

REGIONAL PROSTHETICS COURSE GUATEMALA, 1964

A cooperative regional course in prosthetics was conducted in Guatemala City, C.A., November 9 through December 4, 1964. The course, given in Spanish, was sponsored by the Instituto Guatemalteco de Seguridad Social (IGSS) or Guatemalan Institute of Social Security, with the cooperation of the International Society for Rehabilitation of the Disabled (ISRD) and its local affiliate, the Guatemalan Association for Rehabilitation of the Disabled, and with substantial contributions by the United States Veterans Administration, the Venezuelan Infantile Paralysis Foundation and others. The course represented exceptional cooperation among peoples, public and private agencies, professions, and individuals. The Guatemalan Institute for Social Security, the ISRD, and many local authorities long had been concerned with improvement of prosthetics services throughout Central America and the Caribbean area. The Junta or Board of Directors of the Institute, composed of representatives of the Government, labor, business, employers, the banking system, the medical society, and the University of San Carlos, operates polyclinics, a Traumatology Center, and the Rehabilitation Center as well as smaller clinics in a number of other locations throughout Guatemala. Thus the Institute is concerned with improvement in prosthetics and orthotics throughout Guatemala.

Organization of Course

Major responsibility for initiation, organization, and conduct of the course was assumed by Dr. Miguel Angel Aguilera, Director of the Rehabilitation Center and Vice President of ISRD. Dr. Ricardo Asturias Valenzuela, Gerente General (General Manager or Director General) of IGSS, was most helpful and generous. The outstanding contributions of numerous local doctors, therapists, Mr. Edgar Spalding as translator, and Mr. Castillo, the Center's Administrator, all were important in the successful presentation of the course. Mr. Anthony Staros, Director of the Veterans Administration Prosthetics Center in New York City, played a major role in developing the curriculum and teaching aids. The United States Embassy in Guatemala City was helpful.

Bulletin of Prosthetics Research — Spring 1965

Priority was given to applicants from outside Guatemala (about 12) with remaining vacancies (about 24) filled from a sizable list of applicants within that country. An effort was made to obtain teams of physicians and prosthetic technicians from each country represented, which included Salvador, Honduras, Nicaragua, Costa Rica, and Colombia, as well as Guatemala. Instructors were from Guatemala, the United States, and Venezuela. Thus the course was truly international in scope.



FIGURE 1. Participants in regional course in prosthetics held in Guatemala. Standing in the center are Rudolf Thys (white short-sleeved shirt) and Dr. Eugene F. Murphy (dark suit), the principal instructors. Edgar Spalding, translator and physical therapist is standing on the extreme right and standing fifth from the right is Dr. Miguel Angel Aguilera, Director of the Rehabilitation Center.

The Program

The course was inaugurated at the auditorium of the national headquarters of IGSS. The first week consisted of profusely illustrated lectures and demonstrations covering artificial limbs, amputee management, and alignment and fitting techniques, with Friday afternoon devoted to bracing. In attendance the first week were doctors, physical and occupational therapists, social workers, an administrator, a vocational counselor, and prosthetic technicians.

During that week, a number of Guatemalan doctors discussed anatomy, causes of amputation, postoperative treatment, psychological considerations, and some aspects of biomechanics. Dr. Eugene F. Murphy, Chief, Research and Development Division, Prosthetic and Sensory Aids Service, United States Veterans Administration, lectured in English (understood by many of the participants) upon a wide variety of topics, including biomechanics, fitting principles, alignment, and designs of prostheses and braces. His use of visual aids included about 225 slides and 14 miniature prostheses. Spanish translation was provided by Mr. Edgar Spalding, a

Panamanian-born physical therapist with a master's degree in vocational counseling from Michigan State University; Mr. Spalding is now working at the Rehabilitation Center of the Guatemalan Institute of Social Security. Mr. Rudolph Thys, a German-born prosthetist now working for the Children's Orthopedic Hospital of the Venezuelan Infantile Paralysis Foundation and able to speak Spanish, demonstrated casting techniques and the general principles of socket construction.

The second, third, and fourth weeks were devoted to shop practice in upper- and lower-extremity prosthetics. Although primarily intended for the prosthetists, these sessions were also attended by a doctor from Colombia. Friday afternoon of the second week, however, was devoted to bracing, and bracers from the Polio Center of the National Ministry of Health and from the brace shop of the Guatemalan Association for Rehabilitation also participated in this session.

