MARCH, 1963

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This publication is a reprint of the pamphlet *Stump Hygiene,* published in 1961 from the Biomechanics Laboratory, University of California, Berkeley and San Francisco. This study was supported by Research Grant RG-4856, National Institutes of Health, and Research Grant RD-459 from the OVR, Department of Health, Education and Welfare.

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Orthopedic and Prosthetic

Appliance Journal

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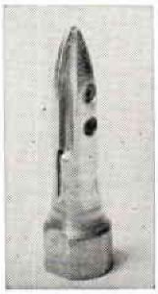

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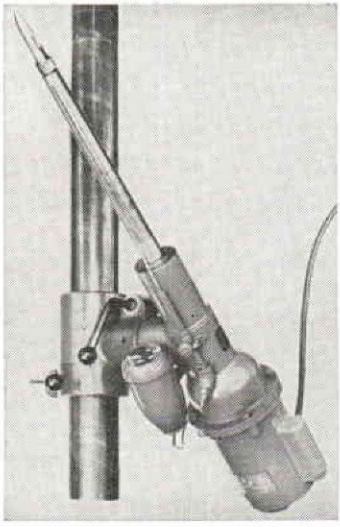

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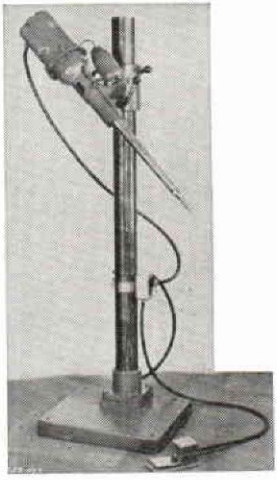

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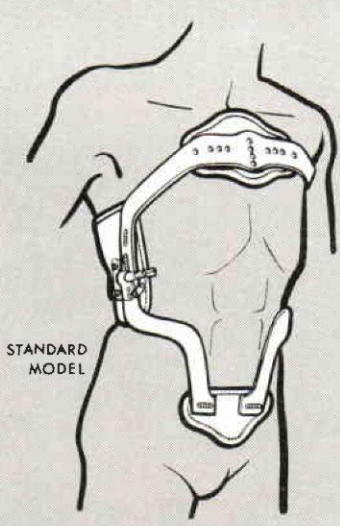

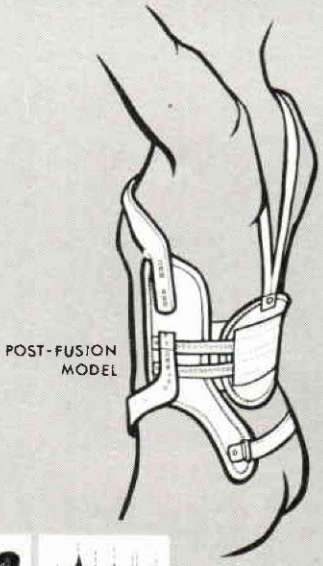

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Above-Knee Prosthetic Techniques In Germany*

By HELMUT HABERMANN

Frankfurt, Germany

The technique of artificial limb fitting has received great impetus in the last fifty years as a consequence of two wars. The endeavors made before this, of course, especially by mechanics who were interested in the subject, and frequently by amputated persons themselves, had led to very serviceable prostheses about which we find valuable references in medical literature.

However, the great number of wounded persons from the two World Wars presented both doctors and technicians with the task of considering prostheses both from the physiological and from the technical side, and of solving the new problems which constantly appeared as progress advanced.

In Germany it was Prof. Schede who had decisive influence on the development of the A/K prosthesis. He was the first to work out the exact physical-scientific principles which are set forth in his book "Theoretische Grundlagen im Kunstbeinbau" [Basic Theories in the Construction of Artificial Legs.] After Prof. Schede, Prof. Zur Verth and Dr. Gorlach also did a great deal for the further development of prosthetic techniques in Germany.

As a result of this medical research and of their own discoveries, many important persons have contributed interesting constructions which have been of the greatest benefit to the prosthetic technique. In this field doctors and technicians have worked together in the closest cooperation and their mutual comprehension has led to the finest results.

In this report I will deal chiefly with the question of German prostheses for thigh amputations since this wish was expressed by the head of your society.

It was good fortune that my father was associated with Prof. Schede in 1916, and that, in an army hospital in Munich, they made the first attempts at a newer development of the prostheses known in those days.

Very soon the following points were recognized as the most important in constructing prostheses:

1. Careful, individual fitting of the stump in the prothesis,
2. Support of the body weight on the ischial tuberosity,
3. Static-dynamic alignment of the prosthesis, and
4. Greatest possible stability through knee- and foot-joint constructions.

In this order I will report on the methods used by us in Germany in making thigh prostheses and trust that this will answer a number of questions which interest the American prosthetist.

The fitting of the stump in the socket can only be accomplished when considered together with the supporting of the body weight on the ischial

* From a lecture by Mr. Habermann, given before the 1960 National Assembly of the American Orthotics and Prosthetics Association in New York City.

tuberosity since these two complexes are closely related. I even consider it necessary to discuss the latter point first, since the socket for ischial bearing has great influence on the general construction of the upper portion of the prosthesis.

All of my statements are based on the supposition that the stump is in a condition to be fitted with a prosthesis: That is, that physiological movements are not restricted by contractions, and also that the scar-area is not painful and the soft tissues over the distal end of the femur have not grown together with it. Stumps which still show contractions are more difficult to fit with a prosthesis, and performance with the prosthesis is reduced. For purposes of clarity I will briefly explain the static and functional situation at an amputation of the thigh.

