DECEMBER, 1965

ORTHOPEDIC & PROSTHETIC APPLIANCE JOURNAL

The Journal of the Limb and Brace Profession

DURWARD R. COON, C.P.O.
President, 1965-66
American Board for Certification
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OFFICIAL NOTICE

The 1966 National Assembly of the American Orthotics and Prosthetics Association will be held October 16-20, 1966

PALM SPRINGS, CALIFORNIA

Reconvened Session

OCTOBER 21-28

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(AOPA Technical Mission)

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(Formerly the Orthopedic Appliance and Limb Mfrs. Assn.)

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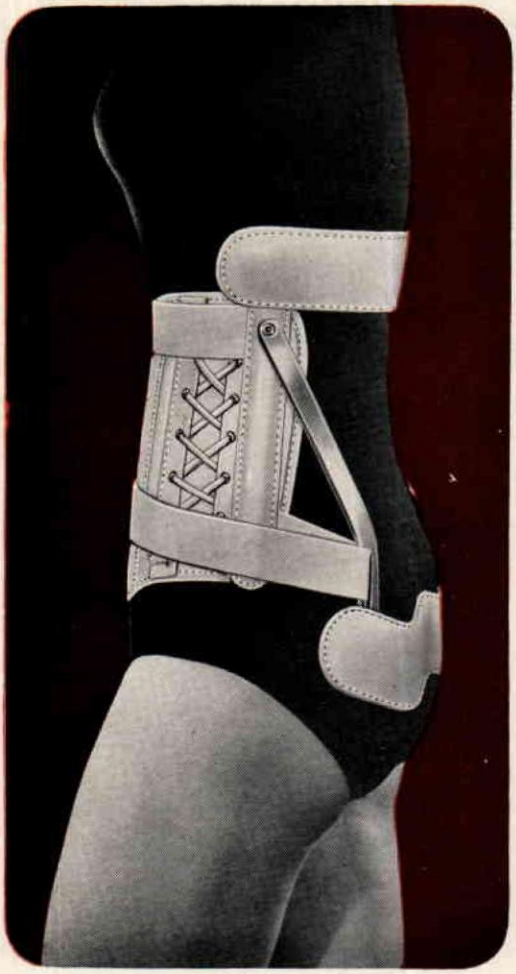

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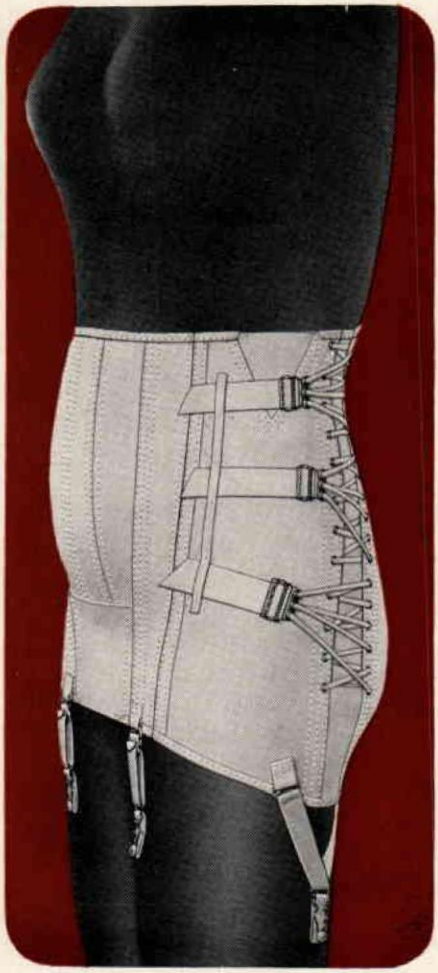

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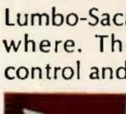

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An Orthopaedic Surgeon Looks at Certification

By CLAUDE N. LAMBERT, M.D.

Chicago, Illinois

An address presented at the Certification Luncheon at the American Orthotics and Prosthetics Association Assembly, Colorado Springs, Colorado, September 1, 1965.

When I missed last year's meeting I thought I would not have to give a talk this year but I soon found out the invitation was easily carried forward another year and hence my appearance here today.

Prior to World War II my interest in prosthetics was practically nil. I am sure that I did what most doctors still do today, namely, told the patient to go to a limb shop and have a limb made and that was the end as far as I was concerned. The companies selected were frequently on a basis of which gave the lowest price or had the best glib talking salesman, or both. I knew nothing of check-out, fit, alignment, etc. To me aluminum was better than wood—perhaps I should have pursued this further. I often wondered how the limb maker happened to be at the patient's bedside when the patient returned from surgery following amputation of an extremity. While in this groggy post-anaesthetic state an attempt was made to quick sell a prosthesis. I found out that the clerk at the admissions desk, for a specified fee, was the informer to the prosthetist and the prosthetist was putting out payola. Unfortunately this still continues to some extent but I do not think it is as rampant as it once was.

I recall very vividly a child with an upper extremity amputation. We had heard of a new type of arm being made in the East, specifically at Kessler Institute, and we obtained one. The chief difficulty was that I, myself, nor no one at the University had the remotest idea how it was supposed to work. The parts of the arm were apparently too delicate for an active child. The arm was soon in a state of dis-repair, so extensive that further use could not be obtained, and we almost joyfully gave up on this one and were very happy in the fact that we would not again prescribe an upper extremity prosthesis.

During World War II I had many acute amputee patients, but under the direction of the Surgeon General I was not allowed to keep these patients for definitive care and prosthetic restoration, but, rather these patients were transferred to Amputee Centers. This was one good result of the Armed Services Medical Care and the real beginning of better prosthetic service.

On my return to civilian practice I'm afraid I again reverted somewhat to my previous status of not being very knowledgeable in regards to prostheses and it was only after my initial baptism in the pilot Upper-Extremity Course at U.C.L.A. in 1952 that I really became, in my own mind, prosthetically oriented.

Since 1952 there has been a considerable change in my own knowledge and feelings. As you know, I have been fairly active in the field of education by helping to conduct the course at Northwestern University Medical School and, in addition, have established Amputee Clinics at both the University of Illinois and Presbyterian-St. Luke's Hospital. With my further interest and knowledge of prosthetics I have become acquainted with the two organizations represented here today, that is, the American Board for Certification and the American Orthotics and Prosthetics Association.

Let us go back a few years in the history of your two organizations. Some of the older men in this audience know the story and I trust will bear with me for a few minutes. I am sure that many of the younger men do not know this history and I hope my remarks, however brief, will be interesting.

The original trade organization was called the Artificial Limb Manufacturers Association (ALMA). This had its beginnings in 1917 after the Surgeon General of the Army had invited the then limb makers of the country to Washington, D. C. to discuss the problem of supplying artificial limbs to World War I veterans. The membership of this association was made up of owners of "Artificial Limb Shops," some of whom also engaged in the manufacture of orthopedic appliances.

In 1946 the Artificial Limb Manufacturers Association increased its membership by opening its doors to those who manufactured orthopedic appliances and the name was changed to the Orthopedic Appliance and Limb Manufacturers Association (OALMA). This organization has continued ever since but with perhaps a final change in name in 1959 to AOPA. It was felt that the fields of orthotics and prosthetics were becoming more of a paramedical service group rather than manufacturing, per se., but the manufacturing companies were not to be deleted from membership.

As a means of up-grading the industry and patterned somewhat after the American Board of Orthopaedic Surgery, the American Board for Certification of the Prosthetic and Orthotic Appliance Industry was founded in 1946 through the joint efforts of the Orthopedic Appliance and Limb Manufacturers Association and the American Academy of Orthopaedic Surgeons.

Since the American Academy of Orthopaedic Surgeons was one of the co-sponsors, the Board in its by-laws has honored the Academy by having at all times three members of the Academy on its Board, each man serving a three-year term.

In 1959 this certifying Board changed its name to its present title of American Board for Certification in Orthotics and Prosthetics or the more familiar ABC. Thus, we have two separate and distinct groups, AOPA which is primarily a trade organization and must abide by trade practice rules as set up by the United States Government, and a certifying group which certifies as to the competency of both facilities and individuals to assure that the patient will receive the best possible appliance.

Most of you will realize that so far the greater interest seems to have been spent on prosthetics and this was very probably justified by the fact that prosthetics needed more up-grading. At the present time, and in the immediate future, you can all see that the trend is toward improving orthotics such as the new study of spine braces, the Milwaukee Brace and the new University of California ankle brace, etc.

One might now ask what is the advantage of belonging to AOPA and/or being certified. Similar questions were asked when the American Board of Orthopaedic Surgery was organized. Doctors had their M.D. degrees, their license to practice and it seemed in the early days that all Board Certification did was to make one eligible to work in a charity clinic since it was easy to state that only Certified Board men would be accepted. During the years, however, Board Certification has become mandatory for appointment and promotion on hospital staffs, universities, etc.

Some of the older Orthopaedic men expressed the belief that we were training and certifying too many orthopaedic surgeons and if the trend continued the older men would soon be out of business. This has proved to be exactly untrue. Each year more and more young men are certified by the Board, more and more cities are represented by certified men and the older man has not been put out of business. Competition has improved the quality of Orthopaedic Surgery.

A similar situation probably exists in prosthetics and orthotics. Some may have resisted the increase in certified facilities for fear that this would make more competition and/or less income. Americans as a whole are a gregarious lot and wish to be with their own "kinfolk" and hence this togetherness is one reason for becoming certified. One does not like to be on the outside looking in but prefers to be an active participant.

In this country today it is estimated there are approximately 1200 facilities dealing in prosthetic and orthotic services. Of these slightly more than 400 or approximately one-third are certified by ABC. About 200 facilities are certification eligible. By this is meant they are owned or managed by a certifee or they employ a certifee who would thus make them eligible. It would seem to me that this group of 200 facilities should be the next group to become certified. Why, since they are eligible, have they not joined? What can AOPA and ABC do to convince these facilities of the desirability and probably the necessity of becoming certified. At my own clinic at the University of Illinois, only certified prosthetic facilities are utilized. Similarly in the Veterans Administration, only certified facilities are recognized. My private cases are referred only to certified facilities because I am properly oriented. Under a provision of the Medicare Bill, those of 65 and over who are eligible for Medicare benefits, also become eligible for prosthetic restoration. I am sure that restrictions will be made to the extent that only certified facilities may participate in this plan as is now in effect with the Veterans Administration. As a result there should be a rush for certification requests.

Of the remaining 600 facilities, about 100 are institutional facilities which in a great many instances, should be certified. Here again, the stimulus for certification is going to have to come from the doctors on that staff insisting upon certified personnel and then facility certification. I can speak quite freely on this subject since at the two institutions where I work we do not have certified personnel in orthotics. All of our prosthetic work is referred to certified facilities. At the University we have available a faculty appointment for a research engineer in Orthotics and/or Prosthetics but so far we have been unable to fill this position. I am sure that when this position can be filled there will go with it a request for a certified orthotist or one who is eligible for certification. At the private hospital it is now a matter of replacement when the present incumbent retires in the near future. This incumbent is an old style orthotist, having been making braces for forty years but who was never stimulated to become a certifee and now it is too late. I am sure similar situations are present at many institutions and the stimulus for certification again, I believe must come from the attending staff doctors.

This is similar to several instances when the American Board for Orthopaedic Surgery was formed. At that time certification was granted all of those of professorial rank if they would only apply. This one man did not apply, stating that he felt the Board would never amount to anything. Some ten years later when the Board had proved itself, he then applied and was informed that despite his academic title he would have to take the examination. He was sure he could not pass and did not take the examination and never did become certified. There may be other orthotists in a similar situation and to my mind the ruling on these men becoming certified must be an individual matter.

There are about 100 additional facilities which could and probably should be certified except for the lack of having certified personnel and thus openings are present for newly trained men. In addition approximately 70% of the eligible facilities of AOPA are certified by ABC. What about the other 30%? The arguments as stated above very definitely apply here.

Certification must be considered, first of all, an honor, secondly, as a badge of achievement of having passed the Board examination, and, thirdly, a necessity for membership.

A great deal of this stimulation to this group must come from within the membership of your two organizations, from personal contact, and also from doctors who are prescribing the prosthetic and orthotic appliances.

I have just received the Report of the Committee on Facilities. I quote from that report, "During the year, the Committee certified nineteen (19) new facilities; eight (8) in prosthetics, seven (7) in orthotics and four (4) in prosthetics and orthotics. In addition, one (1) facility was reinstated, four (4) facilities were granted extension of title. During the same period, two (2) facilities were rejected by the Committee. At the time of this report, thirteen (13) applications for facility certification are in process; two of which were in process at the time the 1964 Report was prepared."

What is of more importance to me is the fact that during that same period 26 facilities had their certification terminated in 1964 and 40 since 1961. Of the group 7 have been re-instated. It is interesting to note the reasons for the termination of certification. Of the 40 facilities since 1961 48% lost certification because they lost certified personnel. This really means an opening for newly trained and certified personnel and such facilities should be encouraged to obtain new certified personnel, and thus regain certification. 30% of this group lost certification because the facility was dissolved. 18% or 7 facilities expressed either disinterest or dissatisfaction and withdrew. I feel this is a group that should be very carefully studied by your Board. What are the disinterests and why the dissatisfactions? If we can obtain these answers we can perhaps prevent such termination of certification in the future.

This brings us back to the role of the relationship between the American Academy of Orthopaedic Surgeons and the American Board of Orthopaedic Surgery and your two organizations. Since its inception you have had at least sixteen Orthopaedic Surgeons serve on your Board. This group of sixteen, I am sure, is definitely orthotically and prosthetically oriented as to the necessity of both facility and individual certification. But what about the remaining almost 3000 members of the Academy? It is to this group that I think our communications have broken down. There is not a sufficiently large number of Academy members who are prosthetically and orthotically oriented. I would venture to guess that not over 50% know of AOPA and ABC and are still prescribing a prosthesis in the old fashioned way of telling the patient to go to a limb shop and obtain a leg.

In addition there is a group of general surgeons who do a large percentage of the amputee work who are definitely not prosthetically or orthotically oriented. This would include the vascular surgeons. At the private hospital where I work I established an Amputee Clinic knowing that the majority of the amputations done on the general surgery service were being referred to limb shops without a prescription and no means established for check-out, training, etc. Slowly this is being changed by personal contact with the general surgery group and by inviting them to attend Amputee Clinics (which they do not do) but the fact that there is an Amputee Clinic has begun to make an impression on them.

This local situation I am sure is repeated many times over throughout the country. It is this group of both Academy members and general surgeons that we must educate to the fact that there are certified facilities and referrals should be made only to certified facilities. To do otherwise would be foolhardy and could be likened unto an orthopaedic surgeon referring a patient to a chiropractor for consultation.

Since the advent of the prosthetic schools at New York University, Northwestern University and U.C.L.A. many of our younger orthopaedic surgeons are being exposed to orthotics and prosthetics and thus should be much better oriented. It is this group that I look forward to in the future of being in command of orthopaedic programs and I am sure will stress the necessity of cooperation with certified facilities.

In turn however, the certified facilities by precept as well as example must prove to the orthopaedic surgeon that they warrant his referrals. This is done by providing adequate, clean, convenient facilities. They request and follow a definite prescription. Their conduct is on a professional level at all times. In the facilities adequate consideration must be given to children and female patients, in that female attendance and help is mandatory. This not only makes good sense but may prevent a law suit. Patients must not be left unattended since a fall may again provoke medical-legal problems.

The remaining group comprising about 400 facilities are chiefly in fringe areas, such as drug stores, corset shops, and surgical supply houses and mail order brace shops. In one respect these drug stores and corset shops cannot be eliminated. I am sure that if a manufacturing company of corsets, say for example, would sell to only certified facilities, they might be held in restraint of trade and this is why you can see these same corsets made by "X" company on sale at certified facilities but also in dry goods stores, corset shops, etc. wherein there is no supervision as far as the manufacturing company is concerned and certainly not as far as AOPA is concerned. This becomes a very touchy subject. Considerable question has been raised about a certain exhibit that was shown at our last Academy meeting wherein a non-certified facility demonstrated a line of corsets, this in direct competition to a similar display of corsets from certified facilities. One question here; which certified facility or AOPA member made these corsets for this company? These were probably under a private brand name.

We might sum up this brief discussion by stating that there are two areas that must be further investigated and improved and/or educated. The first is the approximately 200 facilities that could very rapidly and easily be certified. The stimulus for such certification must come from within the present certified group. In other words, you men here must be further dedicated to the task of convincing these facilities and men of the value of certification. This will probably be most effectively done on a personal appeal basis.

The second group or the institutional facilities will only be changed when the attending doctors demand it and they will demand it only when they become better oriented and educated as to prosthetics and orthotics and the orthopaedic surgeons as a group become aware of the fact that AOPA and ABC do exist. This can be accomplished by direct personal contact of those orthopaedic surgeons who are knowledgeable imparting further information to their colleagues. The fundamental group to be such leaders in this field are those who have become adequately oriented by:

1. Serving on your Board.
2. Participating in activities of CPEI and CPRD and their sub-committees.
3. Clinic Chief of Juvenile Amputee Programs.
4. Presenting further information to the Academy members by papers presented at the Academy meetings and information notes in the Bulletin.
5. Stressing to those attending the Orthotic and Prosthetic Courses the relationship of AOPA and ABC to the specific problem.