During the second week, Mr. Thys demonstrated shop techniques and supervised shop practice. Dr. Murphy, with Mr. Spalding translating, helped in the instruction phases of this work. Two Guatemalan prosthetists, Mr. Juan Aguilar Vaques, who is in charge of the shops of the Rehabilitation Center of the Guatemalan Institute of Social Security, and Mr. Esteban Barahona also provided valuable assistance. Both of these men had received extensive training in the United States. Mr. Thys continued shop training through the third week, but the fourth and final week shop practice was guided by Messrs. Aguilar and Barahona.



FIGURE 2. Practical work on PTB and BE prosthetics in well-equipped temporary workshop.



FIGURE 3. Participants in workshop course.

Technical Aspects

The amputations seen at the Guatemalan Institute of Social Security are entirely traumatic in origin. The social security program covering only a small percentage of workers in the country, originally provided coverage only for accidents that had occurred on the job, but now, to some extent, off-the-job accidents are included. The Rehabilitation Center of IGSS provides services for a greater proportion of upper-extremity amputee cases than is encountered in the United States civilian practice. This high incidence is mainly due to machete accidents. (It is noteworthy that analogous accidents occur at varying levels of industrial progress throughout the world; in the United States the mechanized corn picker is a frequent cause of upper-extremity amputations in agricultural regions.) A number of leg amputations were caused by tractor accidents or highway accidents. The Center also cares for paraplegics who had been in various types of industrial and vehicular accidents. (Basketball is a popular sport among the paraplegics; a major game was held on the second Saturday of the Course.)

Below-elbow stumps retaining considerable rotation were fitted with the type of rotating forearm socket and flexible elbow hinges (made of leather straps) used widely in the United States. Manuals and textbooks prepared at University of California at Los Angeles were available for study. The ulnar aspect of the socket was extended proximally, or high along the ulna, to resist bending moments from loads on the terminal device, with the

opposite side cut down as far as feasible to allow considerable motion of the radius over the ulna during pronation and supination. Stumps which appeared quite short by United States standards nevertheless retained sufficient rotation to be worth fitting with the rotary forearm socket. The stumps were quite capable of rotation since they were relatively long in proportion to the original length of the forearm because of the short, stocky, muscular stature of many of the Guatemalans.

Shorter below-elbow stumps were fitted with the technique developed at Münster, West Germany, by Professor Oskar Hepp and Dr. G. G. Kuhn. Mr. Thys had copies of several well-illustrated German documents for student reference.

The Münster technique involves fitting the socket high and snugly around the olecranon and humeral condyles so that the socket is supported on the stump even without a harness. A V-shaped notch in the brim or proximal edge accommodates the biceps tendon. In Central America, with its banana industry, it was easy to explain the concept of a "banana-shaped" or preflexed prosthetic forearm which curved forward from the socket to bring the terminal device closer to the mouth than would be possible with a simple axial extension of the socket.

In teaching above-elbow prosthetics, the primary emphasis was upon the United States techniques for fitting and harnessing. Since Guatemala usually imports upper- and lower-extremity components from the United States, catalogs as well as measurement sheets in Spanish (prepared by A. J. Hosmer Corporation) were distributed as a matter of information. Polyester plastic resins from the United States are also widely used in Guatemala. Training given in preparation of casts, models, and plastic laminates could be adapted to various amputation sites and prosthetic designs.

For below-knee amputations, the patellar-tendon-bearing (PTB) prosthesis, as developed by the University of California at Berkeley and San Francisco, was emphasized. The UCB manual was made available for study.

Mr. Thys also described the PTB variant, termed PTS (from the French Prothese Tibiale Supra-condylar), developed by Guy Fajal, of Nancy, France. The PTS socket is made with somewhat flexible plastic laminate walls extending above the patella and over the femoral condyles to help support the prosthesis during the swing phase. This design obviates the cuff above the femoral condyles and the diagonal flexible leather hinges generally used in the PTB. (It may be hypothesized that the PTS brim in effect replaces the lower portion of the anterior section of the PTB cuff with its dependent straps or flexible leather hinges.) The publication of Mr. Fajal's *Atlas*, originally in French but soon to be available in five languages, was announced.