The hip-joint on the non-affected side bears the weight during the phases of standing and walking, and at the same time it is a point of rotation for all flexing and extension movements, and for abduction, adduction, and

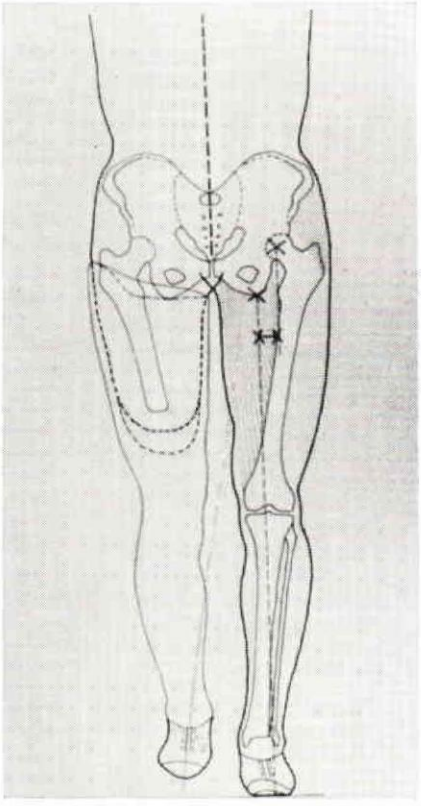


Figure 1. The prosthetic side is here in the swing-phase. On the normal side the abductors keep the pelvis in the horizontal plane. They act around the hip-joint, which, at the same time, is also the point of support.

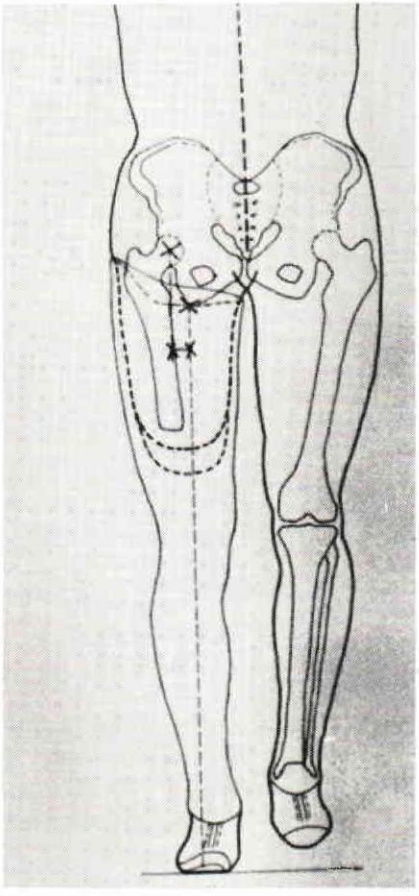


Figure 2. The sound side is now in the swing-phase. On the amputation side the abductors must keep the pelvis in the horizontal plane. The hip-joint is only the point of rotation, it is not the point of support any longer. The tuber ossis ischii is the loading point. But it lies medially from the hip-joint.

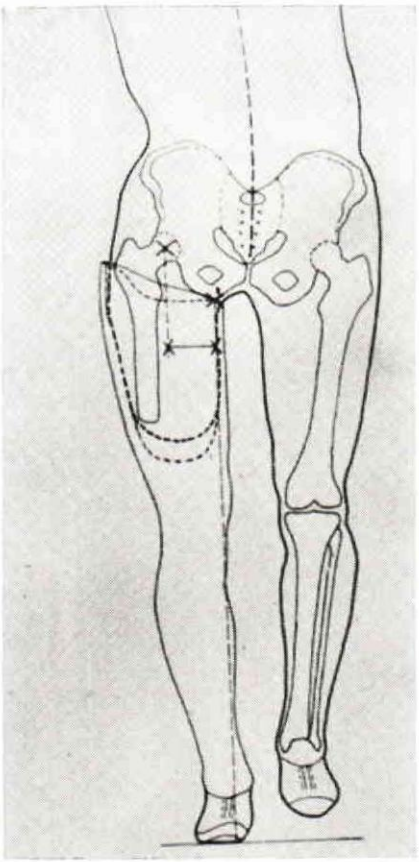


Figure 3. If the medial location of the point of support is very far from the hip-joint, the result will be a lateral shearing and thrust moment of the prosthesis socket. The patient shifts his body weight over the prosthesis.

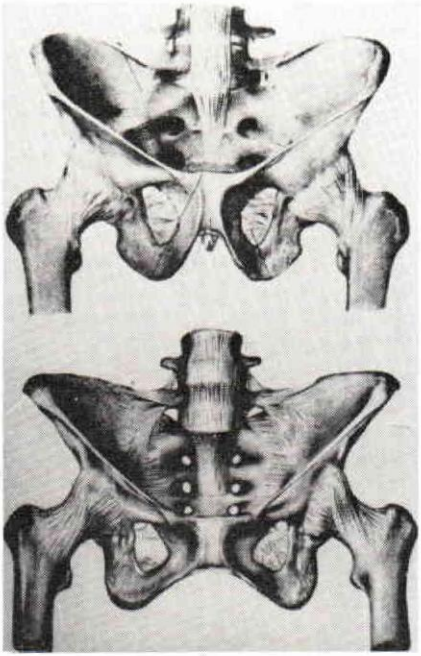


Figure 4. Above male pelvis, below female pelvis. It is clearly shown that in the case of the female pelvis the tuber ossis ischii comes essentially closer to the hip-joint with its lateral portion.

rotation. During the swing-phase of the prosthesis the pelvis is kept in a horizontal position through the action of the abductor muscles on the sound side. The line of support runs through the middle of the hip-joint, knee-joint, and heel, to the ground. The abductor muscles on the non-affected side act directly on the rotation point, the hip, and the line of support.