A final look from my own personal viewpoint on certification: I do not feel that once a facility has been certified, that this means certification forever. I personally have inspected or visited may shops throughout this country, usually unannounced. Some have made a very excellent impression on me. Others I have found extremely dirty, the personnel unkempt and the whole atmosphere anything but attractive. I am sure that this is the usual appearance since many patients have substantiated the condition of these shops.

The residency training programs for orthopaedic surgeons are supervised by a joint committee called the Residency Review Committee and made up of men representing the Council on Medical Education of the American Medical Association and the American Board of Orthopaedic Surgery. Each and every training program is reviewed by this committee at least once in three years. This is not a paper review, but an on-the-spot inspection of physical plant, teaching program, library, operations, etc. Any deficiencies are listed, and the program has one year to make corrections. If corrections are not made the program may be and occasionally is completely disapproved and dropped. If this can be done in medical education, cannot further evaluaton be done at repeated intervals on existing facilities?

Similarly all hospitals are inspected on a routine basis by the accreditation committee of the American Medical Association and the American Hospital Association and if the hospital is found wanting, accredition can be denied. Even the Cook County Hospital of Chicago had to make specific changes in view of the criticism of this accreditation board, especially cleaning up the place and the overcrowding.

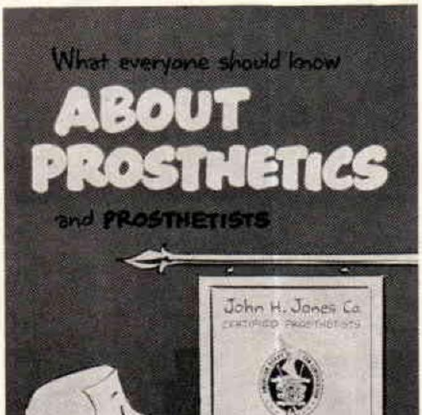
We all tend to become lazy and self assured and it might be a good idea to consider reappraisal of facilities. I can already hear some of you in this audience begin the discussion that such a suggestion for re-inspection should not come from a physician member of your Board. However, when I accepted a position on your Board it was with the idea that I would do as if I were an actual member and say what I felt would be the best for your organization.

You will recall that I previously expressed myself in regards to a prosthetist being a part of a surgical team. In the two years since I discussed this matter there has come into being the immediate post-operative application of a prosthesis. In this experimental study the prosthetist does come to the operating room and begins his work in the operating room as soon as the wound is closed. He does not however, assist with the actual operative procedure and I think this is correct.

It has been my privilege for the last two years to be on the Committee on Facility Certification of your Board and as such have freely expressed my opinion, either approval or disapproval of certifying facilities. In this same spirit and from my personal observation of facilities I would like to suggest that your Board consider the idea of routine re-inspection of facilities to make sure that the initial standards which gave them certification are maintained.

Also to be considered is the sometimes apparent confusion between facility and personnel certification. One additional item is the requirement for membership in AOPA. True, we cannot and should not go backwards. Our theme today is looking to the future. If so, then may not certification by ABC be a pre-requisite to membership in AOPA, similar to Board Certification being a requirement for membership in the American Academy of Orthopaedic Surgeons.

If we—ABC and AOPA are to be "merged" at the top level, should not some of the merging begin at membership level as well.



"WHAT EVERYONE SHOULD KNOW ABOUT PROSTHETICS AND PROSTHETISTS"

Illustrated booklet published by the American Orthotics and Prosthetics Association, Washington, D. C. 1965. 15¢ each.

Reviewed by Alvin L. Muilenburg, C.P., Houston, Texas.

This new scriptographic booklet is a companion to the well known "What Everyone Should Know About Orthotics and Orthotists," which appeared in 1964 under the sponsorship of the American Orthotics and Prosthetics Association.

Both booklets are designed for the information of the public, the medical profession, rehabilitation personnel, and similar groups. They will be helpful in explaining orthotics and prosthetics to interns, residents, students of nursing and others in the rehabilitation field.

Both booklets may be ordered from the American Orthotics and Prosthetics Association, 919 18th Street, N.W., Washington, D. C. 20006.

Birth Defects Bracing—
Why, When and How Much

By ROBERT B. LARRICK, M.D.

Columbus, Ohio

An address presented at the National Assembly of the American Orthotics and Prosthetics Association, Colorado Springs, Colorado, September 2, 1965.

As you are probably aware, the word *Orthopedic* is derived from two Greek words, the combination of which means *straight child.* Nowhere is this derivation more appropriate than in the bracing of the child with birth defects. Among the laity, the designation as an orthopedist is frequently misunderstood, mispronounced, and confused with other specialties or even non-medical occupations. However, it *is* easier to say than orthotics and prosthetics, so maybe there is hope for us. I'll never forget an amputee whom I examined for evaluation of alleged total disability. It was on a hot summer day, and eight of the ten chairs in my air-conditioned waiting room were occupied by the man, his wife, and their six small children. He arrived on crutches with one pants leg appropriately folded up and pinned, so my first question was: "Don't you use a prosthesis?" He bristled and said, "Certainly not! We're Catholic."

Those of you who remember the early Model T Fords will recall that the only way to start them was by cranking, and so that one person could do the job, the choke had an extension on a little ring at the front of the car so that the usually sweating and swearing cranker could also choke—which he sometimes did. Then *progress* came along with the battery- powered starter, and the choke got moved inside. This was fine as long as everything worked smoothly, but on the not-infrequent occasions when it became necessary to crank, someone had to sit in the car to man the controls. My father was a powerful man—he had powerful muscles, a powerful sense of justice, and a powerful temper. As he would crank, it was my mother's hazardous duty to manipulate the choke. If the motor wouldn't start—or even worse, if it started briefly then died—dad would straighten up and shout in a volume indicating he assumed mother was in the trunk and stone deaf, "Did you choke it?" He really should have been a lawyer. At this point, he had her trapped. If the answer was "No" he would ask, "Well, why didn't you?" If the answer was "Yes" he would say, "Well no wonder! You choked it too much." This was my introduction to the "team approach."

INCIDENCE, AND GOALS OF TREATMENT

Today, the problem is even more complex. Cars are provided with neither a crank nor a controllable choke, so if the family bus doesn't start, you have to call a specialist. Up until the advent of early meningomyelocele repair which was pioneered by Doctor M. P. Sayers of Columbus in 1954, the treatment of children with birth defects was in the Model T era. With the development in 1956 of the Holter valve for ventriculo-jugular shunts to prevent hydrocephalus, we have moved into the modern age of such treatment, with complexities demanding the team-of-specialists approach. As with any team, communication among all team members is essential, not only in defining our goal, but also in determining the "plays" that we hope will lead us in that direction. In this regard, we should never lose sight of the fact that the most important members of the team are the patient and his family. Too often we tend to set goals and because we are too busy, too erudite to converse in lay language, or too impatient to repeat, we do not communicate what we are trying to accomplish.

Not only the doctors, orthotists, and therapists, but *ALL* persons associated with *ANY* phase of the care of a child with birth defects should be oriented and re-oriented as often as necessary to make sure everyone knows what to do and why. This includes not only the parents, but also the grandparents, baby-sitters, etc. A brace applied only to maintain correction of club feet may be completely successful. But it is a disappointing, dismal failure if through our errors of omission the parents have expected this brace to make the child walk.

The problem of care and bracing of children with birth defects is a growing one. There are 250,000 such children born annually in the United States. Of these, 60% involve the musculoskeletal system either directly, or indirectly through the nervous system. This means that each year there are 150,000 new patients who are potentially in need of bracing. I say the problem is growing for two reasons: So far, the prevention of birth defects had been pretty much incidental to improving prenatal maternal health. The factors which may have a role in the production of birth defects, such as trauma and exposure to radiation and toxins, are on the increase. Improved obstetrical care reduces the likelihood of a miscarriage which may be nature's way of aborting an abnormal baby. So we may actually see an increase in the number of live births producing children with these defects. Coupled with this is the reduction in mortality rate in these children. Formerly, many such children died in early life of infection, hydrocephalus, or later complications in other organs such as the urinary system. Repair of the defects, shunting, urological procedures, antibiotics, etc., are keeping increasing numbers of such patients around for longer and longer times.

BRACING PROBLEMS

I shall confine my remarks this afternoon to bracing of the trunk and lower extremities. The birth defects child presents some bracing problems peculiar to this disorder, as contrasted to other forms of paralysis such as we see in polio, cerebral palsy, and trauma. In polio and cerebral palsy, we are dealing with motor abnormalities only. With trauma, we deal with motor and sensory problems, but we are usually working with a proportionate body, a normal mentality, and normal upper extremities. By contrast, bracing of the child with a meningomyelocoele must consider the combination of motor, sensory, trophic, and mechanical factors. The motor problems are principally those of flaccidity and un-opposed muscle pull. These factors may give rise to early or late complications such as scoliosis, hip dislocation, and club feet. True spasticity is rare, but unfortunately rigidity and contracture are not. This makes either conservative or even surgical correction of some deformities very difficult, as manipulation frequently produces a compensatory deformity rather than correcting one. For example, we have all seen attempts to force a hip into extension in a brace, produce a deforming increase in the lumbar lordosis intsead. Likewise, bringing a femur from an abducted position to the vertical line may do so only by the production of a tilted pelvis and scoliosis. Lack of bowel and bladder control presents hygiene problems in braces about the pelvis. Sensory loss makes the development of pressure sores an ever-present danger. Trophic disturbance and the attendant bone softening frequently cause pathological fractures when an otherwise innocuous force is applied to a deformed limb. Since this usually occurs in an anesthetic limb and the patient therefore does not offer protestations of pain, the parents should be advised of this possibility so that prompt treatment can avoid further deformity. I say they should be *advised* rather than *warned,* since any indication that such a fracture is a catastrophy or a sign of parental brutality results in such a fear of passive exercise and brace application that the parents are likely to do neither properly. The local mechanical problems facing the orthopedist and the orthotist require some engineering ingenuity. One must not only avoid pressure on a gibbus at the site of the defect, but also must frequently support a collapsing trunk. Commonly a Bricker stoma or "rosebud" must be by-passed. Once adequate braces are on the patient, the use thereof may be complicated by hydrocephalus which causes a disproportionate head size and weight, impaired mental processes, and inability to use the upper extremities normally.

CLASSIFICATION OF BRACES

I have attempted to highlight the scope and problems of bracing the child with birth defects. To discuss the when, why, and how much, requires a classification of braces. I like to think of braces in one or more of four classes: Preventive, corrective, supportive, or functional. The earliest applied braces may fall into the preventive or corrective categories. These may be applied long before the child is ready to assume the vertical position. The *preventive brace* is of simple design, sometimes with no joints at all, and is used to prevent either the occurrence of a deformity or the recurrence of a deformity that has been previously corrected. Since they are easily applied, these uncomplicated braces, besides benefiting the patient, are very valuable training material for the parents who have a tendency to be terrified by the application of cold steel and impersonal leather to their infant. *Corrective braces* with cams, adjustable tension, or what not, can be applied during this same period of infancy. Here I think I should again interject communication with and instruction of the parents. Not only should the parents be thoroughly instructed in how and when to put on the braces, we should make sure they have simple tools such as a Phillips screwdriver and an Allen wrench. There is nothing more discouraging than to work hard to prevent or correct a deformity, only to discover later that you have been defeated by a loose screw which didn't seem worth the trip to the brace shop. The next type of brace is the *supportive brace* which can be applied anytime one would ordinarily otherwise expect the child to stand. This is usually between one and two years of age. This is probably the most neglected and most misunderstood phase of bracing. I am frequently asked: "Why are you putting these extensive braces on this child when he is too young to walk, and with all his troubles he may never walk?" In the first place, the supportive brace may embody elements of the preventive or corrective brace. Even if it does not, and even if the ultimate goal is not independent ambulation, there are still many benefits to be gained by having the child spend some time in the vertical position. Trunk support facilitates the development of more normal gastrointestinal, cardiovascular, and respiratory functions. The stress thus applied to the lower extremities stimulates better bone structure and minimizes the osteoporosis of disuse. Getting into the vertical posision helps produce better eye coordination, balance, and hand skills. In this position, gravity assists rather than retards adequate urine drainage. Not the least of the benefits is the psychological effect on the child who now sees himself in the same position as the people around him, and is thus better able to relate and imitate. *Functional braces* may incorporate features of the preceeding three. They are applied after, or are a modification of the supportive brace. Here is where it becomes vitally important to establish a goal and let everyone know what that goal is. A new goal can be advanced after an old one has been attained with no sweat. However, if because of initial over-enthusiasm, one has to repeatedly lower his sights, this may well appear in the eyes of the parents as a discouraging failure. Obviously, an adequately braced child who needs the support of a standing table and who cannot stand by holding onto something with his hands is not yet ready to master functional braces in parallel bars or crutches. Parents who should be happy that their child can walk with braces and crutches may be very unhappy if they have belived the goal was ambulation with braces only or no assistive devices at all. In functional bracing of the trunk and lower extremities, adequate support should never be sacrificed for mobility. A good rule is to make the braces as extensive as necessary to achieve support, then permit as much mobility as is possible without compromising the former. As the child demonstrates that he no longer needs some part of the brace such as hip locks, corsets, or dorsal extensions, they can be removed. This proposition of early overbracing has some merits. Undesirable postures and habits are avoided. For example, there is no harm in a child with normal musculature crawling, since he will develop the wherewithal to assume the erect position and then a more acceptable efficient propulsion. However, a child who is going to have to depend on some supportive device may be quite resistive to such assistance and future treatment if because of underbracing he discovers the easier, faster way of getting from one place to another is by crawling or scooting. Again it is bad psychology for both the patient and parents to keep adding parts to an inadequate brace. Conversely, elimination of a part indicates progress and reward and thus encourages future enthusiasm and cooperation.

SUMMARY

We have a small terrier named Laddie whose entire existence of one year has been either in the confines of the house or on the end of a leash. Since his only canine companionship is an elderly male cocker who waddles into our yard at mealtime, Laddie gets quite excited about Victor's visits. In fact, he gets so excited we wonder if he may not be a bit queer. After the exchange of a few perfunctory sniffs, Victor with the wisdom of seniority, makes straight for Laddie's bowl of Pard. Laddie, with his ambivalent enthusiasm, continues his investigative sniffing. By the time he has confirmed that the rear end of Victor is male, the front end of Victor has consumed all the food. My remarks to you today have attempted to emulate the front end of Victor: concentrating on the basic principles and meat of the problem, and not being concerned with the possibly more glamorous and heroic aspects.

The when, why, and how much of birth defects bracing can be summed up: Brace early. Brace for prevention, correction, support, or function. Over-brace, then eliminate as indicated. Thank you.

The I.N.A.I.L. Myoelectric B/E Prosthesis

By HANNES SCHMIDL

Director, Institute Nazionale per L'Assicurazione Eontro Glie Infortuni sul Lavoro, Budrio, Italy

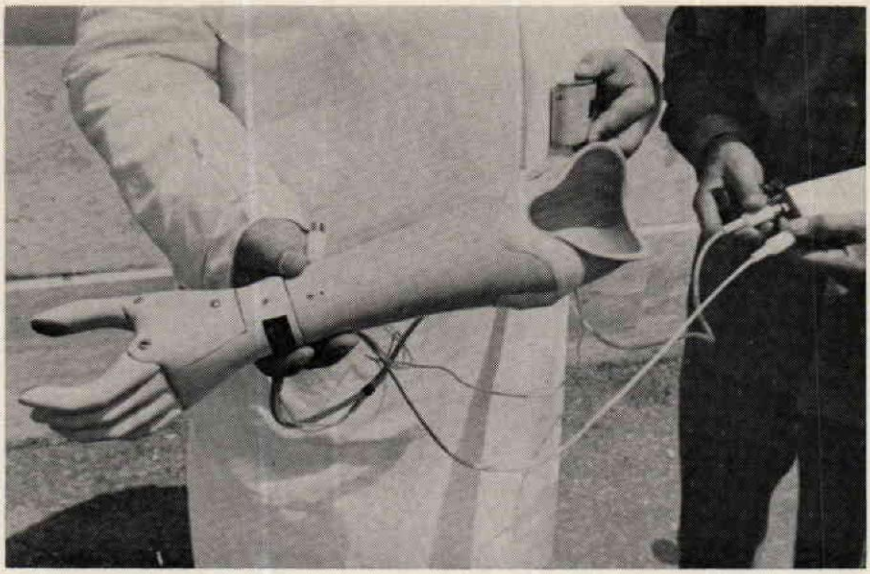
EDITOR'S NOTE: The following article was presented at the AOPA National Assembly in Colorado Springs, Saturday morning, September 4th, 1965. Otto Bock Orthopedic Industry, Inc. of Minneapolis, is distributor of the I.N.A.I.L. system. Questions relating to the component parts and availability of the system may be referred to them.

I appreciate the opportunity to speak before this group of American Orthopedic Specialists on the subject of I.N.A.I.L. Myo Electric Prosthesis.

I shall enter immediately into the subject dealing with the details and technical characteristics of the prosthesis itself. First of all, I should like to explain the meaning of the expression "Bio-Myo-Electric."

The term "bio-myo-electric" derives from the Greek "bios" meaning life or body and "mios" meaning muscle. From this it may be understood that muscular current is being utilized to operate artificial limbs. Here is how it works.

I.N.A.I.L. System: Prosthesis, battery pack, and amplifier



View of B/E Arm, Hand, and Amplifier and Battery Pack (complete system)

The central nervous impulse originating from the brain travels along the neurone causing muscular contraction. At the level of the neural plate and the tendons this impulse generates high frequency electrical waves of very low potential.