During the second week of shop practice, Mr. Thys demonstrated a stump-casting method for a Canadian-type Syme prosthesis. Time did not permit routine student practice of this technique.

In the sessions on above-knee prosthetics, the New York University flexible casting brim was demonstrated by Mr. Thys, and students practiced the method in the later weeks of the course. One left and one right brim of the latest designs were available. Each prosthetist who participated received a copy of the New York University Manual with supplemental pages showing the revised lever method for adjusting anterior-posterior positions and with illustrations of the clips and toggle used for tightening the circumferential straps. It was necessary to apply ordinary plaster-of-Paris bandage, with conventional cotton fabric, rather than the *elastic* plaster-of-Paris bandage recommended by NYU for use with the brim. (Some of the difficulties with wrinkles in the casts encountered in first trials were no doubt attributable to lack of elastic plaster-of-Paris bandages, which originated in Germany but are now also available in the United States.)

Motion pictures were presented that showed the above-knee casting stand developed by the New York VA Prosthetics Center and the adaptation of this stand with additional plates to form a PTB-type cast. A VAPC casting stand with above-knee equipment was available in one corner of the shop room, but it was not deemed practicable to have every student work with it.

Slides were also shown of the University of California brim technique for taking casts, and reprints of the UC Manual were distributed. The German method of forming and hand-shaping casts by a skilled prosthetist was briefly described. Manuals covering the NYU, VAPC, and UC methods were distributed to the prosthetists to enable them to recognize common biomechanical principles and to select the method best suited to local conditions, economics, and available facilities.

Slides and miniature model of the Canadian hip-disarticulation prosthesis were also used as visual aids. The "crossed" strap from behind the hip joint to ahead of and below the knee joint was described. The value of this strap in stabilizing the knee at heel contact, when the hip is flexed and the strap tight, was emphasized. (The potential applicability of this principle to free-knee-joint braces was suggested as an experimental notion.) Slides of the VAPC-DeGaetano mechanical hip flexion desired during walking, were shown. The contribution to good gait of allowing some 15 deg. of hip flexion as well as knee flexion, while assuring the patient that excessive hip flexion was prevented, was mentioned. The possible application of the Canadian hip-disarticulation prosthesis to hemipelvectomies and the improvements introduced both by Lyquist at the Orthopedic Hospital, Copenhagen, Denmark, and by McLaurin and Hampton at Northwestern

University in Chicago were described with the aid of slides and reference to manuals and to past issues of ARTIFICIAL LIMBS. It was expected that Mr. Thys would demonstrate the preparation of a cast on one hip-disarticulation subject during the third week of the course.

Throughout the course the possibilities for rapid, economical, and comfortable fitting of prostheses were emphasized. Greater knowledge of prosthetics and systematic use of clinic teams should lead to improved management of patients, including timely prescription of the devices, fitting techniques, and training methods most likely to be suitable for the individual case. Better understanding of biomechanics and increased use of casting methods and plastic laminating instead of trial-and-error carving should permit rapid fitting of comfortable sockets. Simple shop tools will allow faster adjustment and attainment of more precise alignment between the socket and other parts of an artificial leg or between straps of an arm harness. In turn, early provision of a prosthesis will allow more rapid training of the amputee before deformities develop or the amputee loses motivation. In addition to the practical demonstrations of many rough fittings within a few hours or days, Mr. Thys discussed practical aspects of shop organization, planning of work, and orderly arrangements for materials and prefabricated components. Texts, manuals, and reference books should aid in overcoming problems.

Literature

Numerous illustrated manuals, reprints, and journals were distributed, with a mimeographed list of major textbooks and journals drafted by Dr. Murphy. The participants in the course were urged to agree upon a key person from each country to whom a complete set of literature could be delivered since there were not enough copies of certain documents for all participants. It was also hoped that future literature and information could be sent to each key person for local dissemination.

Training Problems

The film on gait analysis prepared by the Prosthetics Education Center at Northwestern University was shown during the first week of the course to the entire group, in connection with discussions of training. It also was shown to the remainder of the physical therapy staff of the Center of Rehabilitation, to the physical therapy staff of the Polio Center of the Instituto Rehabilitacion Infantil of the Ministry of Public Health and Social Assistance (a government agency), and to the physical therapy staff of the General Hospital in Guatemala City, affiliated with the medical school. Altogether it was seen by almost 100 people. A Spanish translation (probably prepared by Mr. Thys) of the Northwestern University booklet

Gait Analysis was mimeographed by the Rehabilitation Center and distributed to all participants in the course.