During the phase when the weight is borne by the amputated side, that is to say, during the swing-phase of the sound leg, the hip-joint is also a rotation point for the stump, but it no longer carries the full weight of the body. The ischial tuberosity, which bears a considerable part of the weight of the body and is also a point of rotation for the prosthesis, is now located, from a frontal view, below and medial to the hip-joint, while, from the sagittal view, the tuberosity lies behind the hip-joint. The discrepancy between the hip-joint and the ischial tuberosity reduces the power of the abductor muscles to maintain the pelvis in a horizontal position during the swing-phase of the sound leg. This means that through the space between the physiological point of rotation (the hip-joint), around which the abductor muscles act, the mechanical point of rotation and weight-bearing (the ischial tuberosity) there is a shearing force and thrust against the rim of

the superior portion of the prosthesis when abduction occurs. This again means that the abductor muscles are unable to maintain the pelvis in a horizontal position, and in order to re-establish balance there are changes of posture. The aim in fitting the bucket is to bring the prosthesis into line with the pelvis so that the shearing force and thrust, which have both a functional and mechanical origin, are reduced to a minimum. If it is possible, through body weight on the lateral part of the ischial tuberosity, to bring the weight-bearing point of the prosthesis and the rotation-point of the stump closer together, the function of the abductor muscles is improved and the shearing force is reduced. The abductor muscles are then in the position to keep the pelvis horizontal during the swing-phase of the non-affected leg.

If the point of body weight is medial, especially in the area of the pubic bone, the performance of the abductor muscles is considerably reduced and there is a side-thrust by means of which the prosthesis is displaced in a lateral direction and the weight-bearing point of the pelvis is displaced medially. Pressure in the area of the perineum and at the lateral end of the stump are the consequences of this situation.

Very often we find that women who have been amputated have a much better gait and attract much less attention with their prostheses than men. In general this is considered to be a matter of vanity, and it is held that men do not always attach much value to the way they walk. The actual reason, however, is far more probably the difference in the pelvis. In the case of women the position of the ischial tuberosity permits the body weight to be carried proximal to the hip-joint, which makes for considerably better static and functional conditions, whereas in the case of the male pelvis there is a much greater distance between the ischial tuberosity and the hip-joint.

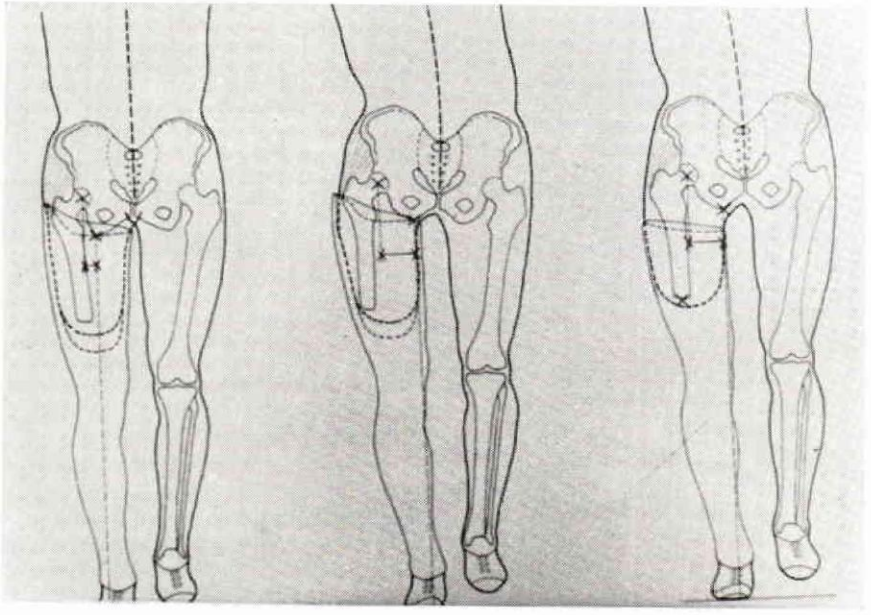


Figure 5. This survey again shows the effects with various initial positions. It is functionally bad in the case of medial support, the same applies to the stump end load without tuber seat.

The facts I have stated show also that when less body weight is supported by the ischial tuberosity, and more by the soft tissues, the non-physiological situation is aggravated, and in the worst case weight on the stump end without any weight being borne by the ischial tuberosity would be particularly harmful.

I must stress the fact, however, that this has nothing to do with the efforts made nowadays to establish contact of the end of the stump with the bottom of the bucket, for this development is based on quite different considerations which have nothing to do with the static conditions I have mentioned. I myself am convinced that the contact of the stump end with the bottom of the bucket if it is properly modelled can have a very favorable influence on the circulation, in particular, of the stump-end. The attempts I have made myself in this direction have shown very positive results up to now.

Naturally, the body-weight is not borne only by the ischial tuberosity, for, by the moderate compression of the stump in the bucket, the surfaces of the stump carry weight too. But this must not be allowed to disturb functional activity in the hip area. All these processes in the pelvic and hip area of the amputated side are, in our opinion, of decisive importance and we must do everything possible to see that when the socket is fitted to the stump the muscles which move the hip-joint are not restricted in their physiological action. I will remind you in this connection of the typical walk of a person with a dislocated hip, where incompetency of the abductor hip muscles leads to "waddling," the upper part of the body being shifted each time to whichever side bears the weight. The results in this case are comparable with those in a thigh prosthesis when the ischial tuberosity lies medially and thus rests on the socket. In this connection I should like to draw your attention to the highly interesting studies by Prof. Radcliffe who also dealt with this subject in detail. I think I may assume that our views about the problem do not differ very much.

But other features are important too in fitting the socket to the stump. Hip extension on the amputated side, effected by the Musculus glutaeus maximus, can be impeded by the way in which the ischial tuberosity rests upon the socket, since, at extension, the ischial tuberosity lies behind the rotation-point, the hip-joint. Therefore, the socket for ischial bearing must be shaped in such a way that the ischial tuberosity can roll on the surface of the socket in the phase of hip-extension. The front rim of the bucket, which is about 1 inch higher than the ischial bearing socket, offers a

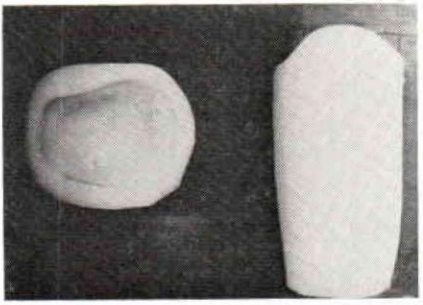


Figure 6. Socket shape as it is produced by our method.