Electromyology has recorded these signals both in depth (muscular mass) and at the surface. We are interested in the surface, or contact derivation.

Through the use of electrodes and by exploiting the gain of a transistor amplifier; micro-relays and electrical circuits can be closed. Furthermore, using electrical or pneumatic power, one can thus obtain movements.

The two pairs of contact electrodes can pick up an electrical impulse as small as 20 - 30 microvolts (a microvolt is one millionth of a volt) from a dry normal skin surface overcoming even a fairly thick fatty layer.

The muscles of the amputation stump retain the property of emitting impulses strong enough to be picked up and amplified to the point of securing the closure of relays. Our transistor amplifier gives an effective gain of 40 to 100 thousand times and can be adjusted according to the need.

On a below-elbow prosthesis, two terminal relays operate the electrical circuits. A pair of electrodes placed over the flexor muscles close the fingers of the artificial hand. Another pair of electrodes placed over the extensor muscles open the hand. The action is smooth, accurate and, if desired, strong.

The sensitivity of the grip is such that the tips of the fingers can pick up an egg without crushing the shell, or lift a weight of 33 pounds.

An important feature of our design is the micromotor. It is of greatest importance that the micromotor begins to operate only if the muscle begins to contract. Thus, once the amputee has grasped an object, he does not have to concentrate on keeping the muscle contracted to maintain his grip.

With this type of prosthesis the stumps in which pronation and supination have been preserved can move freely since, by means of suitable calibration of the amplifying apparatus, the pronator and supinator impulses do not interfere with flexo-extension and therefore with closing and opening. At the same time, opening and closing can be achieved in both maximum pronation and supination.

A prosthesis for a person with the forearm amputated consists of: battery — amplifier — hand.

Battery—The battery supplies power for closing and opening the fingers of the hand and power for the operation of the amplifier. The consumption of the amplifier is very little whereas that of the motor is considerable. However, experiments have been carried out, always under strain, in which a minimum of 1400 movements and more have been obtained.

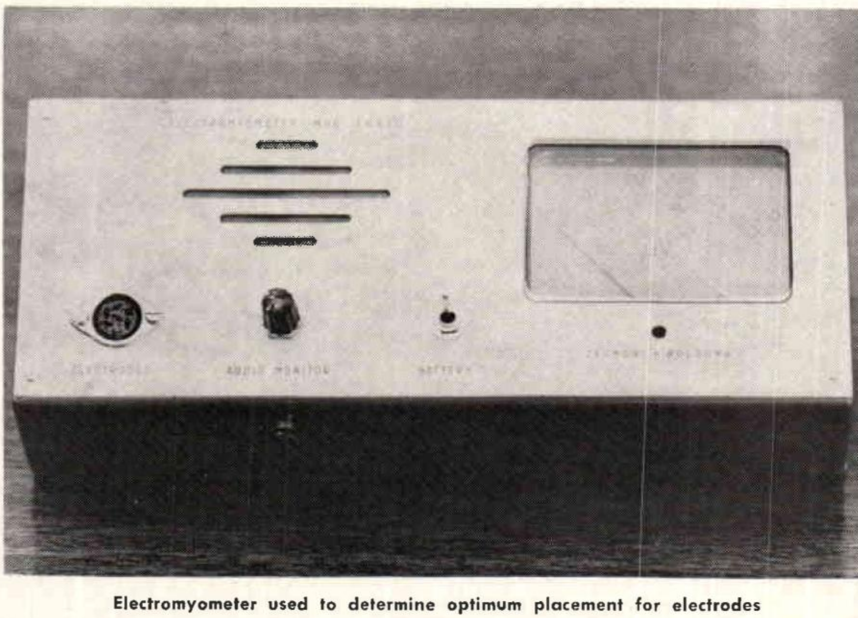
It is considered that the utilization of an artificial hand involves a series of about 400 movements a day. Therefore, the effective use of the hand is assured for at least two days before the battery requires recharging.

The battery, 6.8 x 2.4 x .65 inches (172 x 60 x 16mm) in size, can be recharged. It is slightly curved in shape so as to fit against the abdominal belt on which it is placed. It weighs 12.34 ounces (350 grams), and is made up of nickel-cadmium elements. Its average tension is 12 volts, and its capacity 0.45 amp. hrs.

The various components of the prosthesis are connected by special highly screened leads and plugs.

The Amplifier—The amplifier with transistors is enclosed in a casing measuring 4.15 x 2.4 x 0.8 inches (105 x 60 x 20mm) with a total weight of 4.6 ounces (130 grams). It is made up of two identical silicon transistor channels having a total gain of over 40,000.

The transistors are coupled in a special way so as to make it possible to amplify a band of frequencies involved in the myoelectric field. Frequencies above and below these vales are filtered out. In this way an amplifier has been achieved that cuts out disturbances due to house current dis-



Electromyometer used to determine optimum placement for electrodes

tribution as well as disturbances set up by the micromotor and broadcast transmissions. Through a potentiometer, the total gain of each single channel can be adjusted. This makes possible excellent adaptation of the prosthesis both as between individual and individual and, on the same individual, as between the electrodes placed on the flexor muscles or on the extensor muscles.

Hand—The hand, in plastic, is articulated at the junction between the metacarpal bones and the phalanges of the long fingers and of the thumb by means of ball-bearings; the fourth and fifth fingers are included in the movement of the second and third and are made of an elastic material. In the wrist cavity there is housed an electric micromotor which, through a reduction gear and a mechanical device incorporating screws and a slider with levers, operates the fingers. In particular this mechanism is made up of an electric motor with reduction gear and mechanical device in a single unit.

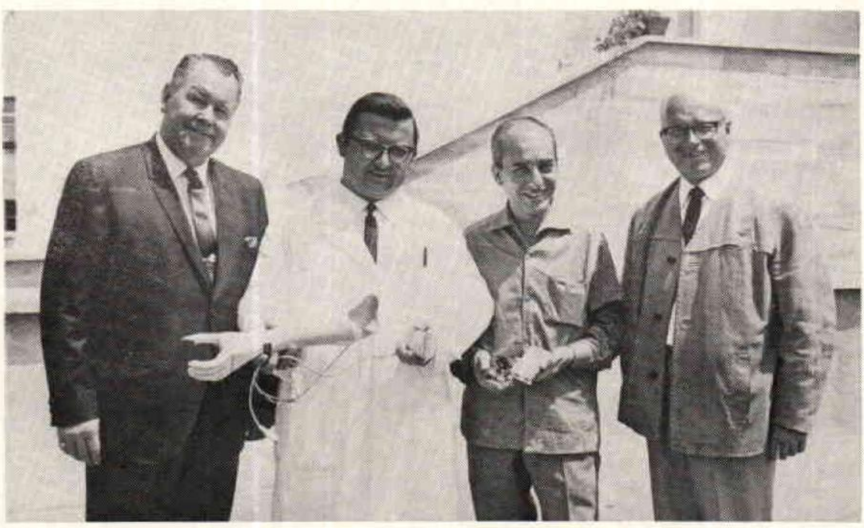
The micromotor operates on direct current and turns over at 15,000 rpm.

The total weight of the hand is about 12.34 ounces (350 grams).

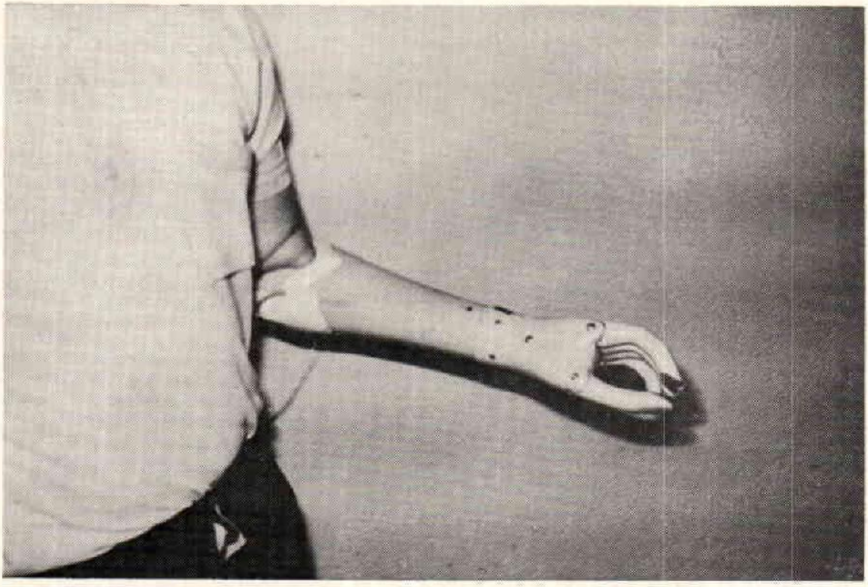
The strength of the grip at the tips of the fingers (measured by the dynamometer) reaches about 15½ lbs. (7 kgs), while with a pincer grip it can lift about 33 lbs.

To operate the prosthesis, the brain orders the flexor muscle to contract. This generates tiny signals called electro myographic, or EMG potentials. These EMG signals are picked up by the surface electrodes built into the socket of the prosthesis and amplified so as to run the small micromotor in the hand.

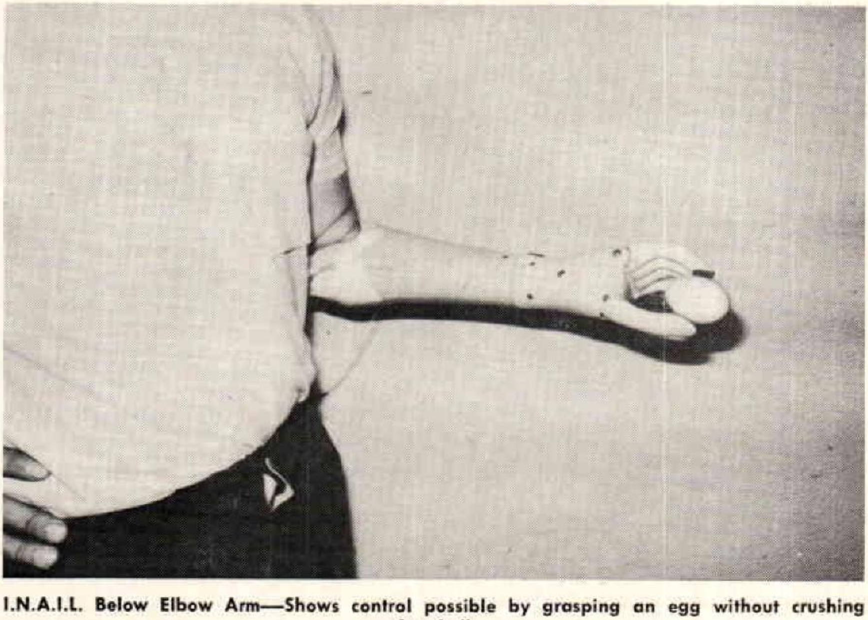
If the amputee wants a strong grip, he continues to order the flexor muscles to contract. Each command strengthens the grip until it reaches the maximum force. Conversely, when a light grasp is desired, the hand can be closed softly over the object. Ordering the muscle to contract further the amputee can progress from a soft grip to a strong grip thereby crushing or compressing any fragile or soft object in his artificial hand.



Left to right—John R. Hendrickson, Hannes Schmidl, Nino Zagnioni (Electrical Engineer), and Max Nader



I.N.A.I.L. Below Elbow Arm applied to amputee



I.N.A.I.L. Below Elbow Arm—Shows control possible by grasping an egg without crushing the shell

This particular prosthesis illustrates the principle of myo-electric control. It is possible, through attachment of other pairs of electrodes, to provide supination as well as pronation. In the case of an above elbow amputee, it will be possible to provide elbow extension and flexion.

We are at present organizing the mass production of the I.N.A.I.L. myoelectric prosthesis. At this stage modifications will be made to the external structure of the hand, which will be covered by a glove for appearance sake.

Myo-Electric and Pneumatic Control

Working with arm amputees using the Myo-Electric principle, it occurred to us that we might be able to combine the system with the Pneumatic System developed at Heidelberg, Germany.

This type of control, according to our research, would be of particular value to quadriplegics, especially in those cases where it is possible to apply an orthosis that can be operated by means of myo-electric impulses picked up from the facial muscles.

The special nature of these impulses makes it possible to obtain an extremely sensitive control exploiting the functioning parts of the body. Where it is not possible to apply electrodes to the facial muscles to operate a pneumatic control, an orthosis could not be used.

The possibilities of the application of Myo-Electric—Pneumatic Control are being studied at our Institute and we are convinced that they open unhoped-for horizons in the rehabilitation of the paralyzed.

VIETNAMESE REHABILITATION PROJECT ANNOUNCED

Dr. Howard A. Rusk, President of the World Rehabilitation Fund, Inc., has announced that the Fund is undertaking a major rehabilitation project for Vietnamese military and civilian disabled. The project is being financed by the Agency for International Development, U.S. Department of State, and will provide equipment and supplies to enlarge the present rehabilitation center in Saigon and to construct three smaller centers in the provinces.

AOPA member Juan Monros arrived in Saigon early in December to begin work as director of the prosthetics and orthotics portion of the project. Mr. Monros, who speaks English, French and Spanish, has conducted similar crash training programs in Peru, Brazil, Haiti, India and Ethiopia. One such project, sponsored by VRA and the World Rehabilitation Fund in 1962, has offered 1,000 sets of prefabricated brace parts to the new project.

Production of 500 artificial limbs and braces per month within a six-month period, and 1,000 per month by the end of the year, is the goal of the Vietnamese center. At present only about 60 new limbs and braces are produced each month. Prosthetic-orthotic equipment and supplies are being flown to Vietnam from the West Coast for use at the new center.

The estimated number of amputees in Vietnam varies from 10,000 to 35,000, and includes a large number of veterans wounded in the fighting against the French more than ten years ago.

Possibilities of Technical Orthotic Aid for the Paralyzed Lower Extremity *

By HELMUT HABERMANN

Frankfurt, Germany

This paper was presented at the Annual Assembly in Bremen, Germany, of the "Bundesinnungsverbandes"

[Translated by SIEGFRIED W. PAUL, C.P.O.]

The orthotic profession is facing an especially difficult task in bracing of the paralyzed lower extremity. Difficult, because an appropriate application of the appliance must be based on the specific and individual design of the orthosis.

Orthotic appliances for the paralyzed looked very much alike several years ago. They were orthoses with thigh and leg lacers, and quite often with an ischial seat and foot plates with a molded sandal. At the knee joint a swiss lock was as good as standard. The lower bars had a simple stirrup, and stops at the ankle joint, but the almost free motion defeated the functional purpose. Pelvic belts with hip joint, in most cases with a restricting lock, were added for the more severely paralyzed with involvement of the hip muscles. This resulted in a complete enclosure of the extremity, muscular damage, and the restriction of important joints. No doubt, this method accomplished a maximum of mechanical fixation which could not be exceeded by any other technique.

Professor Schede once wrote much about, "mechanically aided paralyzed," and I quote: "One is able to stand up any patient, if he is in fixation from the top to the bottom but all he would become is a statue leaning against something, unable to move."

The past years have seen a considerable change of opinion on the side of the physician as well as the orthotist. The principle of total fixation or stabilization of the joints does not determine the design of the orthosis, but the purposeful synergy of stability and functional freedom of motion of the patient. This development has been influenced by the deciding progress of the strictly doctoral therapy. The immediate and careful treatment by the physician for cases of poliomyelitis is preventing lasting damage to the kinetic system as well as to the joints. Purposeful positioning of the extremities has made contractures of the joints a rarity today. The diseased muscles are being placed at ease and the hyper-extension avoided. The blood circulation of the damaged muscles is stimulated through thermotherapy and light massages. The muscles are re-trained through early applied controlled physical therapy. Therapeutic procedures supported by load resisting exercises and active exercises in warm water whirlpools are extraordinarily successful. At times lengthy, tiresome and intensive treatments of the polio patient should not be under-estimated in their effectiveness. They are of tremendous psychological value since they represent the first

* Translated and reprinted with the permission of the author and the publishers from *Orthopaedie-Technik,* Wiesbaden, Germany, Heft 9: September 1963.

steps for the patient to ambulate with or without assistance, on his way towards the regaining of his physical independence.

Today we know that a fairly correct evaluation of the overall damage to the muscular system can not be made until after approximately two years. Damage to the neuro-muscular unity resulting in the loss of the ability to ambulate leaves the physician the choice between two therapeutical procedures: (a) Surgery, or (b) application of an orthosis. If the occasion arises, surgery as a pre-requisite for the successful application of an orthosis.