Bracing

On the first Friday afternoon of the course, principles of both lower- and upper-extremity bracing were discussed with the aid of a great number of slides. On the Friday afternoon of the second week of the course, bracing was again discussed with more emphasis upon the technical problems. As noted above, the bracemakers from the shops of the Polio Center of the Ministry of Public Health and Social Assistance and from the shop operated privately by the Guatemalan Association for Rehabilitation of the Disabled were invited to attend. Several actual cases were analyzed in some detail.

Many of the knee joints for long-leg braces were prefabricated joints purchased from the United States; they appeared to be drop-forged ring locks of very good quality. In most cases, double-ring locks were used, a situation very desirable from the standpoint of structural strength and rigidity though somewhat inconvenient for the patient in moving between standing and sitting positions. In almost all cases, the ankle portion of the brace involved a stirrup riveted to the shoe with a simple rivet fastened in the stirrup providing a pivot of a simple overlap joint for the sidebar of the brace. It was pointed out that such a design is relatively unstable and subject to more rapid wear in contrast to the more desirable box or clevis joint routinely used at the knee. The prefabricated clevis ankle joints (for example, the Klenzak type) were mentioned as examples of relatively slender joints, which were as readily available from several commercial sources as the knee joints seen.

Almost every brace seemed to be fitted with a right-angle stop which positively prevented plantar flexion. It was pointed out to the group that these right-angle stops at the ankle, because of the high moment, torque, or leverage generated at heel contact with leg inclined forward, tended to cause the knee to buckle. If the patient also had a paralyzed quadriceps muscle group, his knee would then buckle uncontrollably unless he were fitted with the typical locked knee joint with the drop-forged double-ring locks. Then, however, he would be unable to bend his braced knee during swing phase. Thus he would be forced into undesirable choices either to vault on the other leg by forcible plantar flexion of the opposite foot (impossible if he also had a right-angle stop on the other foot or if he had paralysis of the opposite calf-muscle group), or to circumduct the locked and stiffly braced leg (impractical if, as seemed to be common, the brace were fitted with a mechanical hip joint and pelvic band), or to walk with a swing-to or swing-through gait with the aid of crutches.

It seemed worthwhile to determine whether some of the cases with mild paralysis might not have been fitted *without* right-angle stops but allowed either free plantar flexion (at the expense of audible toe slap) or plantar flexion against resistance of some form of spring or elastic strap to reduce risk of stubbing the toe. Thus, the moment about the ankle joint at heel contact could be reduced, the tendency of the knee to buckle would be reduced, and some patients with only weak quadriceps might be able to walk with *free* knee joints but merely fully extended knees with adequate stability during the stance phase yet freedom to bend the knee during the swing phase. A simple *reversed* right-angle stop blocking dorsiflexion, as advocated by Habermann of Frankfurt, or the more complex UCLA hydraulic ankle resisting motion toward dorsiflexion from *any* position would assist knee stability. Even if a small amount of toe drop occurred, increased knee flexion might, in certain cases, compensate to provide adequate toe clearance during swing phase without all the additional complications encountered with locked knees.

Many of the braces seen were riveted to rubber-soled shoes or to very flexible leather-soled shoes, apparently made without reinforcing steel shanks along the longitudinal axis. In such cases, of course, the right-angle stop of the stirrup would limit heel motion but would not fully prevent downward forcible motion of the ball of the foot and the toes if the patient had sufficiently strong muscles. Conceivably, the bending moment at heel contact could result in downward motion of the ball of the foot, pivoting of the arch about the forward end of the brace stirrup, and tendency of the human heel to rise out of the heel of the shoe, partially destroying the apparent purpose of the right-angle stop of the brace.

Apparently each paraplegic at the Rehabilitation Center is fitted with a pair of braces. During the rehabilitation process, training is also given in vertical standing frames made of pipe fittings with support provided from straps and towels, or equivalent. An adjustable-angle standing frame would allow more gradual transition from completely horizontal through increasing angles over a period of time until the subject could safely tolerate the vertical standing. This concept apparently was not currently used. Simple pegs or adjustable clamps to secure the straps from accidentally sliding along the pipe frames of the standing rack would also be desirable.