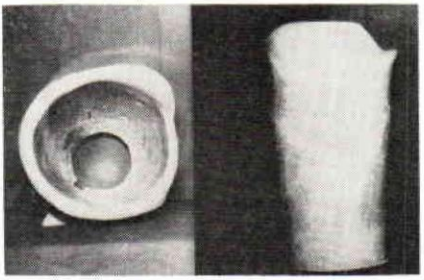


Figure 7. Example of bad socket shape; there are complaints in the perineum, as the tuber ossis ischii has no fixing point on the socket, resulting into a lateral shearing moment. The deep cutting at the socket can be clearly seen, but this does not bring about any improvement of the situation.

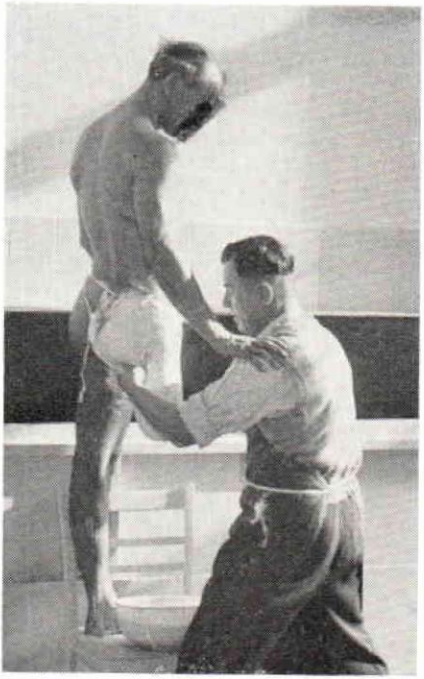


Figure 8. Plaster cast of stump.

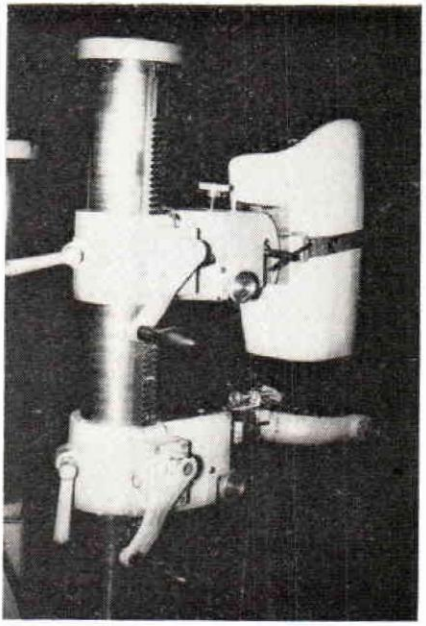


Figure 10. The upper socket is clamped in the setting-up appliance.

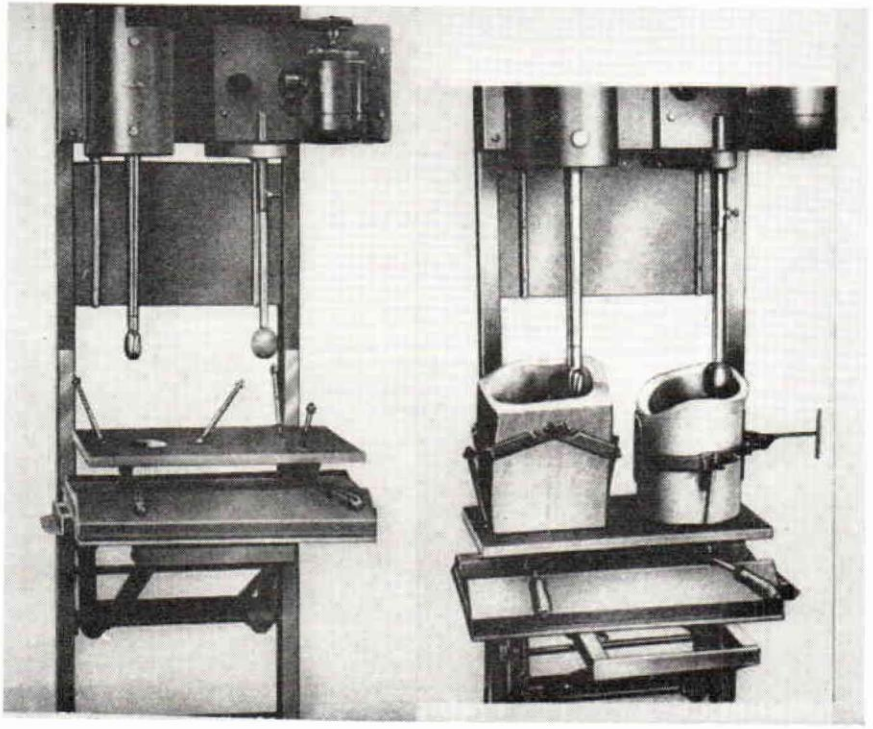


Figure 9. Copying machine supplying precise reproduction of the plaster model contours on the socket.

counter-support in this case. The contraction of the Musculus glutaeus maximus at hip-extension is provided for by leaving a certain play for the muscular tension at the side of the ischial bearing socket, since otherwise this powerful muscle would push the prosthesis in a lateral direction. All other muscles in the area of the superior portion of the prosthesis must be given so much play when the socket is fitted that, at contraction, there is no change in the position of the prosthesis.

The contours of the bucket which fit these requirements can be established, according to our experience, only by a plaster cast of the stump. For a better demonstration, therefore, I should like to show you our method with a plaster model. (In a speech delivered on September 5, 1960 at the meeting of A.O.P.A. at the Waldorf-Astoria Hotel the lecturer demonstrated in detail the application of a stump plaster cast.)