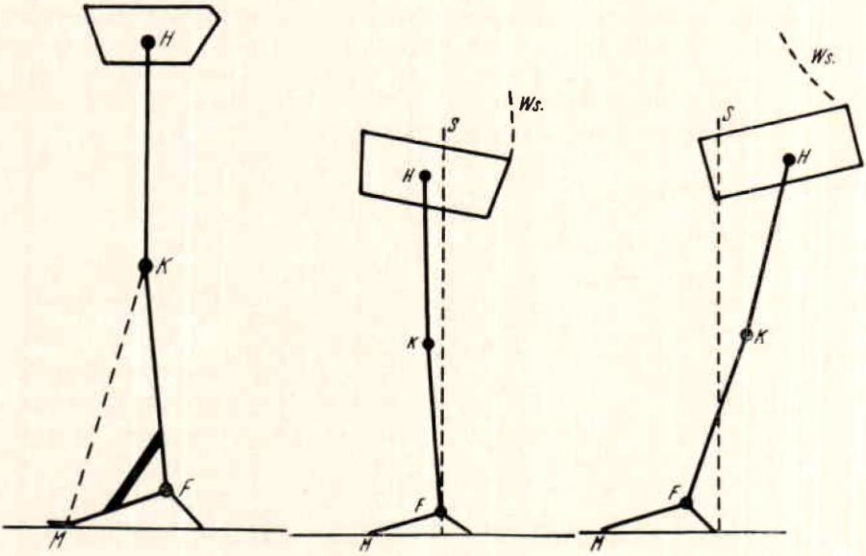
The surgical procedures include the osteotomy for the elimination of contractures and malalignment, tendon transfer as well as muscle plastics and the immobilization of joints. The arthrodesis fixation of the paralyzed extremities should be mentioned as a more or less final surgical procedure which requires a rather strict indication. Surgery of this type is creating a irreversible situation, and thorough evaluations of the individual case are a necessity. The indication for an orthosis will be given if surgical techniques are unable to assure a definite improvement of mobility, or if damages through mal weight bearing are to be expected. The physician and the orthotist will have to discuss the design of the orthosis before a prescription can be made. However, the prescribing physician should be able to expect that the orthotist has full knowledge of each and every technical aspect.

Orthoses can be of many different designs, but only one will meet the requirements of the individual case. It is difficult to determine the technical features of an orthosis in advance, since the patient instinctively will try to compensate for the liability of his paralyzed extremities. He will still activate existing muscles, swinging his shoulders and other compensatory body movements. Such proceedings demonstrate how disadvantaged pelvic components often can be. They simply limit compensatory freedom of motion and become in spite of their erective and supportive action limiting and bothersome. An exemption would be the considerable loss of muscles of the pelvic area. But even here, should we only use pelvic components if the hip muscles are bilaterally weak or completely paralyzed. The paralytic scoliosis is an additional indication which necessitates complex bracing with the use of pelvic and spinal attachments.

Clinics started to use temporary splints like plaster shells which are easy and fast to fabricate, after it was realized that an evaluation and period of training was necessary. These temporary splints are most useful in determining the mechanical support needed for satisfactory ambulation. This method is also of therapeutic value for the patient. Physician and orthotist are often surprised with how little assistance a patient is able to ambulate. Quite often we will be able to observe a gait that appears impossible to the observer familiar with the normal phase of locomotion. Often we would be disappointed to think that we could improve such a gait through mechanical assistance. We would only restrict the patient in his movements and he would lose control over his motions. It is difficult, and at times, impossible to analyze such proceedings.

An orthosis can only be properly designed if the orthotist has full knowledge of the various methods used to accomplish one or the other effect.

We should mention the mechanical stop controlling the dorsal flexion of the foot in connection with this. The full value of the dorsal stop for the stabilization of the lower extremity joints has even today not been fully realized. The dorsal stop at the ankle joint will find application if the gastrocnemius is paralyzed. The action of the dorsal stop in relation to the knee joint is also of great importance since we stabilize the knee joint during walking phases from mid-stance to heel off.



Illustrations 1, 2 and 3

ILLUSTRATION #1

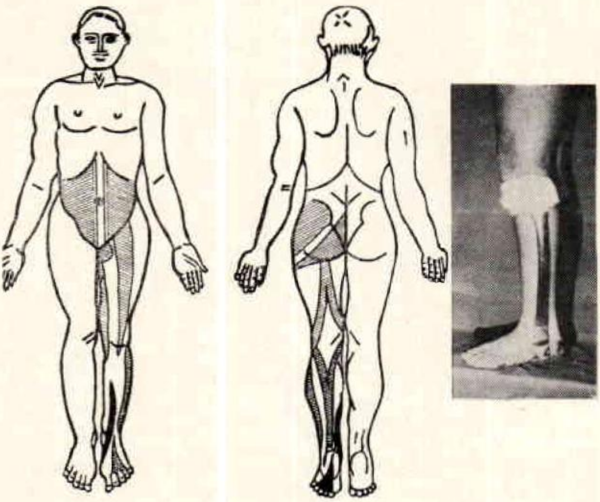
This means that it is possible to influence the stability of the knee joint positively from the ankle joint. However, hyper-extension of the knee has been created. This necessitates the incorporation of the thigh in the orthosis in many cases.

ILLUSTRATION #2

The mechanical knee joint will have to be aligned in such a manner that it permits just as much recurvatum as it takes to stabilize the knee. The influence on the hip joint and pelvis should not be overlooked. Increase of the equinus position (increase of the dorsal stop) will react positively on the stability of the knee. The pelvis will be tilted anteriorly (the hip joint flexed) especially if the gluteus maximus and medius are paralyzed. The dorsal stop will have to be so adjusted (taking the height of the heel into consideration) that the stability of the knee is assured and the pelvis erected. A "gluteus strap" is of assistance if the need arises. The pelvis will find its erection and point of stabilization through the leverage of the fore foot.

ILLUSTRATION #3

However, it would be wrong to believe that the dorsal stop has to be used for every orthosis aiding a paralyzed lower extremity. The individual case should always be the determining factor. A present arthrodesis will eliminate a dorsal stop very often. Such a surgical procedure will simplify the design of a orthosis. In many instances the stability of the knee can only be achieved through a mechanical knee lock. This is definitely true about the paraplegic patient. Even though we should try to find a design avoiding a knee lock whenever possible, a freely moving knee is of psychological advantage to the patient. Furthermore existing muscles will be exercised with every step and the appearance of the gait is more natural. It will take special effort and repeated experimenting to reach this goal. A financier has very little understanding of the time of testing involved to find the best mechanical solution for the patient. He will only see the completed product and not the effort it took to accomplish the final features. It is possible though to establish basic principles in spite of the difficulties involved in pre-determining the final design of an orthosis. Paralysis of the lower leg for instance.



Pat. Lu.
Bauchm. gut
Hüft-u.Obersch.M. gut
Tibialis ant. ausgef.
Fibularis M. schw.
Extensoren schw.
Gastrocnem. schw.
Tibialis post.ausgef.
Flexoren ausgef.

ILLUSTRATION #4

Patient Lu.	
Abdominal muscles	functional
Hip & thigh muscles	functional
Tibial anterior	paralyzed
Fibularis muscle	weak
Extensors	weak
Gastrocnemius	weak
Tibialis posterior	paralyzed
Flexors	paralyzed

ILLUSTRATION #4

The gastrocnemius, flexors and tibialis anterior and posterior would result in a typical valgus deformity. We would observe a weakness of the powerful plantar flexion and the stability of the knee besides the malposition of the foot. The appearance of the gait becomes awkward. The foot will slap to the floor without any resistance at heel contact. The lifting of the heel from the floor is also impossible. This picture of a deformity would question the need for an orthosis. This question, in general can not be answered with a Yes or No.

The patient no doubt is able to ambulate, and it happens only too often that the patient ingeniously compensates for the lost motions during the phases of gait. It depends on the individual case to justify an orthosis. An orthosis is indicated where it is necessary to enable the patient to do extensive walking and to improve the appearance of his gait. The knee stability of the patient will also benefit from an orthosis.

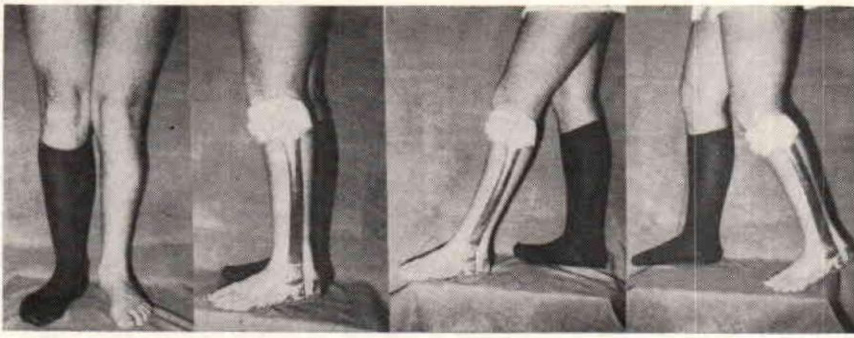


ILLUSTRATION #5

Another example will demonstrate how it is possible to stabilize the joints with little mechanical effort.

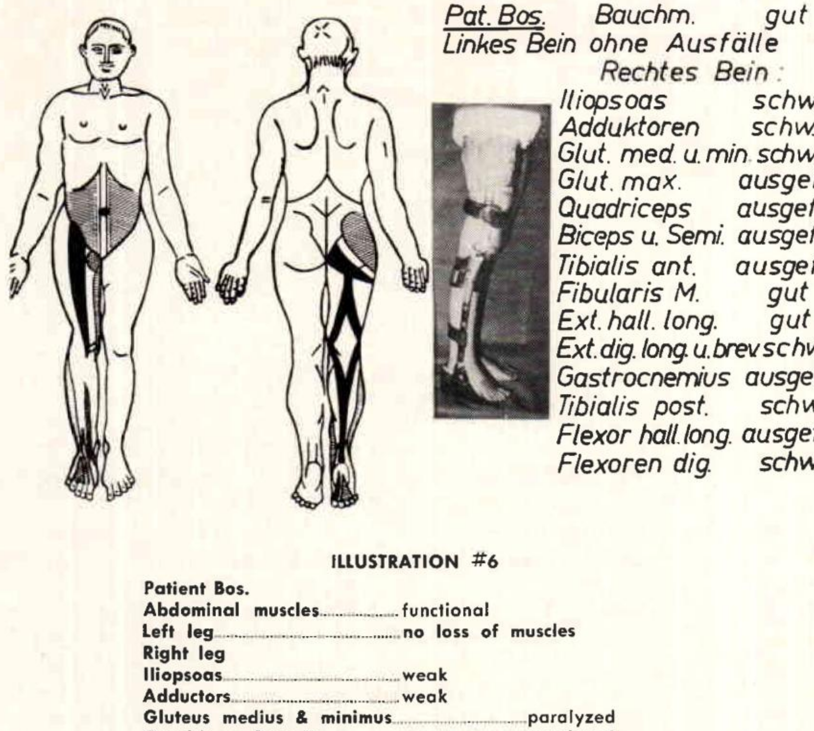


ILLUSTRATION #6

Patient Bos.

Abdominal muscles	functional
Left leg	no loss of muscles
Right leg	
Iliopsoas	weak
Adductors	weak
Gluteus medius & minimus	paralyzed
Quadriceps femoris	paralyzed
Biceps, semitendonosis & membranosis	paralyzed
Tibialis anterior	paralyzed
Fibularis	functional
Extensor hallucis longis	functional
Extensor digitorum longus & brevis	weak
Gastrocnemius	paralyzed
Tibialis posterior	weak
Flexor hallucis longus	paralyzed
Flexor digitorium	weak

Demonstrates the relatively extensive loss of muscles of this patient. In this case, the gluteus medius and minimus are partially paralyzed. The gluteus maximus as well as the quadriceps, biceps, semitendonosus, semimembranosus, gastrocnemius, flexor hallucis longus and the tibialis anterior are completely paralyzed. The iliopsoas, adductors, tibialis posterior and the digital flexors are weak. The function of the abdominal muscles, fibularis muscles and the hallucis longus are functioning normally. We are confronted with a situation which would make an ambulation without fixation of the hip and knee joint usually questionable. But in this case, was it possible to utilize an orthosis which had neither locks at the knee joint nor at the hip joint. Sufficient stability was provided even though it was not at first expected.

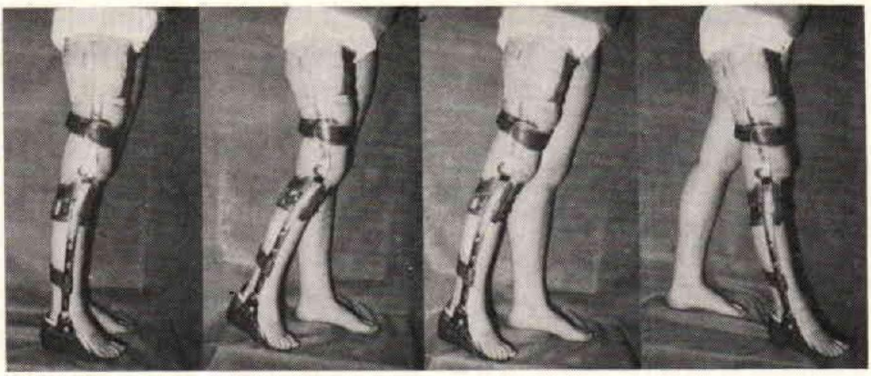
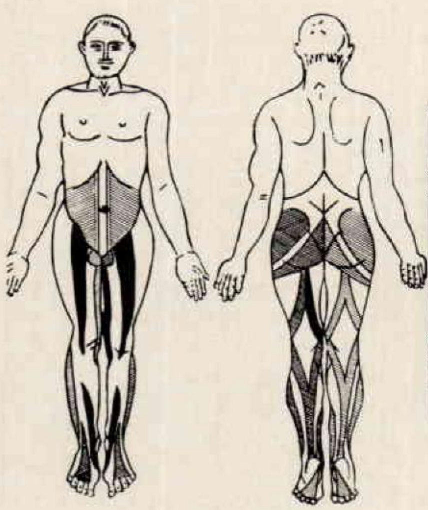


ILLUSTRATION #7

The mechanical dorsal stop was of greatest importance in the case of this orthotic problem. The stabilized foot has the function of a knee lever action, as previously indicated. The extremely posterior located mechanical knee joint became through this lever action markedly more effective. But not only the influence on the knee joint was of advantage, the hip joint gained the ability of full extension based on the foundation of the fore foot. The weak gluteus minimus and medius aided little, but still were some support. It should not be overlooked that the hip muscles of the unaffected side are fully functional and represent a partial compensation for the affected side. It is recommendable in such a case to use an orthosis with a short thigh lacer. Such a lacer helps to establish an intimate contact between orthosis and extremity, especially in the region of the hip joint. Ischial weight bearing is impractical, since it would interfere with the extension of the pelvis in this particular case. Only a well designed orthosis with a dorsal stop can feature the stability of joints without application of locks. Some support for the function of this orthosis was found in the flexor digitorum longus and brevis supplementing the knee joint. The rather weak adductors, gluteus medius and minimus supported the hip joint. It should be a most desirable task for the orthotist to design an orthosis which stimulates the function of such weak muscular forces and still permits a secure but much more natural gait. The next case is a polio patient with partial paralysis of both lower extremities.

ILLUSTRATION #8

The status of the muscular system is: (a) Functional abdominal muscles, as well as on the right side the gluteus maximus, medius and minimus, biceps, semitendonosus, semimembranosus, gastrocnemius, tibialis posterior, fibularis longus and the flexors. On the left side: the gluteus maximus,



Pat. Rö. Bauchm. gut.
Iliopsoas re. gut, li. schw.
Addukt. re. gut, li. ausgef.
Glut. max., med., u. min. re. gut, li. schw.
Quadric. re. u. li. ausgef.
Biceps re. gut, li. schw.
Semi. re. gut, li. ausgef.
Tibialis ant. re. u. li. ausgef.
Tibialis post. re. gut, li. schw.
Fibularis long. re. gut, li. schw.
Extens. re. u. li. schw.
Flexoren re. u. li. gut

ILLUSTRATION #8

Patient Ro.

Abdominal muscles	functional
Iliopsoas—Right	functional
Left	weak
Adductors—Right	functional
Left	paralyzed
Gluteus maximus, medius & minimus—Right	functional
Left	weak
Quadriceps femuris—Right	paralyzed
—Left	paralyzed
Biceps—Right	functional
Left	weak
Semimembranosis & tendonosis—Right	functional
Left	paralyzed
Tibialis anterior—Right	paralyzed
Left	paralyzed
Tibialis posterior—Right	functional
Left	weak
Fibularis longus—Right	functional
Left	weak
Extensors—Right	weak
Left	weak
Flexors—Right	functional
Left	functional

medius and minimus are weak, and the important quadriceps is not functional. The quadriceps of the right side is also paralyzed. The iliopsoas of the right side is functional but weak on the left side. The adductors of the right side are not involved, but on the left side along with the semimembranosis and semitendonosis are not functioninng. The biceps, gastrocnemius and fibularis longus of the left side are also weak. The tibialis anterior on both sides are paralyzed and the extensors show only little function. Primary bracing was applied to the left side only in spite of the severeness of the paralysis. The orthosis featured a free ankle joint and a lock at the knee joint.

This young man had suffered continuously from his handicap and his awkward gait caused him to feel depressed. He was fitted with a new orthosis six months ago. We had the intention of accomplishing free motion at the knee joint. The weak muscles of the calf and the functional extensors made it necessary to move the ankle joint extremely anterior. The locating of the ankle joint along with the dorsal stop was most important in creating the most beneficial alignment for the mechanical knee and hip joint.

