Orthotics, Spinal Cord Injury, and Other Severe Disabilities

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On a purely personal note, may I suggest as we turn from the prosthetics side to orthotics that this area has a historic interest for me. After I had poliomyelitis 50 years ago, in July 1924, I became involved a great deal in the era of the wooden wheelchair, crutches, canes, full-length leg braces, and then short ones. I still use orthopedic shoes and two canes.

The number of patients requiring orthotic and other aids is perhaps 10 times as great as the number of amputees. Though there is a good deal of interrelationship among these various areas of orthotics, spinal cord injury, and aids for other severe disabilities, there is also great diversity. We have not entirely postponed this area, though it received a lesser share of the available limited budgets. There are much more diffuse, much more difficult problems in orthotics than in limb prosthetics. There is a much larger diversity of indications, which creates more problems in selecting a type of device or orthosis for an individual than in the case of a prosthesis for an amputee. An amputation is literally clean cut. Anybody can look at the result and diagnose that the patient is an amputee at a certain level. Any observer knows what is missing — everything beyond that point. Thus prostheses, though individualized, fall into a relatively few major groups. But a patient may require an orthosis from a defect of a long bone, the joints, the muscles, the brain, the spinal cord, or the peripheral nerves; he may or may not have sensory feedback, and he may or may not have spasticity. These variables and their many combinations greatly complicate the problems of design as well as of prescription. Though orthotics problems long have received some attention by intramural and contractual efforts, they are now gaining greater momentum.

The group at the Miami VA Hospital has been involved in a number of basic studies related to spinal cord injury, some of which provide a transition from the preceding papers on electrical stimulation to other experiments as well. (Dr. Ross Davis was unable to attend the confer-
ence, but his colleague, Dr. John Gesink, a biomedical engineer, made the oral presentation.)

Certainly, spinal cord injury, as referred to by Dr. Hofstra, is a major topic for the Veterans Administration. The work for this program includes a variety of devices for control of the environment (lights, TV, alarm, etc.) and for independent mobility. The key point in all this development, since the introduction in England of the POSSUM control, has been the rapid development of new and useful means operating with small excursions and extremely light forces (puffing, sucking, or slight chin motion, head and neck motions, etc.) These systems have been relatively expensive, and it has been only in recent times that anybody was able and willing to spend the money to provide adequate evaluation of their utility in helping the severely handicapped.

Mr. Robert Green, clinical engineer of the VA Hospital Cleveland, describes environmental controls for the severely disabled. Mr. Green represents a new breed of biomedical engineers working directly with patients in the clinical area.

Mr. Lipskin of VA Prosthetics Center has also been involved deeply in the development and the evaluation of these types of environmental control systems, but his topic at this point is on the control of electrically powered wheelchairs by the severely disabled. There are also problems in providing mobility out-of-doors, though not on roadways where both vehicle and driver must be licensed.

Professor Donald M. Cunningham and his colleagues at University of California have worked for a number of years on an ingenious variable-height-powered wheelchair for the quadriplegic or other severely handicapped driver. The original work, under SRS sponsorship, aimed also at curb-climbing and at a mechanism for shifting the chair and occupant into a sedan. Recently, under VA support, the emphasis has been on a versatile chair that can safely be used in vans, and which has other desirable features.

Dr. Jacqueline Perry and Mr. James Allen of Rancho Los Amigos Hospital have recently been working on an ingenious plan to provide both power and controls to fold a hospital bed into a semblance of a wheelchair, thus allowing the severely disabled patient to move independently from his hospital room to recreation and therapy areas. The need for able-bodied staff members to assist the patient in transferring from a conventional hospital bed to a conventionally powered wheelchair would thus be greatly reduced.

Mr. Charles Scott, president of Mobility Engineering, Inc., is already known through his work at the UCLA Prosthetics Education Program to many people in the prosthetics field. Mr. Scott, an engineer, has been working on safety features for holding wheelchairs in vans, has been designing a special van control system to permit versatile and safe
operation by quadriplegics and other severely disabled patients, and has been developing much stronger wheelchairs to resist the deceleration loads which would develop in the event of highway accidents. The VA Prosthetics Center has bought two of Mr. Scott's vans for Castle Point and Long Beach VA Hospitals. Eventually we hope that there will be a group of controls, power lifts, vans, wheelchairs, and experience in evaluating the various combinations. Thus there will be a basis for rational prescription.

Professor Newell of Texas A&M University and his colleagues have been cooperating with VA Prosthetics Center and Texas Transportation Institute on safety during mobility. (Dr. McDermott of Texas A&M University, who has been working specifically on the safety aspects, gave the oral presentation.)

Mr. Martin Prast, a paraplegic veteran, and his father, an engineer, have been fascinated by the possibilities for developing an adult-scale version of the Parapodium designed by Mr. Motloch at Ontario Crippled Children's Centre, Toronto, for children with spina bifida. The Prast Research Associates project aims at a device which the paraplegic can don readily and wear while in a wheelchair. He should be able to rise independently to a standing position and then move on a level surface using an adaptation of the swivel walker principle. Though energy consumption (especially without using crutches) would be much higher than that required for using a wheelchair, the Parapodium concept would allow passage through doors too narrow for a conventional wheelchair. Indeed, freedom of the hands (even if by allowing forearm crutches to hang from forearm clips) would allow use of the hands and arms on door knobs, door jambs, or other features of the environment to assist propulsion as well as to manipulate locks and door latches. The Parapodium would also allow independent standing, movement about a kitchen or an office, and access to cupboards and closets. Alternate periods of standing and sitting should be beneficial in avoiding pressure sores and decalcification of the long bones.

Dr. McDowell, an orthopedic surgeon and consultant to the VA Hospital, Richmond, Virginia, has developed a system for immediate post-operative application of upper-limb orthoses. Originally designed for use on quadriplegics after tendon transfers, the system has also been used after operations for arthritis.

These papers, added to those on electrical stimulation, display a rapid acceleration into relatively new fields, a full range from applied research through development and evaluation to development of safety standards and a pattern of activity to help a variety of severely handicapped patients to be more independent.