In this way we obtain a complete impression of the stump in which all the contours are reproduced and at the same time the anatomical position of the ischial tuberosity is fixed. This plaster cast is now the pattern for the upper part of the prosthesis. It is reinforced with plaster around the outside and cast in a receptacle so that it can be fixed on the copying machine. The machine shapes with mechanical precision the form of the plaster model in the upper part of the prosthesis. The copying machine saves the orthopedic technician the work of routing by hand. By the use of feelers of various sizes the transfer from the model to the prosthesis can be varied in size. This makes it possible, by using a larger feeler, to keep the diameter of the socket a little smaller, as is the usual practice.

After this comes the fitting of the copied thigh piece in the static apparatus. The position can now be adapted at a higher or lower level, in abduction or adduction, flexion or extension. When the thigh piece has been fitted into the static apparatus the stump is inserted into it with the help of a sock. Now the actual adjustment takes place, as I have already described. Not until the ischial tuberosity is supported properly from the lateral aspect and we are satisfied with the fit of the thigh piece in general is the final position fixed, it being necessary to make sure that the abductor muscles in particular, but also the other hip muscles too, are able to function physiologically both when the amputated person walks and stands. Figures 10 through 17 demonstrate the fitting.

The section planes thus obtained are the prerequisite for every further construction. Many variations are possible, it being necessary only to shift two parts and bring them together, without changing the position of the shaft in the apparatus. Any protuberance of the knee assembly can be corrected cosmetically and adjusted; a twist of the horizontal section plane suffices, and the position of the shaft itself remains unchanged.

The thigh piece is placed upon the knee assembly in such a way that the ischial tuberosity lies vertically above the middle of the knee-joint and the lateral margin of the heel. The separate parts of the prosthesis are now screwed together and prepared for the first steps. One can now see whether the thigh piece is properly adjusted to the contours of the stump and allows for the proper functioning of the muscles, for every cramping of muscle contraction shifts or twists the shaft and makes the position of the ischial tuberosity on the prosthesis unsteady.

At the moment we are engaged in experiments to fit the upper portion of the thigh piece without the shaft, and also to determine the position of the shaft independent of this uppermost portion of the thigh piece. These experiments are based on the consideration that the ischial tuberosity is a

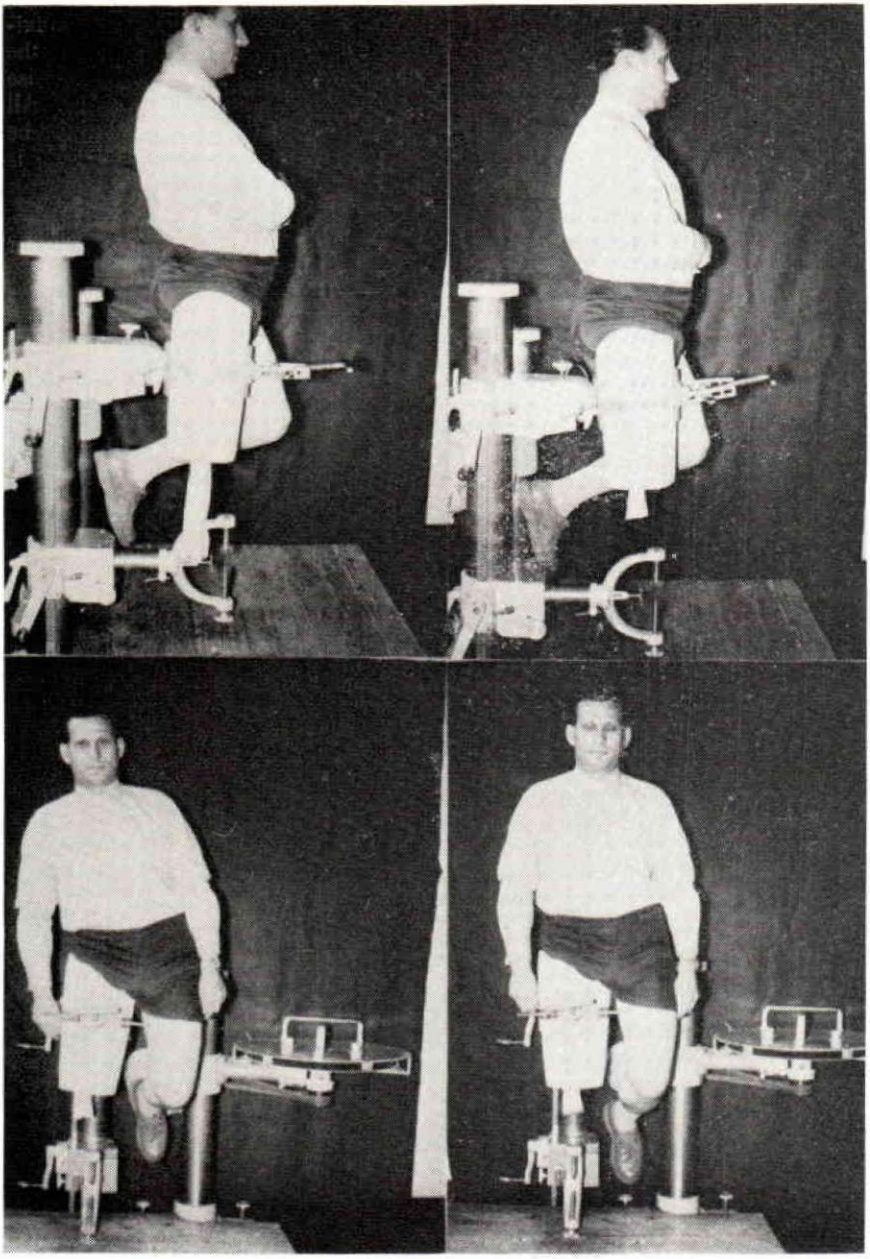


Figure 11. Excessive extension position of the socket must be compensated by the patient with increased lumbar lordosis. In the case of increased abduction position of the socket the patient must shift his body weight to the prosthesis side for the maintenance of balance. In normal posiion the hip musculature may keep the pelvis and the upper part of the body under favorable conditions.