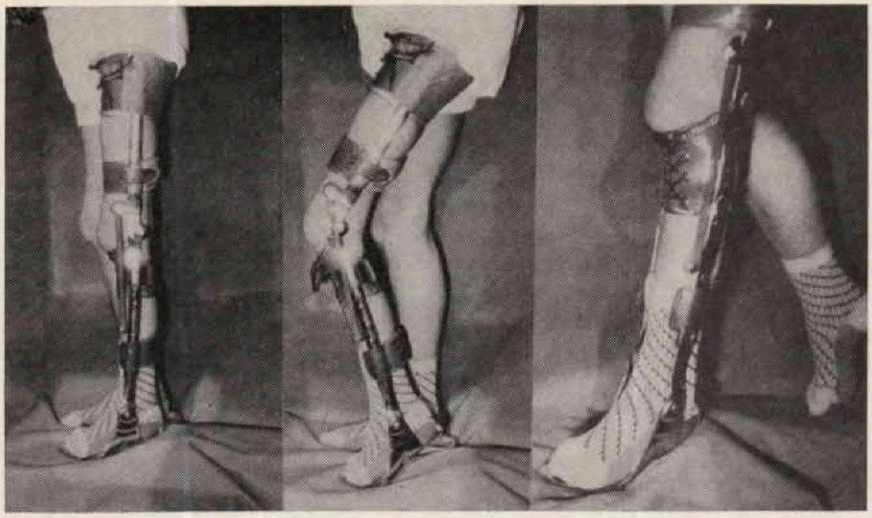
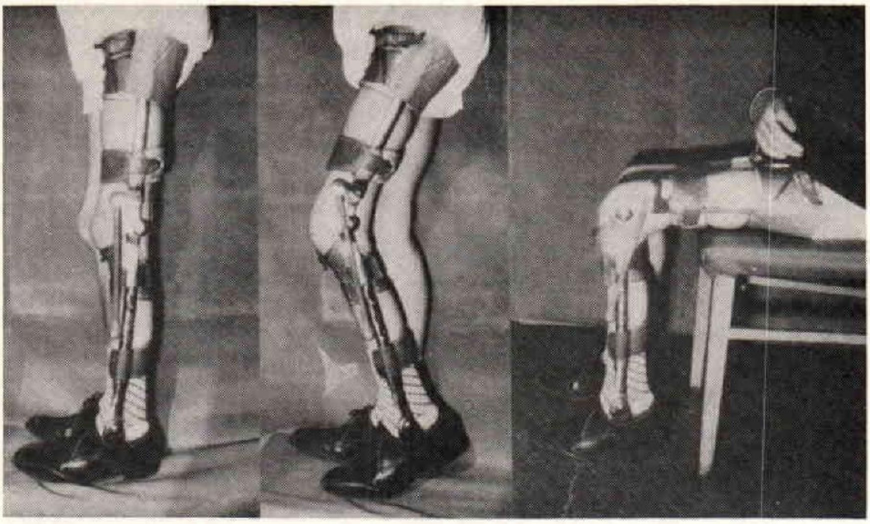


ILLUSTRATION #9

This picture demonstrates the extremely posterior location of the mechanical knee joint. A short thigh lacer was incorporated to assure good contact between orthosis and extremity. Sufficient knee stability was not achieved immediately, even though the stops of the ankle and knee joint were carefully aligned. The missing knee extensors of the right side represented one cause for instability which was noticed on inclines and uneven ground. The inability to use the extensors of the left side for compensatory movements was another reason. Full knee stability was accomplished after application of a knee extension assist. The extension assist consists of an especially fabricated strong elastic tendon with reinforcements of fabric at the points of attachment. The points of attachment of this assist in relation to the knee joint can be moved anterior or posterior. A correctly located assist will assure assistance in extension up to a flexion angle of 140 degrees, the average flexion of the knee during the gait phase. Another benefit of the assist is the fact that the extension assistance changes to flexion assistance once the knee has been flexed beyond 140 degrees. The extension assist moves posterior to the knee center during knee flexion.

ILLUSTRATION #10

There is a marked difference between the laterally attached assist and knee caps or other knee extending elastic straps which exert pressure on the knee joint during flexion. Only patient and extensive testing made it possible to establish a relatively good gait and a considerable freedom of motion. I would like to mention that the strong flexors as well as the weak gastrocnemius somewhat assisted in stabilizing the joints. It was also important to permit full plantar flexion to prevent a pushing force during knee flexion. The mechanical stops of the ankle joint must also be accurately adjusted for the height of the heel. It was most satisfying to witness the joyfulness



of this young man about the freely moving knee joint which permitted him to ambulate almost normally with only little restriction.

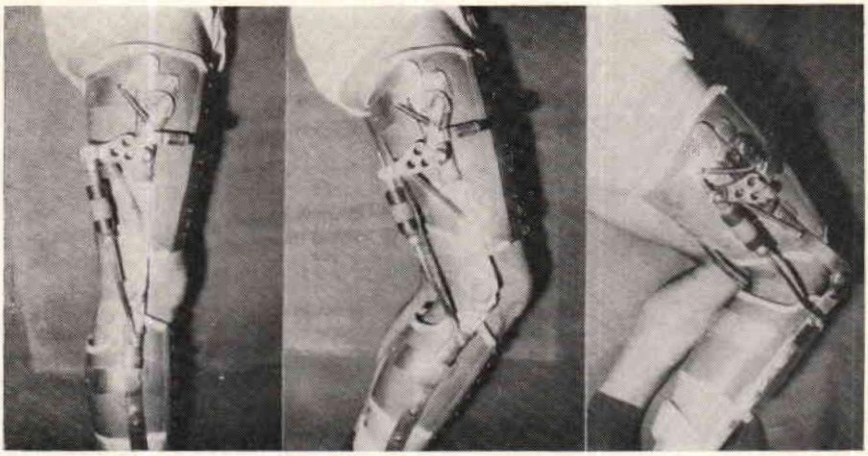
Taking such experiences into consideration, the orthotist should always make a thorough study of the muscular conditions of his patient before he carefully plans the design of the orthosis. His aim should be the utilization of even the weakest muscular functions, and the least restriction of motion from the orthosis. These considerations are of the greatest importance to the patient. However, I have to mention that we reach our goals only after a period of training and getting familiar with the new and different orthoses. A positive approach on behalf of the patient is a necessity for success.

I am going to demonstrate an experimental orthosis as the last example of my representation about individual technical aid for the paralyzed lower extremity. This orthosis was designed for a very specific cause.

The patient had experienced a considerable recovery from severe poliomyelitis. An orthosis was not an absolute necessity any more. However, on occasion it would happen that uneven ground, doorsteps, and carpet borders would cause instability of his knees. Compensatory movements were not sufficient to prevent falling. The result was a history of torn and pulled ligaments, hemorrhages and severe damage to the knee joints, etc.

An experimental orthosis was designed featuring free motion of the knee during the walking cycle. However, the motion at the knee would come to a stop if the patient should stumble. This locking of the knee joint could not become active spontaneously, but had to become effective with some elasticity. The forces occurring at the knee are excessive and the solution achieved is definitely not suitable for general application. Nevertheless, I believe it to be of value to continue to work with this particular problem. We know of many cases which in case they stumble, need a soft applying brake to prevent a fall. There is definitely a very close parallel to the prosthetic knee.

The present case found a full mechanical solution of the problem. The cosmesis of the design was not acceptable nor recommendable. The me-



chanical principle of the connecting rod as was used for this particular case. The involuntary flexion of the patient's knee was brought to an "elastic stop" at a flexion angle of 145 degrees and injury of the knee prevented. A lever could be triggered to accomplish full knee flexion.

As I have mentioned previously, the forces at the time of the braking of the knee are excessive. Pneumatic or hydraulic brake units should be most useful for such a case, providing they had a cosmetically acceptable design and location. I have mentioned this problem because of the demand for this type of technical assistance which so far has not found a satisfying solution. It is the soft, elastic braking when standing up under heaviest pressures that would be most desirable. The illustrations demonstrate only a modest beginning in a state of testing.

The above captioned statements are meant to demonstrate the many possibilities for orthotic devices in case of paralysis of the lower extremity. My primary interest concentrated on designs which feature a maximum of stability, and still permit the highest degree of motion without mechanical interference.

I see in this the essentials of modern technical orthotics. There is also the demand for an intensive study of each case in its individuality when it is presented to us. It will only be through such efforts that it will become possible to aid the patient with the best possible orthotic appliance.

An Improved Method of Cast Removal

By LAWRENCE J. DELANEY, M.D.

Newton Centre, Massachusetts

EDITOR'S NOTE: William A. Tosberg, C.P.O., Chairman of the *Journal's* Editorial Committee, suggests that Dr. Delaney's article will be of interest to orthotists who must apply plaster of Paris casts for the construction of splints and braces. "I admit that the electric saw used for the removal of casts is terrifying to many patients, especially children," Mr. Tosberg writes, "and I have quite often found the Gigli saw superior."

Since time immemorial, plaster of Paris has been used to immobilize fracture sites. For obvious physiological and kinesiological reasons, usually the joint below and the joint above the fracture site is immobilized in plaster of Paris.

To begin with, plaster of Paris was applied directly from a mixture in a bucket. Over the last 20 years there has developed the impregnated bandage type of plaster of Paris, which is in common use. The usual extremity cast is applied in three stages. The first stage is the application of a stockinette which is a woven knit, sleeve-type cloth pulled over the arm or leg. Step 2 consists of the application of sheet wadding, which is a cotton-wool type wrapping placed over the bony prominences and sometimes over the entire area to be casted. The 3rd step consists of the application of the actual plaster-impregnated bandage.

At some time after the application of the cast, it must be removed. At the present time, the usual method of removal entails the use of an electrically powered circular saw which has a vibratory motion. Although it is publicized that this vibrating circular saw will not cut the skin, this is not true and anyone who has removed casts has experienced either cutting of the skin, or anxiety—ranging from minimal to severe—of the patient who is having the cast cut off. The current cast-cutting saw is a loud, noisy apparatus which scares the young and timid.

The new method is only a slight, but essential, change in the previously described application. Steps 1 and 2 are exactly the same as previously described. However, an extra procedure is done between steps 2 and 3 and this simply is the imbedding or placing of a Gigli saw over the cotton-wool and under the plaster. The Gigli saw comes in lengths of 12, 20 and 25 inches and longer if desired. The average price is about 50¢ per saw. Essentially, a Gigli saw is a wire with a cutting edge—that is, it is flexible, it is small, and it has two loops, one at each end. These loops are allowed to protrude from the proximal and distal ends of the cast. When the time comes for removal of the cast, one uses the handles which are standard and have been in manufacture for over 50 years. These are applied to the saw blade and with a back and forth action, the cast is cut through in either one or two places with no injury to the skin, no electrical apparatus and no loud noise and/or heat which previously was needed to remove a cast.

It is believed that this methodology is a great improvement over the standard procedure for removal of casts especially in those who are young and/or timid. The cost is about 50¢ per cast, per saw. See illustrations 1 and 2.

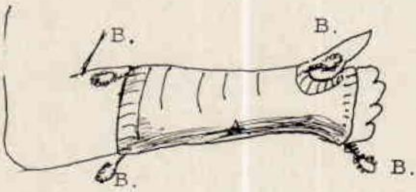


FIGURE 1. Metacarpal Cast
A. Cast
B. Two Gigli Saws

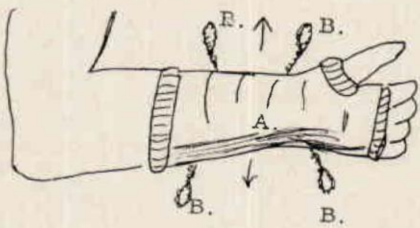


FIGURE 2. Metacarpal Cast Removal
A. Cast
B. Two Gigli Saws

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4. *Operative Orthopedics,* by W. C. Campbell. Second edition, Vol. 2. Published by C. V. Mosby Company .

Books Received

Lumbar Disc Lesions: Pathogenesis and Treatment of Low Back Pain and Sciatica, by J. R. Armstrong, M.D. Third edition, Baltimore, The Williams and Wilkins Company, 1965, 307 pages, illustrations. $13.50.

This excellent British text first appeared in 1952 and has been revised considerably. Orthotists will be particularly interested in the discussions of the conservative treatment of lumbar disc lesions.

Prosthetics, by Carl Dame Clarke, Ph.D. 336 pages, illustrations, published by the Standard Arts Press, Butler, Maryland, U.S.A., 1965. $10.00.

This book covers external prostheses, primarily from a cosmetic viewpoint. Restoration of regions such as the nose, the ear, the chin, the cheek, is described, as well as prostheses for the breasts and extremities.

Problems of Amputation, by Jean Sommelet, J. M. Paquin, and Guy Fajal. No. 5-6, Atlas d'Appareillage Prothetique et Orthopedique, Nancy, France. 1964. 150 pages, illustrated.

This publication is written in French, English, German, Spanish and Italian, with all five texts appearing concurrently on facing pages. Captions for the numerous illustrations also are in all five languages.

Osteomyoplastic Amputation, Levels of Amputation, and the Human Frame and Amputation are discussed in relation to the work of the prosthetist in designing and fitting artificial limbs. Sixty-five large scale line drawings augment and explain the text.

This is a useful book for the prosthetist who wishes to enlarge his working knowledge of anatomy and the relation of the stump to the prosthesis.

Late Sequelae of Amputation

THE HEALTH OF FINNISH AMPUTATED WAR VETERANS

By KAUKO A. SOLONEN, H. J. RINNE, M. VIIKERI and E. KARVINEN

Helsinki, Finland

EDITOR'S NOTE: This report, reprinted by permission of the editor and authors from *Annales Chirurgiae et Gynaecologiae Fenniae,* Vol. 54, Supplement 138, 1965, is from the Kaskisaari Rehabilitation Centre and the Institute for Occupational Health in Helsinki, Finland. Because of its length, it will be published in two parts. Col. Barbara R. Friz of the Committee on Prosthetic and Orthotic Education, National Academy of Science-National Research Council, has given the *Journal* the following comments on the article:

"An unusual opportunity to study the late effects of amputation on a large sampling of World War II veterans in Finland was provided by a situation in which the amputees were available as subjects for a period of three weeks. By taking advantage of this opportunity, a team of investigators was able to conduct an extensive study and, subsequently, to report an impressive list of findings which contribute significantly to the store of knowledge in this area. The investigators apparently used every possible measure, including a large control series, to ensure the reliability of the findings.

"The authors discuss and compare their findings with others in this field, thus increasing the scope and value of the article. It is reassuring to note that the general physical condition of these amputees in their middle years compares favorably with that of uninjured individuals of the same average age."

INTRODUCTION

Of the disabled servicemen from the 1939 - 1945 wars on whom amputation of the upper arm, forearm, thigh and leg had been carried out, about 5,000 survived. Those who have had to do with our war veterans admire the sturdy perseverance which most of these seriously disabled men show as active members of the community, employed in even the heaviest occupations.

It is to be expected that because of the severe physical loss greater stress than usual will fall upon that part of the body which must compensate for the lost function or continue its earlier function despite the extensive change. Now, about twenty years after the wars, we can expect to gain an idea whether amputation of an extremity has any effect upon the general health of the amputee, *i.e.* of the late results of amputation. Similar studies based on more limited series of Finnish war veterans have already been carried out to some extent (Solonen and Aho 1958, 1959). As is well known, amputees themselves believe that many of the disorders from which they suffer after the loss of an extremity, pain in limbs or back pain, symptoms of fatigue, heart diseases, etc. are directly or indirectly attributable to the amputation. At variance with this belief is the opinion held by many doctors that amputation does not cause any noteworthy injury beyond that entailed by the loss of a limb in itself Some authors (Arens 1962, Belz 1962, Warmuth 1962) have drawn attention to the marked difference between the subjective symptoms and the clinical and radiological findings in the area of the motor-skeletal system in amputees. Such a difference is not confined to amputees, however, but is commonly met with, particularly in cases of arthrosis deformans. The fact that persons with lower limb amputations and good prostheses have as much back pain and deformities as those with poor prostheses has attracted attention. It should be remembered, however, that even though the artificial limb fits well, is of correct length and weighs little, the fact remains that when a person loses a large part of his lower limb, for instance, he also loses a large part of his active organism, which is replaced by a dead detachable substitute which lacks sensibility and which makes demands on the strength of the remaining organism. At the same time, the centre of gravity of the body changes and, furthermore, occupies different positions according to whether the artificial limb is being worn or has been removed, whilst it is always in a different position than before the amputation. Banfo (1960) found that after an extensive lower limb amputation, for instance, the centre of gravity may move from its original site to as far as the level of the twelfth thoracic vertebra. The centre of gravity, moreover, moves laterally from the central sagittal plane. It is understandable that to preserve the equilibrium of the body under such conditions both when moving and standing requires quite a changed position of the trunk, different effort and muscular function (Müller and Hettinger 1952, Bauer 1954). That deformities and degeneration of the spine arise or become exacerbated as a result of amputation is being more and more generally admitted (Lange 1952, Arens 1957, Borgmann 1959, Endert 1959, Mayr and Schoch 1959, Schöneberg 1960). However, as was already indicated, the radiological state of the spine does not always reveal the severity of the condition (Biström 1954, Solonen 1959). It must not be forgotten, on the other hand, that if certain pathological changes of the spine are radiologically demonstrable, the spine must be considered inferior to a healthy one and, at any rate potentially, diseased.

The assertion that amputation of one lower limb causes increased deformity and subjective symptoms in the remaining limb has been challenged, for one thing, on the grounds that even a healthy person when walking always places weight on one leg at a time and thus a single lower limb is designed to carry the whole of the body weight; there is thus no reason to believe that the capacity of the healthy lower limb of an amputee is less than that of the healthy leg of a non-amputated person (Schöneberg). This is a specious argument, however. In 24 hours an amputee applies more weight to his healthy limb than to his artificial one. In walking, weight is placed for a shorter period on the artificial than on the healthy limb and in standing more weight is borne by the intact limb than by the prosthesis (Bauer). It should also be remembered that in the morning and evening at home a person with a lower limb amputation ofter moves about without his artificial limb, jumping or walking on crutches and thus placing a particularly heavy strain on his only sound leg. Because of the normal weight-bearing involved when the patient walks both with and without a prosthesis, the position of the foot changes, thus provoking various disturbances.