Physical Facilities

A lecture hall was constructed from a large room, usually the vocational counseling section of the Rehabilitation Center, with writing-arm-type student chairs and a remotely controlled slide projector. A motion-picture projector was available when needed. Small adjoining offices were provided for the foreign instructors, and these also served for storage of the very considerable supplies and reference materials available for the course. An

adjoining large room temporarily was fitted with typical wooden work benches, each with a "peg" vise and many with machinist's vises. A pair of scales was provided for weighing plastic resins. Parallel bars were available for use during early training and trial alignment of leg amputees. The physical facilities were very adequate.

Special Events

The course was inaugurated on Monday morning, November 9, in the auditorium of the 10-story modern building which is the national headquarters of the Guatemalan Institute of Social Security, with speeches by Dr. Ricardo Asturias Valenzuela, Gerente General (general manager or director general) of the Institute, Dr. Fuentes, the chief medical officer of the Institute, Dr. Miguel Angel Aguilera, Director of the Rehabilitation Center and prime mover of the course, Mr. Francisco Caceres Barrios, Personnel Director and Chief of Public Relations of the Institute, and Dr. Noel Sandino of Nicaragua. After a brief ceremony of welcome to the students and to the foreign faculty members, the group proceeded a comparatively few blocks to the Rehabilitation Center where the major part of the course was conducted.

On Wednesday evening there was a reception at the Atico (penthouse) of the national headquarters of the Guatemalan Institute of Social Security. A marimba band provided music throughout the evening. A shoemaker and a secretary from the Rehabilitation Center, in native costume, performed indigenous dances. On Thursday noon of the first week, the Guatemalan Physical Therapy Association was host at a reception before lunch.

On Friday evening, at 6:30, the Guatemalan Association for Rehabilitation of the Disabled, was host for the visiting faculty and doctors in the building of the local medical association, once the residence of a former president of the country. Representatives of Costa Rica, Nicaragua, and Honduras described the programs in their own countries. Later that evening, Dr. Aguilera entertained an international group at dinner at his home.

On Saturday, November 14, the entire group made a bus tour. The original intention had been to visit a rehabilitation clinic at Escuintla, a town south and west of Guatemala City towards the Pacific Ocean. Because of delays in replacing weak tires as a precaution before climbing over mountain roads, it became necessary to cancel that portion of the trip. The group visited the United Nations Park, overlooking Lake Amatitlan, rode in a launch on the lake itself, visited an open-air market under a great spreading ceiba tree (the national tree of Guatemala) in the plaza of the town of Palin, and rode over a narrow winding mountain road on the shoulder of the Fuego volcano ("Fire," moderately active) and down into the next valley to visit the town of Antigua.

The country has had four capitals. The third, Antigua (a name presumably related to the English word "antique" and also meaning old) was destroyed in an earthquake in 1773, so the present Guatemala City was established as the capital. Though much has been rebuilt, there are still extensive ruins at Antigua.

The group had lunch at the Posada Belem or the place of the Bethlehemites, a rebuilt monastery which is now a hotel. Dr. Asturias, Dr. Fuentes, and Mr. Caceres joined the group. Mr. Cabrera, a safety engineer for the International Labor Organization, who is about to spend a year working in Guatemala, spoke about the importance of accident prevention. Dr. Araya, of San Jose, Costa Rica, and Dr. Galo, Tegucigalpa, Honduras, were speakers among other participants in the course. Dr. Asturias closed the meeting with a brief speech about the importance of the course and of rehabilitation.

On Tuesday, November 17, it was finally possible to visit Dr. Dorothy Dillon, Cultural Affairs Officer of the United States Embassy in Guatemala City. She had been as busy with the planning and execution of a United States Exhibit at the Industrial Park as our participants had been with the prosthetics course. She had been helpful in the initial organization of the course.

On Tuesday evening, November 17, a television program on prosthetics and the importance of the clinic team approach was presented under the sponsorship of the medical society. Dr. Carlos Edwin Rosal, who had participated in the course, was master of ceremonies, with Dr. Aguilera and other team members from the Rehabilitation Center. Mr. Thys prepared a PTB cast for a patient, and Dr. Murphy briefly demonstrated an APRL hand on a mockup training arm.