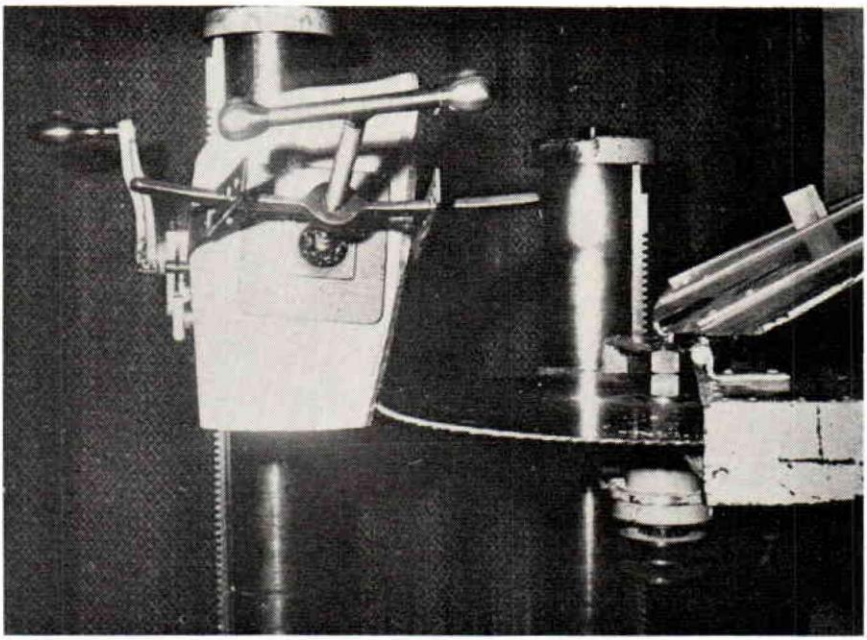


Figure 12. The upper socket is horizontally cut off at the bottom in the position ascertained.

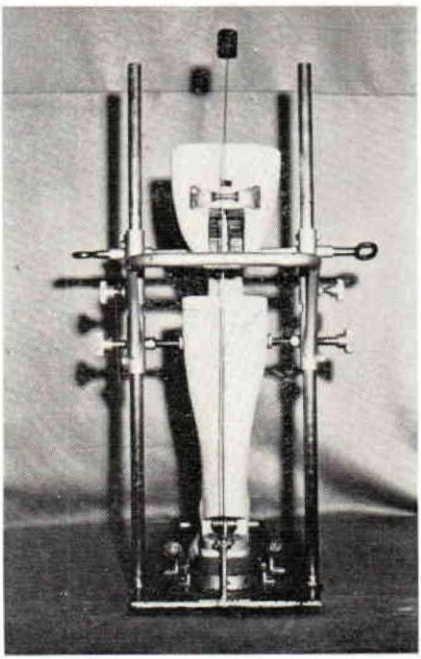


Figure 13. The knee attachment is mounted in a setting-up device. All cutting lines run horizontally.

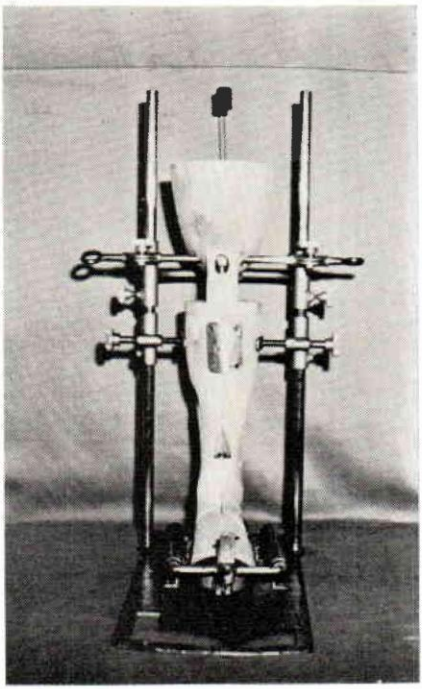


Figure 14. Also the outward position of the foot is taken into account.

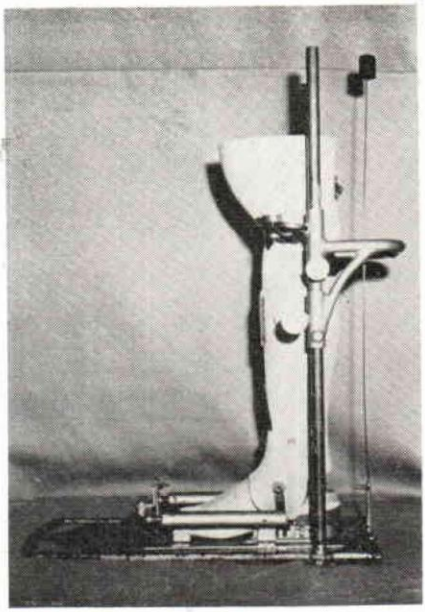


Figure 15. Side view of the appliance. The position of the knee-joint to the axis of the ankle is determined.

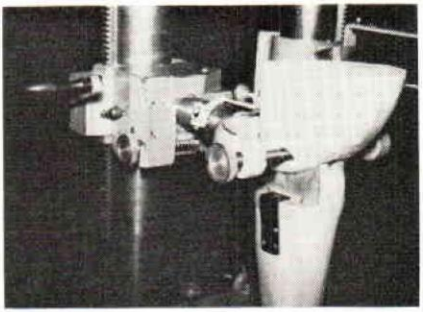


Figure 16. The mounted knee attachment is now clamped in the great setting-up appliance between 2 dead centers. . . .