Solely to maintain his balance an amputee uses considerably more energy than a healthy person. For movement, more than the normal amount of energy is likewise demanded from muscular resources that are smaller than normal. Even the loss of an upper limb disturbs movement and the maintenance of balance in the absence of auxiliary movements and the weight of the arm. When there is loss of large portions of some organic system it would not be surprising if this were also to affect the function of the interior organs. The correlation between amputation and hypertension, obesity and disorders of the internal organs has, in fact, been investigated elsewhere.

As regards their primary aetiology or patho-anatomy the deformities and degenerative changes of the skeleton and joints, the reduced mobility or other secondary injuries of the body in amputees hardly differ from similar changes in non-amputated persons. However, an investigation of the frequency and the degree of severity of such findings is called for, particularly as it is unlikely that observations made in other countries are directly applicable to Finnish amputees. Since the results may also be of significance from the point of view of medical insurance, it would seem important to determine the correlation between the expected pathological changes and the primary injury. For this reason we have tried to render our investigation as reliable as possible by using a large control series.

MATERIAL

The amputees investigated were all disabled in the 1939 - 1945 wars.

The following abbreviations will be used to indicate the various groups: Upper arm amputations—AE, forearm amputations—BE, thigh amputations —AK, lower leg amputation—BK, amputation of two limbs—D and control series—C.

TABLE 1

INVESTIGATED AMPUTEES

Group	No. of cases	Age yrs.	Average age	Average time since amputation, yrs.
Upper arm amputations (AE)	48	36—54	45	19
Forearm amputations (BE)	24	37—58	45	19
Amputation of thigh (AK)	65	36—54	44	18
Amputation of lower leg (BK)	157	27—59	44	18
Two limbs amputated (D)	17	35—57	45	19
Total	311			

As a control series we used non-amputated persons of the same age groups who had fought during the war and who were otherwise chosen at random.[1]

TABLE 2

CONTROL SERIES (C)

No. of persons	Age	Average age
92	33—67	45

[1] Our thanks are due to the Helsingin Reserviupseeripiiri r.y. and the Helsingin Reservialiupseerit r.y. for the assistance they gave us in collecting the control series.

Occupation of the investigated war disabled men, who were chosen at random:

Heavy labour (farm labourers, lumberjacks, unskilled workers, builders, etc.)	42 per cent
Medium heavy (carpenters, painters, platers, drivers, etc.)	20 per cent
Light work (shopkeepers, tailors, shoemakers, etc.)	25 per cent
Intellectual workers	11 per cent
Persons who could not be referred to any particular profession	2 per cent

It should be mentioned that of the 17 persons with two limbs amputated, 7 had undertaken heavy labour. Reamputation had only been carried out in a few cases and in the present investigation no particular attention has been paid to this point.

METHODS OF INVESTIGATION

The team of investigators consisted of an orthopaedist, a specialist in internal medicine, a radiologist and a physiologist.

An orthopaedic examination was carried out on the amputees immediately upon their arrival at the Kaskisaari Rehabilitation Centre for a routine course of rehabilitation and on the use of a prosthesis arranged for the war disabled. It should be mentioned that the law provides the possibility for all war amputees to take part in these three-week courses in which about 300 persons participate yearly. The amputees of the present series represent an average sample of the amputated war disabled. The medical, radiological and physiological examinations were carried out during this course and it is our belief that at the time of the examination the treatment given at the institute had not yet had any significant effect upon the amputees investigated. To obtain as reliable case histories and examination results as possible we made it clear to the persons involved that the check-up examinations and tests were a routine check-up and that the results obtained would not be of any direct use for them. For the examinations the usual orthopaedic, medical and radiological methods were used. Each specialist carried out all the examinations in his particular field himself and the results are thus evaluated on a uniform basis. The following radiological examinations were carried out:

Upper limb amputations: Cervical spine, thoracic spine, lumbar spine, shoulder joints, elbow joints, wrist joints, stump and miniature radiogram of the chest.

Lower limb amputations: Thoracic spine, lumbar spine, hip joints, knee joints, ankle joints, foot, stump and miniature radiogram of the chest.

Control group: All the above (except the stump).

All radiograms were made in two planes perpendicular to one another. The miniature radiograms of the chest, 10 by 10 cm, were taken in an anteriorposterior and a lateral direction with contrast medium. To obtain as objective an evaluation of the results as possible, the radiograms of the stumps were laid aside and the rest of the radiograms were mixed, so that the radiologist evaluating them did not know to which group of amputees the patient in question belonged. In the evaluation of the radiograms we tried as thoroughly as possible to follow the radiopathoanatomical classification of the following authors: Köhler (1953), Schinz *et al.* (1953), Brocher (1957, 1959), Schmorl and Junghanns (1957).

No attention has been paid in the present investigation to the *prosthesis,* since a single artificial limb is always an aid of short duration and thus not of any particular significance so long after the amputation. Many of the amputees of the present series had had five or six or even more prostheses since their amputation.

RESULTS

General Condition

The general condition of the persons examined was, as a rule, good. In only a few cases, 3 per cent of the amputees and 2 per cent of the controls, was the general condition considered below normal.

TABLE 3

STATE OF NOURISHMENT

Amputees	Overweight %	Normal %	Underweight %
AE	12	81	6
BE	17	79	4
AK	37	60	3
BK	21	78	1
D	35	65	—
Total	24	74	3
C	12	84	4

In classifying the series into three weight groups (overweight, normal, underweight) the basis for the division was an excess or deficit of 15 per cent, the number of kilograms being compared with the number of centimetres exceeding one metre of the subject's height. The weight deficiency due to amputation was calculated according to Braune and Fischer's table (1893).

There was no clear difference in the weight distribution of the upper limb amputees and the controls. Among the lower limb amputees there were clearly more overweight persons than among the upper limb amputees who had both legs intact, or among the controls. The difference is statistically significant ($P < 0.01$). There was a relatively greater degree of overweight among the persons with thigh amputations. The group with two amputations is so small that statistical tests cannot be applied to it.

In a series of 1,100 thigh amputees, Meyeringh and Stefani (1956) did not find a greater tendency to overweight than in a normal population. According to Loos' (1957) investigation of 647 amputated persons, there were no differences worth mentioning between the percentages of overweight persons in the different groups. According to him, this would seem to indicate that the limited mobility of the lower limb amputees does not contribute to the devolpment of overweight.

A number of routine laboratory tests were carried out on all persons investigated, the results of which are given in table 4. These values are the mean values for all the amputees.

TABLE 4

SOME LABORATORY FINDINGS

Group	No. with ESR over 20 mm/ hr.	Hgb mean value g	Cholesterol mean value	Pathological ECG
AE	2			3
BE	2			2
AK	7			7
BK	7			7
D	2			2
Total	20 (6%)	14.3	267.4	21 (7%)
C	5 (5%)	14.0	300.7	6 (6%)

Only conditions following thrombosis of the coronary artery and evident signs of deficiency in the function of the coronary artery, severe rhythmic and conductive disturbances and signs of hypertrophy of the right or left side of the heart were considered pathological electrocardiographic findings. There was no cases of angina pectoris in our series (though one subject in the control series had thrombosis of the coronary artery some weeks after the examination). There were 21 (7 per cent) pathological electrocardiograms among the amputees and the percentage did not significantly exceed the corresponding figure for the control group. Neither were clear differences observed between the groups in the other laboratory tests. No explanation can be advanced for the difference between the cholsterol values.

Meyeringh *et al.* (1960) compared the ECG findings of more than 1,000 amputees with those of other war disabled men who had not lost a limb. They concluded that cardiac disorders are not caused by factors related to the condition following amputation. Neither did they find among the amputees any tendency towards sclerosis of the coronary artery. On the other hand, these authors mention cardiac disorders arising from the inflammatory conditions that occasionally occur as sequelae of amputation.

The connection of the condition following amputation of the left arm with subsequent angina pectoris has also been discussed in the literature (Delius 1953 and Sturm 1957).

The results of measurement of arterial pressure are given in table 5.

TABLE 5

INCREASED ARTERIAL PRESSURE

Group	Arterial pressure 150/90	Systolic pressure 160 mm. Hg	No.	Total %
AE	2	4	6	13
BE	2	1	3	13
AK	4	5	9	14
BK	12	6	18	11
D	2	1	3	18
Total	22	17	39	average 14%
C	5	4	9	10%

The increased arterial pressure was confirmed by repeated measurements. The highest value, 240/150, occurred in the group of thigh amputees.

In order to avoid errors of measurement, particular attention was paid to the technique used.

The percentages of hypertonics in the various groups were more or less the same. Neither were they any higher than the frequency of hypertonia reported in the literature for a population of the same age (Master *et al.* 1943, 1950, Bøe *et al.* 1957).

Some authors considered increased arterial pressure to be a late result of amputation (Schneider 1940, Veil and Sturm 1946). It has been assumed that irritative processes in the stump may affect the midbrain by way of the nerves. Inflamation may also increase contraction of the arteries and in the case of hypertension impair the condition of those who already have a tendency to this disease (Bommes 1940). Other authors have not found higher blood pressure values in amputees than in other population groups (Schulze 1942, Bodechtel 1948 and Meyeringh and Stefani). Rausche (1939) and Loos (1957) have demonstrated a greater frequency of high blood pressure than is commonly met with only in amputees who are overweight.

The commonest diseases observed in the amputees are given in table 6.

TABLE 6

DISEASES

Group	Pulmonary Emphysema %	Chronic gastritis %	Condition following gastric operation %	Chronic inflammation of the large intestine %	Neurocirculatory asthenia %
AE	8	4	2	—	2
BE	8	8	—	4	8
AK	8	6	3	—	6
BK	6	10	2	1	6
D	6	6	—	—	6
Total	7	8	2	1	6
C	1	6	—	—	3

The emphysema was diagnosed clinically. It was slightly commoner in the amputees than in the controls. The incidence, however, presumably lies within the normal range. The same applies to the other diseases mentioned. Some of the amputees had chronic bronchitis with severe symptoms at the time of the investigation. The amputees referred to the group gastritis had, as a rule, had their symptoms for several years; in some of these cases there was radiologically verified ulcer, while some had not been previously diagnosed. Those operated on for ulcer are not included in the group of gastric catarrh. The history mentioned inflammation of the large intestine in two cases. In neither of them had the inflammation been ulcerative.

The group of neurocirculatory asthenia included those patients who for a number of years and independently of stress had had chest pain, lability of the pulse, dizziness or other symptoms of the vegetative nervous system. Within the range of the present investigation it was not possible to penetrate deeper into these disturbances. Other diseases established in the amputees included 3 cases of diabetes, 2 of which were diagnosed for the first time, 2 of gall-stones, 1 of urinary calculus and 1 of hiatal hernia.

In the control group 4 cases of gall-stone and 2 of urinary calculus were found.

TABLE 7

RESULTS OF MINIATURE RADIOGRAPHY OF THE CHEST

Group	Pulmonary emphysema %	Inveterate pulmonary tuberculosis %	Adhesions of the pleura %	Myopathia cordis %
AE	8	10	—	10
BE	12	4	—	8
AK	8	5	—	23
BK	8	4	4	15
D	6	—	6	18
C	4	3	6	9

There are no clear differences between the miniature radiographic findings in the amputees and the controls. The higher incidence of myopathy of the heart in amputees was not statistically significant. Neither is the difference in this respect between thigh amputees and other amputees statistically significant. Signs of inveterate pulmonary tuberculosis were observed to an extent that agreed with the figures reported, for instance, by Virtama (1962) and Härö (1963).

In table 8 the number of cases in each group is given in which no disease referable to internal medicine, no mental disorder nor any pathological miniature radiographic or laboratory findings were established, apart from the original injury, either at the examination or in the previous history.

TABLE 8

HEALTHY PERSONS IN THE DIFFERENT GROUPS

Group	No. of persons	Per cent
AE	13	27
BE	6	25
AK	15	23
BK	53	34
D	4	24
C	37	40

According to these observations, those with a lower leg amputation seem to form an intermediary group between the other amputees and the control group, the difference in either direction not being statistically significant. The difference between all other amputees compared as one group with the controls was statistically almost significant ($P < 0.05$).

The Stumps

The evaluation of the stumps must to a large extent be based on anamnestic information. The classification cannot, therefore, be very exact. The stump was considered good if the amputee has been continuously able to use a prosthesis. In other words, the stump was not particularly tender, there was no pain worth mentioning and on inspection the stump was faultless. A stump was considered satisfactory if its condition only prevented the use of a prosthesis to a small extent, or if there was periodic pain and tenderness, if there was excessive sweating or coldness of the stump, or if the scar was to some extent painful while the stump was still fit for a prosthesis most of the time. A stump was considered poor if it was clearly inferior to that described above as satisfactory, if, for instance, wearing a prosthesis was often and continuously impossible owing to the condition of the stump (too short, great tenderness, poor shape, etc.) or if there was persistent pain or marked coldness. Also troublesome joint contracture caused the stump to be referred to the group of poor stumps.

Table 9 shows the distribution of the stumps in these groups in per cent of the number of persons of each group. Amputees with two stumps are not included in this table. In evaluating the stumps, damage to the stump of acute character and short duration was not taken into consideration.

TABLE 9

STUMPS

Group	Good or satisfactory %	Poor %
AE	69	31
BE	75	25
AK	71	29
BK	77	23

In the present series, lower extremities with a prosthesis were not so often too short as they were observed to be in a previous investigation on Finnish war amputees (Solonen and Aho 1958), evidently as a result of better servicing and checking of the prostheses. The length of an upper extremity prosthesis is not so important as that of a lower limb.

Table 10 shows to what extent the amputees of the different groups use a prosthesis.

TABLE 10

USE OF PROSTHESIS

Group	Always %	As a rule %	Seldom %	Not at all %
AE	44	31	17	8
BE	46	38	12	4
AK	98	2	—	—
BK	96	4	—	—
D [1]	65	6	6	24

[1] Prosthesis on one or two extremities.

In table 10 the prosthesis has been marked as used *always* when it is used every day during work, *as a rule* when used more or less regularly although not always even at work. *Seldom* indicates that the prosthesis is being used less frequently than in the former group, for instance on Sundays only or on some special occasion.

So-called Fatigue Pain

"Fatigue pain" occurs comparatively often in the joints of the intact leg and the stump. The anamnestic frequency of fatigue pain in the present series is seen from table 11. (Fatigue pain in the same person has in some cases been referred to different anatomical areas).

TABLE 11

ANAMNESTIC FATIGUE PAIN IN JOINTS OF THE LOWER EXTREMITIES

Group	Intact leg				Amputated leg	
	hip %	knee %	ankle %	foot %	hip %	knee %
AK	11	39	27	5	9	.
BK	6	27	10	3	5	9
C	2	1	3	—	.	.

With regard to the fatigue pain in the knee joint the difference as compared with the control group is statistically highly significant. This is not the case, however, if amputations of thigh and leg are compared. The rate of ankle pain is also highly significantly higher in lower limb amputees than in the control group but here the difference between thigh and leg amputations is also significant.

It should be mentioned that 11 (17 per cent) of the thigh amputees and 95 (65 per cent) of the lower leg amputees had no fatigue pain at all in the intact leg. 60 (92 per cent) of the thigh amputees and 138 (88 per cent) of the lower leg amputees did not complain of fatigue pain in the amputated leg.

Muscular pain in the lower limbs was common. The amputees as a rule call this pain cramp. 4 per cent of the lower leg amputees and 3 per cent of the thigh amputees stated that such muscular pain constituted a marked symptom in their intact leg and 2 per cent of the thigh amputees had this pain in the stump as well. One subject of the control group had had similar pain.

The upper limb amputees, particularly the labourers, stated that they often had fatigue pain in the uninjured arm. 38 per cent of the upper arm amputees and 29 per cent of the forearm amputees said that they often suffered from fatigue pain in the upper or lower part of the intact arm. Such a history was not given in the control group.

11 (45 per cent) of the forearm amputees had no fatigue pain in the amputated upper limb. Likewise all upper arm amputees were free from such symptoms, evidently because the stump was little used.

Anamnestic pain clearly localized to the joints of the upper limb occurred in both the intact and amputated upper limb. The information obtained on the clinical and radiological symptoms in the area of the shoulder joint has been collected in tables 12 and 13.

Findings in the Upper Limbs

As usual, symptoms due to degeneration are much commoner in the area of the shoulder than in that of the elbow joint. The frequency of so-called periarthrosis appears from table 12. Only those cases were included in which there was clear limitation of movement. In all cases the abduction of the upper limb was a minimum of 90 degrees.

TABLE 12

PERIARTHROSIS OF THE SHOULDER JOINT

Group	Frequency in per cent	
	Intact side	Side of amputation
AE	38	27
BE	13	29
AK	—	—
BK	—	3
C	.	1

There was quite frequently periarthrosis of the shoulder joint of both the amputated and the uninjured arm. The higher frequency of periarthrosis in persons with upper limb amputations than with lower limb amputations is highly significant. On the amputated side, the symptom is relatively less common in the forearm amputees than in upper arm amputees. The difference is not statistically significant, however, because the chance of randomly existing difference is 6 per cent (the highest level for an "almost significant" result is usually 5 per cent).

