 to 45 years of

age, viewed computer-generated, dynamic symbols representing lips and teeth forming three exemplar syllables and six linearly interpolated intermediate approximations of the three exemplars. Subjects participated in three experimental procedures: (a) labeling each symbol presented in random order; (b) determining if the third symbol in a triad was more like the first or second member of the triad; and, (c) rating each symbol on a scale from 1 (most like *ba*) to 9 (most like *va*). Labeling functions exhibited abrupt transitions between response categories, but peaks in discrimination functions did not coincide with category boundaries. Mean rating functions tended to linearity, and ratings yielded unimodal distributions with peak locations depending on the stimuli. These data, while somewhat atypical, encourage the further use of animations in studies of speechreading. [JDS]

Wiley TL, Oviatt DL, Block MG (University of Wisconsin, Madison, WI). Acoustic-Immittance Measures in Normal Ears. *J Speech Hear Res* 30:161-170, 1987.

Air-conduction thresholds, contralateral/ipsilateral acoustic-reflex thresholds, and tympanograms were obtained for 77 women and 50 men, 20 to 30 years of age. Norms are presented for frequencies 125 to 8000 Hz. [JDS]

Wilson RH, Fugleberg RA (VAMC Long Beach, CA). Influence of Signal Duration on the

Masking-Level Difference. *J Speech Hear Res* 30:330-334, 1987.

One hearing-impaired and three normal-hearing subjects judged 13 synthetic, digitally gated 500 Hz signals with 1 ms rise-fall times, while signal duration was varied. S;ioN;io threshold integration functions diverged from the S;igpN;io or the S;ioN;gp threshold integration functions as signal duration declined from 100 ms to 6-10 ms. Below 6-10 ms, threshold integration functions converged for these parameters. [JDS]

Wolfe VI, Steinfatt TM (Auburn University at Montgomery, AL). Prediction of Vocal Severity Within and Across Voice Types. *J Speech Hear Res* 30:230-240, 1987.

Listeners categorized two productions of /a/ and /i/ each by 20 male and 31 female patients with a variety of laryngeal disorders, and these ratings were compared with spectrographic and acoustic analyses. Cronbach's alpha for interjudge reliability was 0.95. Spectrographic noise (accounting for 61 percent of the variance) was the single best predictor of severity of voice disorder; the natural log of period standard deviation correlated 0.95 with breathiness; and period coefficient of variation correlated 0.64 with severity of strained voice. Other factors relate to different voice types, while some variables found good predictors in previous studies proved inefficient in this one. [JDS]