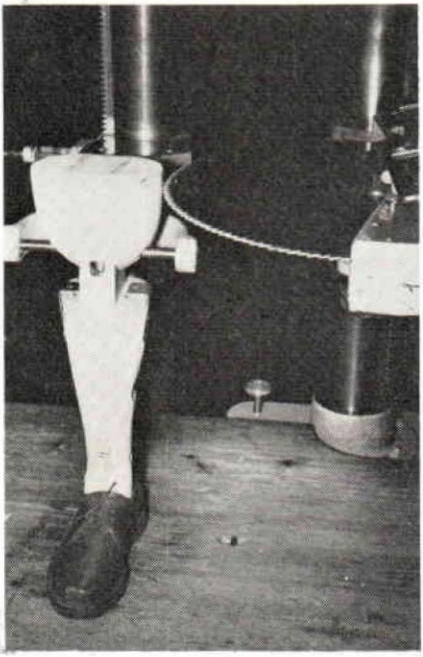


Figure 17. and horizontally cut off by the circular saw adjusted correspondingly.

Figure 18. The patient can load the prosthesis in the flexion position. The knee-joint is not locked but is controlled by a connecting bar from the pelvis to the knee-joint.

portion of the pelvis, whereas the movements of the stump are independent of the pelvis and consequently of the basic principle of weight-bearing. In these experiments the shaft is cut through immediately below the uppermost portion of the thigh piece, and the lower part of the shaft can then be put into a position corresponding to the position of the stump, without this affecting the position of the ischial tuberosity. The results obtained up to now reveal a remarkable freedom from pressure in the area of the upper thigh piece, but nothing final can yet be said.

So far I have reported the most important things about our methods of construction, and I hope that the reader has understood my statements. I have concentrated intentionally on the essential features which are characteristic of our methods of fitting and construction, and have not mentioned details which I consider to be of secondary importance. I have also deliberately avoided the question of the expediency of prostheses. This point can perhaps be dealt with in later discussion.

At the conclusion of my statements, however, I should like briefly to mention knee- and foot-joint constructions, because I am of the opinion that a prosthesis which is satisfactory statically and in motion can still be further improved by the use of suitable joint constructions.

There has always been a demand for greater safety in artificial knee-joints. In 1916 Prof. Schede and my father made the first attempt to use hip extension mechanically for knee extension. It actually was possible to control the knee-joint by this means. But many other difficulties prevented further pursuit of this idea.

This experiment showed, however, that the safety of the knee-joint construction must be independent of the muscles acting at the hip. The principle of a knee-brake also was rejected as a solution, since the knee, in falling, is bent and does not bear weight. But if the brake does function in spite of this, the fall with the stiffened knee-joint is all the more violent.

The result of these considerations was the physiological gliding joint according to the principles of Dr. Schede-Habermann, which through the particular form of the joint condyles affords far greater security as regards weight bearing in the free knee movement. The peculiarity of this construction is that together with blocked dorsi-flexion of the foot-joint the mechanical point of support moves backwards horizontally, so that there is no tilting in the sense of a spontaneous and uncontrolled flexion or extension. The pelvis too maintains its normal movements when the amputated person walks.

There is no doubt that even if anatomic contours are imitated, the construction of artificial knee joints is still hindered by the fact that it is not possible with the means available to orthopedic technicians to reproduce joint surfaces, the ligamentous apparatus and the muscles.

This conviction led therefore to the construction of the toothed wheel segment knee joint, which is not identical with anatomic contours. When the knee joint is flexed 2 toothed segments, each with a different radius, turn against each other, the point of contact of the two segments quickly moving backwards, so that the prosthesis is flexed, but in the static phase remains capable of bearing weight because of the return of the point of contact. Since there is no friction involved the knee joint can be easily guided and controlled by the active forces of the stump. Owing to its construction the joint reacts quickly to all movements of the stump. The swinging and natural pendulum movement of the leg is deliberately accelerated by the toothed segments, so that no delay is caused when the amputated person takes a step. Rubber bands or springs to accelerate the movement of the joint are not necessary. This joint, which outwardly has no similarity with the natural

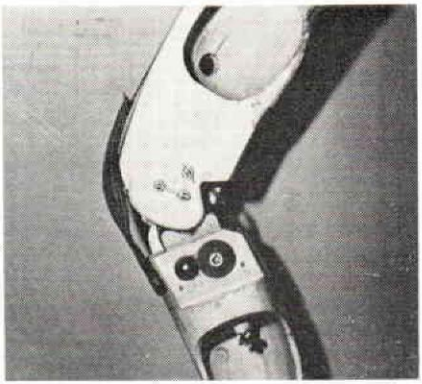


Figure 19. The physiological knee-joint as designed by Dr. Schede-Habermann.

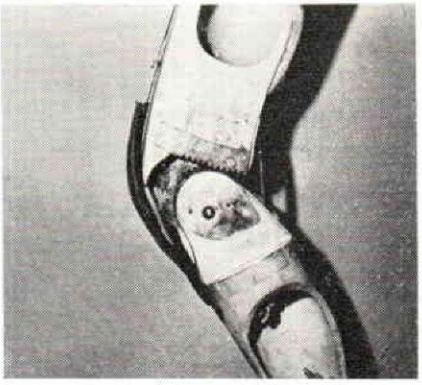


Figure 20. The toothed-segment knee-joint in flexion position. The toothed-segments are rolling against each other in backward direction and thus offer knee security also in the flexion position.

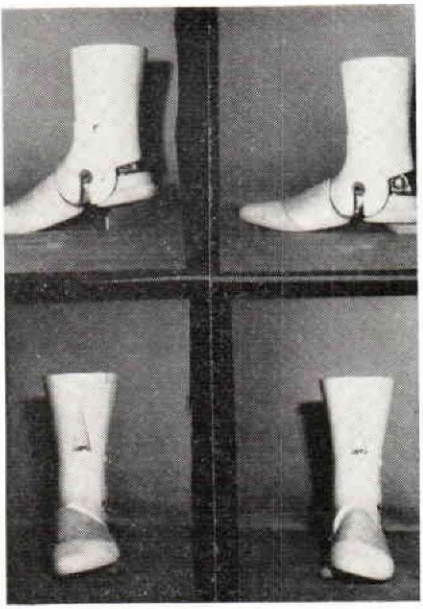


Figure 21. As a supplement to the knee construction we employ a foot technique in which the foot position can be adapted to the requirements of the gait as well as to the heel height of the shoe. This foot construction makes up for unevenness of the ground through supination or pronation of the forefoot. As consequence of this, no cants occur which may have any disadvantageous effects on the tuber seat.

knee-joint, nevertheless affords the amputated person the greatest safety in walking and standing as well as freedom of movement of the joint, that is, without braking and locking. Together with a good and individually constructed shaft such knee constructions are capable, in our opinion, of giving the wearer a maximum of prosthetic quality.