On the whole, the number of positive findings is very small in all groups. Reckoned in per cent, however, they are more frequent in the amputees. There are no significant differences. Neither could any difference be observed with regard to the severity of the changes.

TABLE 13

RADIOGRAPHIC FINDINGS IN THE AREA OF THE SHOULDER JOINT

Group	Periarthrosis		Acromioclavicular arthrosis		Humeroscapular arthrosis	
	Intact side %	Side of amputation %	Intact side %	Side of amputation %	Intact side %	Side of amputation %
AE	2	—	2	6	2	2
BE	4	4	—	4	2	6
	right	left	right	left	right	left
C	2	2	1	1	1	.

TABLE 14

PAIN ON MOVEMENT OR LIMITATION OF MOTILITY IN THE ELBOW JOINT OF UPPER LIMB AMPUTEES

Group	Intact arm		Amputated arm
	Pain %	Limited motility %	Limited motility %
AE	4	4	—
BE	12	—	21
C	—	—	—

TABLE 15

RADIOGRAPHICALLY DEMONSTRABLE DEGENERATIVE CHANGES IN THE ELBOW JOINTS

Group	Arthrosis		
	Intact arm %		Amputated arm %
AE	15		—
BE	21		17
D	6		—
	right	left	
C	7	3	

Arthrosis was most commonly observed in the elbow joint of the intact arm of forearm amputees. Arthrosis was commoner in amputees than in the control group, in which arthrosis was commoner in the right, *i.e.* the more stressed elbow.

Neither the history nor the clinical status of the wrist and hand of the intact upper limb in the AE and BE group revealed anything noteworthy except that arthrosis was clinically diagnosed in the wrist of one AE amputee. Radiologically, arthrosis of the wrist joint was diagnosed in one forearm amputee and four upper arm amputees but not in the control group. The arthrotic changes were slight in all cases.

Part II of "Late Sequelae of Amputation" will appear in the next issue of the *Journal.* The material included will be:

Results (continued)

- Findings in the back and spine
- Findings in the lower limbs
- Flat-foot
- Circulatory disturbances
- Miscellaneous
- Phantom

Physiological Examination

- Method
- Results

Discussion and Conclusions

Summary

References

New UCLA Rehabilitation Center Opens

The new Rehabilitation Center of the University of California, Los Angeles, opened in September of this year. The UCLA Prosthetics Orthotics Program is housed in the new building, as shown in the following photographs and description.

Members of the first class to be given in the new UCLA Rehabilitation Center laboratories at work in the Prosthetic-Orthotic Laboratory. (Fig. 1). Designed to enable students to work on both braces and artificial limbs, the layout and equipment have been carefully planned to provide the most efficient, clean, and safe environment possible. Some interesting features are:

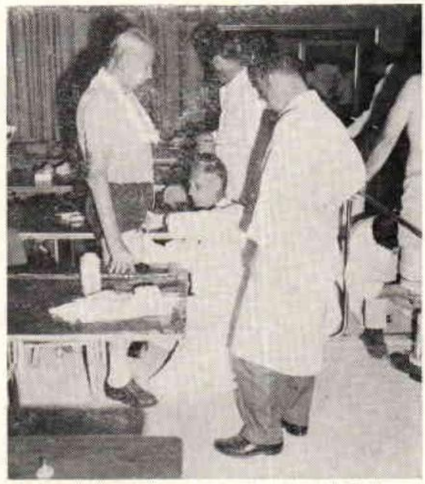
1. Laboratory benches. Each student has a six-foot Formica-topped bench. They are mounted in pairs, with a powerful dust-collector to serve both. Hand tools are mounted on a revolving tool-board fastened to a sliding rail under the center of the bench. High and low vacuum supply for plastic laminating is provided through the panel on the lower left side of the bench. A very accurate regulator is provided for each system so the vacuum can be controlled. A Dunmore hand grinder is provided at the lower right portion of each bench, over the dust evacuator funnel. A machinist bench vise with adaptors for gripping sockets is mounted on one corner of each bench, and a "Milmo" vertical fabricating jig at one end. On the left is the hopper for plaster shavings hinged to the end of the bench so it can be folded out of the way when not in use. Shavings are collected in a disposable plastic bag.
2. Fume hoods. A large fume hood is mounted over one end of each pair of benches to evacuate the toxic fumes from plastic laminating and foaming operations. The entire building is air-conditioned.

FIGURE 1

3. Dust collection system. Barely visible as grey boxes mounted on the wall on the upper right hand part of the photograph are the dust collectors for the machines mounted along the wall. There are three separate units, one for each group of three machines. Dust is kept to an absolute minimum by these machines and the fume hoods.

The Examining Room is a busy area when the students are measuring their patients and taking down prosthetic information. Mr. Alvin L. Muilenburg, of Houston, Texas, who serves as a part-time teacher at UCLA, is seen checking the measurements made by a student. (Fig. 2). The Examining Room is equipped with twelve examining tables that may be folded into the wall so the room may be cleared for other uses. Sliding curtains may be pulled around each table, forming a small examining room so patients may be worked with in private.

FIGURE 2 →



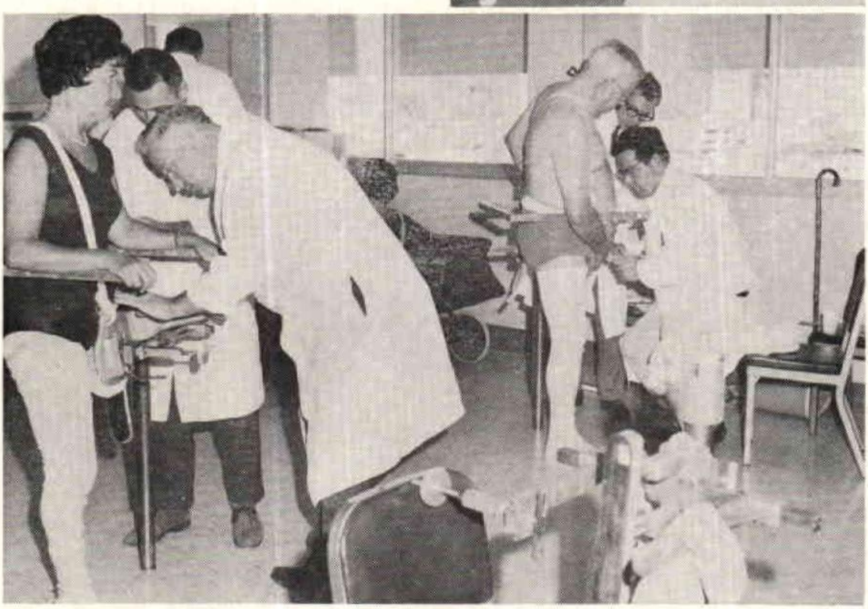


FIGURE 3

After the lecture-demonstration on the use of the VAPC casting machine, the students work in pairs making casts of their patients. (Fig. 3). The amputees remain in their Examining Room until time to be cast, and are returned to that room as soon as the casting is completed. Amputees are never allowed to enter any of the other laboratories for reasons of safety.

Students in the first class in Above Knee Prosthetics observe a lecture-demonstration on taking a cast of an above knee stump by Mr. John J. Bray (kneeling at right, back to camera). (Fig. 4, page 330).

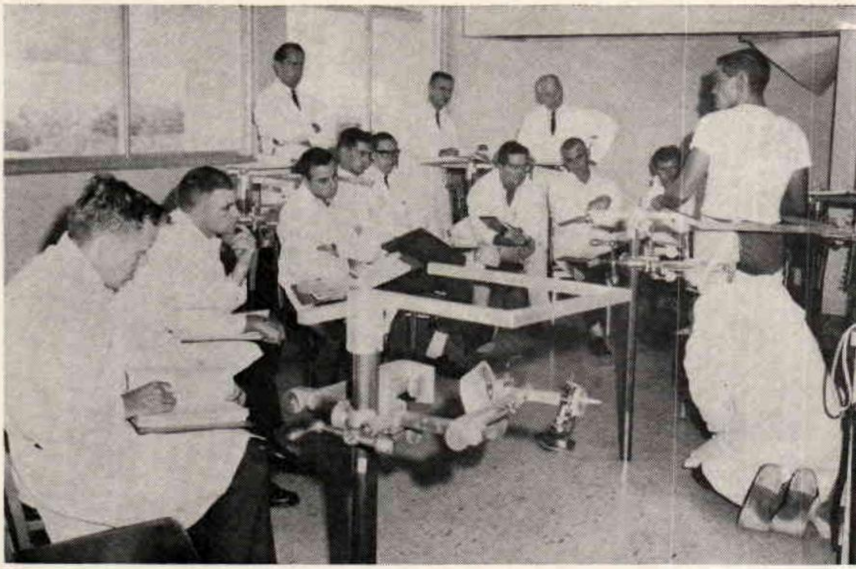


FIGURE 4—Demonstration: Taking cast of A/K Stump

FIGURE 5

The first class to complete a course in prosthetics at the new U.C.L.A. Rehabilitation Center—Course X-463, Above Knee Prosthetics, September 20-October 15, 1965. Front row (left to right): Maurice LeBlanc, Staff Specialist, Prosthetics-Orthotics Program, UCLA Rehabilitation Center; Frederick J. Ball, Adept Prosthetics, Downey, Calif.; Jean Fleetwood, Intermountain Limb & Brace, Salt Lake City, Utah; John J. Lessar, Schindler's Artificial Limb & Truss, Spokane, Wash.; Stanley A. Norell, Navy Prosthetic Research Lab., U.S. Naval Hospital, Oakland, Calif. Back row (left to right): John J. Bray, Associate Research Prosthetist-Orthotist, Prosthetics-Orthotics Program, U.C.L.A. Rehabilitation Center; Charles M. Scott, Assistant Research Prosthetist-Orthotist, Prosthetics-Orthotics Program, U.C.L.A. Rehabilitation Center. Certificate Students: David N. Dupree, Miami, Florida; Leslie A. Dent, Billings, Montana; Joseph M. McGuiness, San Jose, Calif.; Daryl L. Venema, Baltimore, Md.; Keith E. Vinnecour, Los Angeles, Calif.; Louis E. Wildman, Grand Junction, Colo.

AOPA Survey of Teaching and Instructional Activities of Prosthetists and Orthotists

By J. WARREN PERRY, Ph.D.

Deputy Assistant Commissioner, Vocational Rehabilitation Administration, Washington, D. C.

and

LESTER A. SMITH

American Orthotics and Prosthetics Association

The American Orthotics and Prosthetics Association circulated a questionnaire to its membership in June, 1964, asking for information on teaching activities of prosthetists and orthotists. The information received by the Association on the number, type, and settings of lectures and demonstrations on artificial limbs and braces follows.

This Survey was an attempt to document an impression that we thought was true and wanted to document: that many prosthetists and orthotists around the country are engaged in a considerable number and variety of instructional and teaching activities. This was not intended to be an exhaustive study of this subject, but within the limitation of a questionnaire, we wanted evidence to show that, as a part of their own professional development, members of the Association are taking an active role in interpreting the nature of their work to others.

Results of this questionnaire are attached, and we hope you will take the time to examine the many ways in which members have contributed to the educational programs of universities, colleges, hospitals and rehabilitation centers throughout the country. These data are reported in the same order in which the questions were asked.

At colleges and universities, the involvement of prosthetists and orthotists in instructional activities has centered around courses for residents in orthopedic surgery and physical medicine, physical and occupational therapy, and in nursing courses. It is worthy to note that a sizeable number of civic and service clubs, and high school guidance programs have also requested Association members to provide orientation talks on prosthetics and orthotics.

Instructional activities of these kinds are a most influential, direct means of dissemination of information about the fields of prosthetics and orthotics. We wish to take this opportunity to express our appreciation to all of you who participated in this Survey.

1. Have you or members of your staff participated in teaching activities in which you have discussed or explained any aspect of prosthetics—orthotics? Yes 109; No 10.
2. How many of your staff have done this?

Firms Reporting	*Number of Staff*
46	1
36	2
14	3
5	4
2	6
1	8

2. Where was this done?

a. *University-college setting**

nursing courses	53
physical therapy courses	48
occupational therapy courses	27
orthopedic surgery	36
physical medicine	30
prosthetic-orthotic education	29
other	

b. *Hospitals* ---------- 76

c. *Rehabilitation Centers* ---------- 51

d. *Your Facility* ---------- 83

e. *Other* ----------

* Number indicate different courses during the academic year.

4. Who were the students in the teaching that you did?

residents	67
nurses	74
P.T.'s, etc.	78
M.D.'s	15
Rehab. Coun.	11
Prosthetists & Orthotists	13

(These indicate the numbers of prosthetists and orthotists who spoke before these groups—not the numbers of students taught).

5. Have you been asked to provide prosthetic-orthotic appliances as instructional materials for any of the courses in geographical areas near you? Explain. *No,* 16; *Yes,* 74; *Occasionally,* 6.

6. Aside from courses, have you been asked and have you been involved in any orientation activities in explaining and describing the fields of prosthetic-orthotics? To what kinds of groups? Explain. *Civic,* 9; *Service,* 23; *Nurses & PT's,* 12; *Hospitals,* 28: *Clinics,* 15; *Guidance (High Schools),* 8.

New Facilities Certified

By action of the Facilities Committee of the American Board for Certification, the following Facilities have been granted Certification since the publication of the 1965 *Registry of Certified Facilities and Individuals:*

ALASKA

Anchorage:

ALASKA ORTHOPEDICS — O
187 West 27th — FAirfax 2-2178
Eugene C. Fleishauer, C.O.

CALIFORNIA

Anaheim:

LERMAN & SON ORTHOPEDIC APPLIANCES — O
119 South Harbor Boulevard — 635-2650
Curtis R. Sherman, C.O.

Downey:

ADEPT PROSTHETICS MFG. — P
8724 E. Imperial Highway — SPruce 3-3338
Jesus G. Nunez, Owner

Hollywood:

KARG PROSTHETICS — P&O
5430 Santa Monica Boulevard — 463-4821
Ferdinand J. Karg, C.P.O.

San Francisco:

BRACE & LIMB SHOP — P&O
Letterman General Hospital — JOrdan 1-3071
(Private Patients Not Accepted)
Tony J. Cruz, Jr., C.O.

Sunnyvale:

SIERAKOWSKI ORTHOPEDIC AND SURGICAL CO. — O
295 E. Washington Avenue — REgent 9-5750
Ted T. Sierakowski, C.O.

HAWAII

Honolulu:

ORTHOPEDIC APPLIANCE FACILITY — O
Tripler Army Medical Center — 867692
(Private Patients Not Accepted)
James P. Murphy, C.O.

INDIANA

Evansville:

J. E. HANGER, INC. OF INDIANA — P
416 North Main Street — HArrison 2-6712
William H. Richardson, C.P.

MINNESOTA

Minneapolis:

KENNY REHABILITATION INSTITUTE — O
1800 Chicago Avenue — 333-4251
(Private Patients Not Accepted)
Lorrin H. Madsen, C.P.O.

MISSOURI

St. Louis:

SHRINER'S HOSPITAL FOR CRIPPLED CHILDREN — O
2001 South Lindbergh Boulevard — HEmpstead 2-3600
Leo V. Tippy, C.O.

NORTH CAROLINA

Chapel Hill:

LIMB & BRACE DEPARTMENT — P&O*
N. C. MEMORIAL HOSPITAL
University of North Carolina — 966-4132 Ext. 630
J. D. Ferguson, C.P.O.

TENNESSEE

Nashville:

GIBSON & GREER ORTHOPEDIC APPLIANCES — O
2110 West End Avenue — ALpine 4-6482
Leroy Cook, C.O.

TEXAS

Houston:

SHAMROCK BRACE COMPANY — O
2210 Maroneal — MOhawk 6-1991
Willard E. Lanier, C.O.

UTAH

Salt Lake City:

INTERMOUNTAIN LIMB & BRACE CO — P
457 East 2nd South — 328-8115
Leonard W. Jay, C.P.

VIRGINIA

Norfolk:

JAC. BOODEN ORTHOPEDIC SUPPLY CO., INC. — P
2418 Granby Street — 627-4191
Jacobus Booden, C.P.

WASHINGTON

Seattle:

PROSTHETICS RESEARCH STUDY — P
Eklind Hall, Room 409, 1102 Columbia — MAin 2-7717
(Private Patients Not Accepted)
Joseph E. Traub, C.P.

WISCONSIN

Madison:

ALJAN COMPANY, INC. — P
1134 Regent Street — 257-4256
Alfred Smith, C.P.

Wausau:

WELDON'S PROSTHETICS AND APPLIANCES — P
1506 Sixth Street — 845-6866
John L. Weldon, C.P.

* Extension of Title to Include Prosthetics

BOOK REVIEW

L'ATTELLE MONOTUBULAIRE (THE SINGLE TUBULAR SPLINT) Article Two of the Atlas d'Appareillage Prothetique et Orthopedique, by Guy Fajal and J. M. Paquin, directed by Professor L. Pierquin, of the Faculty of Medicine, Nancy, France. March 1964. Translated and reviewed by W. N. Peterson, C.P.O.

The transcription of the title L'Attelle Monotubulaire "The Single Tubular Splint" is the second subject of a series the authors intend to print, each pertaining to a specific Orthosis or Prosthesis. Each subject will have a separate and removable binding consisting of a plastic sleeve, whereby pages can be added or deleted as required to keep the article up to date. All articles will combine to make an Atlas entitled *Orthopedic and Prosthetic Appliances.*

According to the authors the idea or inspiration leading to the development of the "Single Tubular Splint" came from reading a German book (Schanz 1923) in which unilateral splints are described for genu-valgrum, genu-varium and tuberculosis conditions of the lower limb.

The availability of metal tubing with the necessary strength and lightness also was a factor in development of the splint.

The purpose of the splint is to retain a flail knee in extension while weight bearing.

A description of the splint is as follows: As Mono implies, it is a single upright attached to the lateral side of the leg. It consists of a metal tube commencing superiorly at the level of the gluteal fold and the junction of the antero-posterior lateral or sagittal line. The distal end of the tube terminates an inch or two superior to the lateral malleoli, at which point the tube is spring loaded and activated by a rod or tube insert, descending to the caliper slot.

At the level of the patella tendon a metal arm is welded to the upright extending anteriorly and medially to approximately the medial condyle of the tibia. Attached to this arm is the anterior portion of a molded type of P.T.B. socket, with a Velcro or leather strap as a posterior retainer. To the superior posterior tube, another arm or band is welded on an angle to encompass the line of the gluteal fold, terminating medially and anteriorly short of the adductor longus tendon. The thigh is held anteriorly in the gluteal band by a billet attached with single rivet to the medial end of the band and by a lug with buckle attached also with a single rivet on the band, posterior to the upright. The author emphasizes the single rivet to allow the retainer to swivel and adjust to contour. The band of course is upholstered: Anteriorly an upholstered pad is placed behind the billet and held in place by the billet passing through leather slots at each end of the pad.

The placement of the caliper slot will startle most older Orthotists, who will well remember how exacting we had to be with a slot for Thomas calipers and of course never succeeded in eliminating all the excursion of the brace due to being distal to the true axis.

The setting of the slot in this splint is the key activating the force or excursion to stabilize the knee. The authors recommend the shoe be divided in length by thirds, the caliper slot is placed at the half line of the middle third, or more posteriorly the less flail the knee is.

A lateral view of the leg and brace present a triangle; the sagittal line passing approximately through the malleoli, the anterior line the splint, and the base the shoe. The anterior or splint line acts as a prop against the knee, then as body weight advances over the splint the telescopic spring section absorbs the excursion and shock at the same time, produces a superior posterior thrust to the anterior tendon area of the knee, thus retaining extension in weight bearing. I might add with reference to the anterior placement of the slot, that the slot is at sole level and the heel to this point is continued as a wedge.

Another interesting factor of this splint viewed laterally and anteriorly is that the upright is straight. No attempt is made to align the splint to anatomical contours. The author refers to this as modern esthetical lines.

The author mentions and illustrates several various types of fastenings at the knee and thigh, also the fact a lock knee joint can be used, hip joints with lock, or torsion bar, combined with plastic pelvic corset, etc. He also points out several defects which can be made in construction and alignment, i.e. the metal arm at the knee can be too shallow causing hyperextension pressure to the knee and anterior thrust of the gluteal band, or the opposite, knee arm too anterior to the knee in extension, thus causing flexion of knee and anterior thigh cuff pressure. He also remarks on the caliper slot as being malplaced, causing either internal or external rotation, if it is not at 90° to the caliper.

This splint (and I use the word splint as it appealed to me more as a splint than a brace), has more merit than one is ready to acknowledge at first. It is beyond doubt unorthodox in several respects, and I would venture to say our patients would not voluntarily accept the modern esthetical straight lines, particularly the lack of proximity to the anatomical line of the knee and lower thigh. Our experience has been that cosmesis plays a very important role in the acceptance of an orthosis or prosthesis by the wearer. While the author stresses the simplicity of fabrication, the easy manner of attachment and removal, I personally feel this is not a factor, as compared to patient resentment. It is difficult to analyze the true function and effects of the splint, without first having made and fitted several. However, in visualizing the various activating forces of the splint I would center on the following:

First and usually present with a flail knee are hamstrings which are either too loose or too tight. In the case of the former no provision is made to prevent hyperextension of the knee either below or above knee level except the small socket retainer strap which in any case would be inadequate.

Secondly, the superior posterior thrust is directed below the tibial plateau, and consequently there is no opposing force anteriorly above the knee to resist the anterior thrust of the femoral condyles on the tibial plateau. The author at one point does illustrate a posterior metal arm instead of the anterior one, with a patella cap instead of the tendon socket. This would, through the patella, support the joint better as a whole, but still provides no posterior support or stop. In the second case, or with a knee holding at 180°, the constant thrust I feel would eventually stretch the hamstrings with resulting hyperextension unless (which is not probable) the hamstrings were strong enough to resist. There would be a further problem in the case of the tendon socket approach, that is if the quads were active at all pressure on the tendon at 180° extension would trigger flexion contracture as it does in a P.T.B. prosthesis if not preflexed.

Since we seldom find a normal foot with a flail knee, our attention would be directed there. It would appear that inasmuch as the telescopic spring force is also directed downward and is maximum at the push-off phase, would the foot be enabled to retain sufficient dorsiflexion in the swing phase to prevent the spring from plantar flexing the foot where the spring becomes the least active.

Should a stop be necessary, which visually I can see in most cases, it would of course be set retaining the foot at 90° to the sagittal plane.

Application of a rigid stop would present problems especially because it would be resisting the severe stress arm of the entire length of the splint. In preventing plantar flexion, the anterior thrust of the posterior gluteal support would become a pressure area.

The answer might lie in a spring-loaded stop, the author later mentions. However, it would be difficult to locate a spring small and firm enough to counteract the telescopic spring force.

In the event of a valgus position of the ankle a medial T strap could be used. However, in a varus position it would be difficult to cope with.

The author does not mention an extra heavy steel shank from the heel to the M.P. area. Without this it is conceivable that the shoe, and in turn the foot, would be forced towards equino-varus, and/or with the 90° stop, a cavus position.

The foregoing is not intended as criticism. Undoubtedly the authors as fabricators of the splint have considered these various aspects and apparently they are of little consequence as compared to the practical results which their enthusiasm for the splint suggests.

In any case the splint is interesting and should we find a patient acceptable to its modern esthetic lines, we shall then obtain a full practical view.

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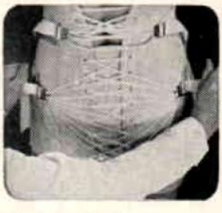

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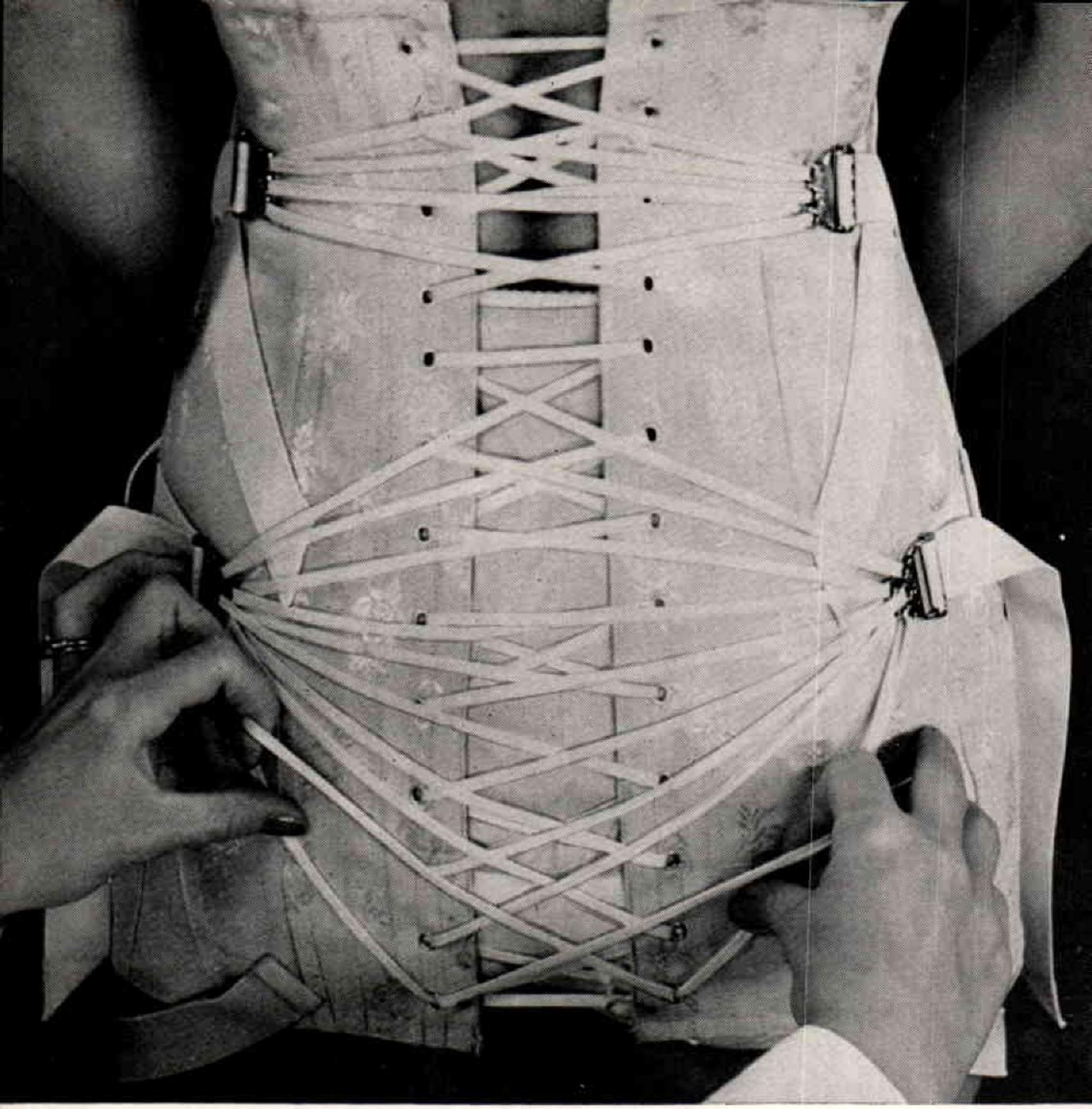

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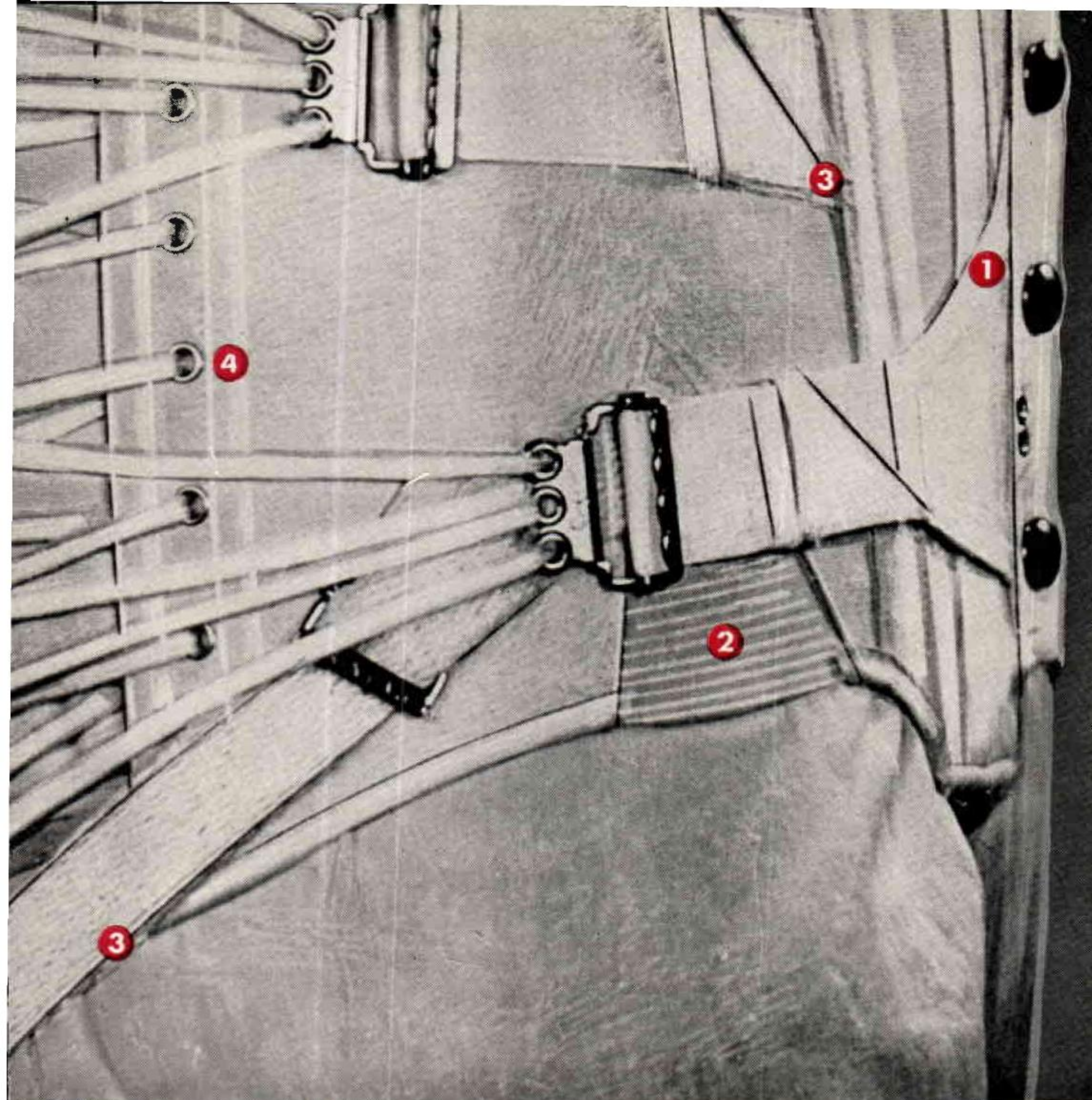

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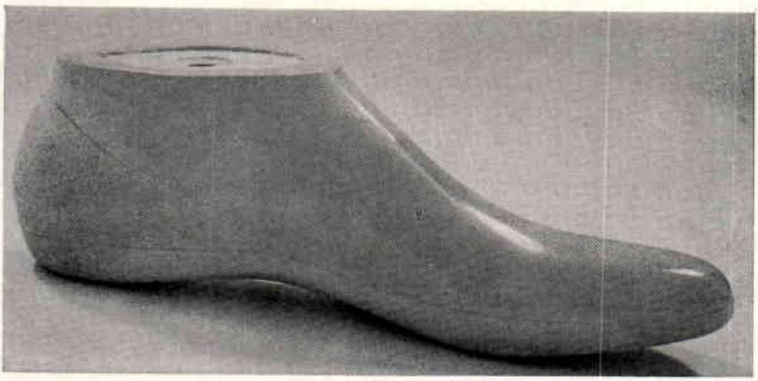

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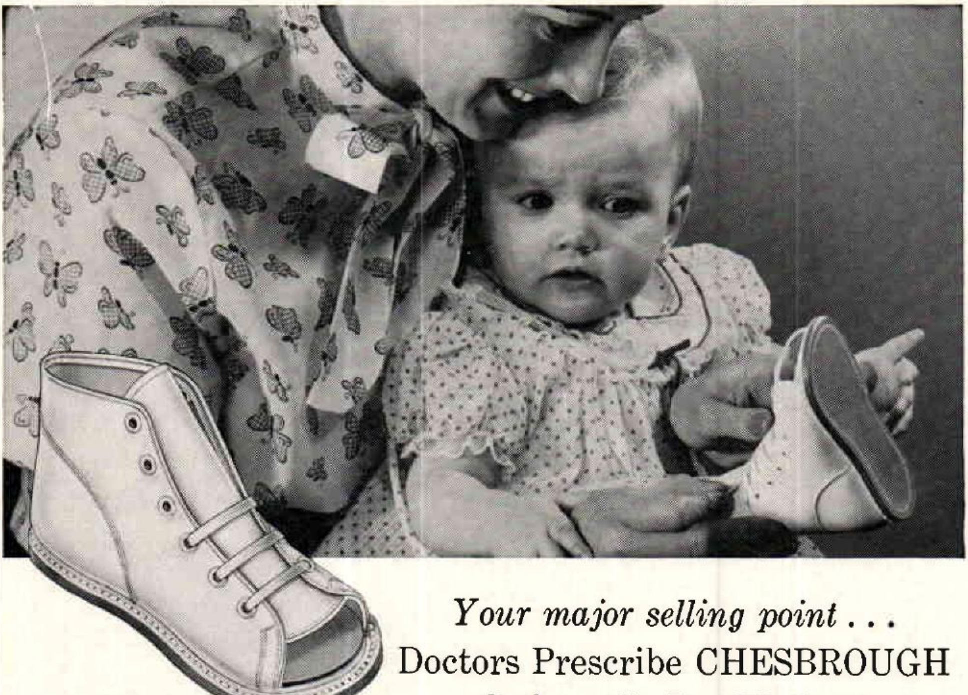

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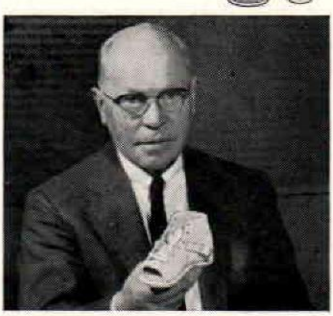

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