With these last statements I will close my report, and hope that I have given you an idea of our theories in the technique of prosthesis construction. For lack of space my statements are necessarily incomplete and only represent our personal view. I have not mentioned the use of either synthetic products or plastic materials, since it is a matter of course that every progressive firm today considers this question. For the most important elements of prosthesis construction, however, that is, fitting, statics, and function.

Orthopedic technique has a responsible task to fulfill in providing prostheses for persons who are physically handicapped or injured in accidents.

Every effort must therefore be made to give these people the feeling that they are again useful members of human society.

Power Steering for the Mono Drive*

By ANDREW KARCHAK, JR., JAMES R. ALLEN,
ROY SNELSON, C.O., and VERNON L. NICKEL, M.D.†

The mono drive unit has become a popular method for applying power to standard Everest and Jennings wheel chairs. Manual steering capability is the chief limiting factor for patients with upper extremity involvements. Paralyzed patients requiring wheel chairs have varying degrees of involvement and will select the most economical chair they can control at the time. If their selection is a mono drive unit which they are capable of controlling as it is or with assistive devices, progressive upper extremity involvement would necessitate rebuilding the chair or buying a new one. Since this problem has actually occurred at Rancho Los Amigos Hospital, and repetitions appear probable, there seemed to be a valid need for a powered mono drive steering unit.

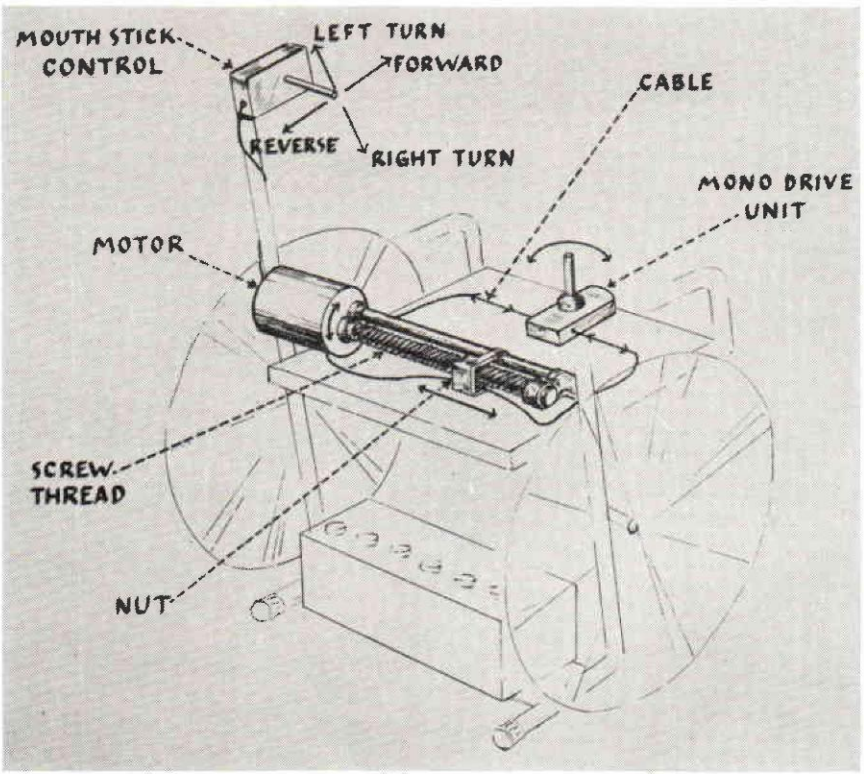


Figure 1

* Supported by Grant RD-518, Department of Health, Education, and Welfare, Office of Vocational Rehabilitation, Washington, D. C.

† Karchak, Research Engineer—Orthotic Department; Allen, Research Engineer—Orthotic Department; Snelson, Department Head—Orthotic Department; Nickel, Head Orthopedist and Chief of Surgical Services, Rancho Los Amigos Hospital.

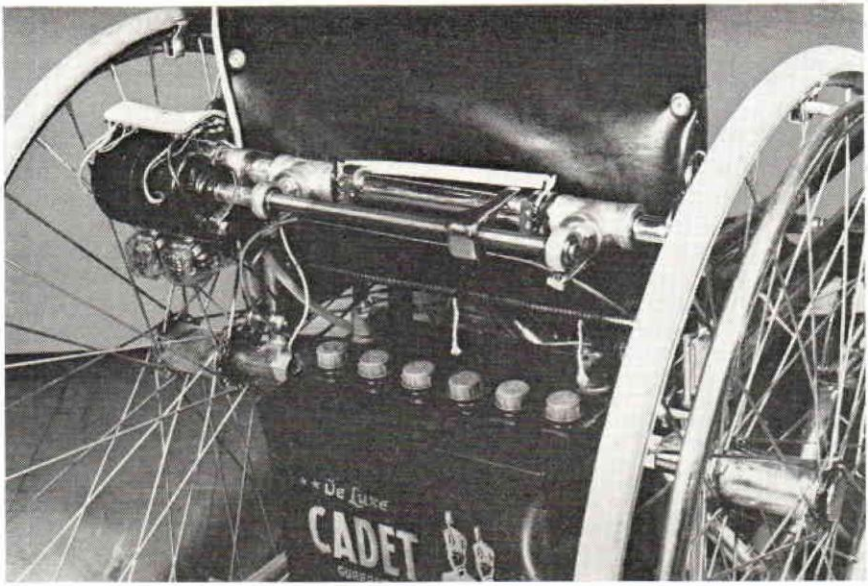


Figure 2

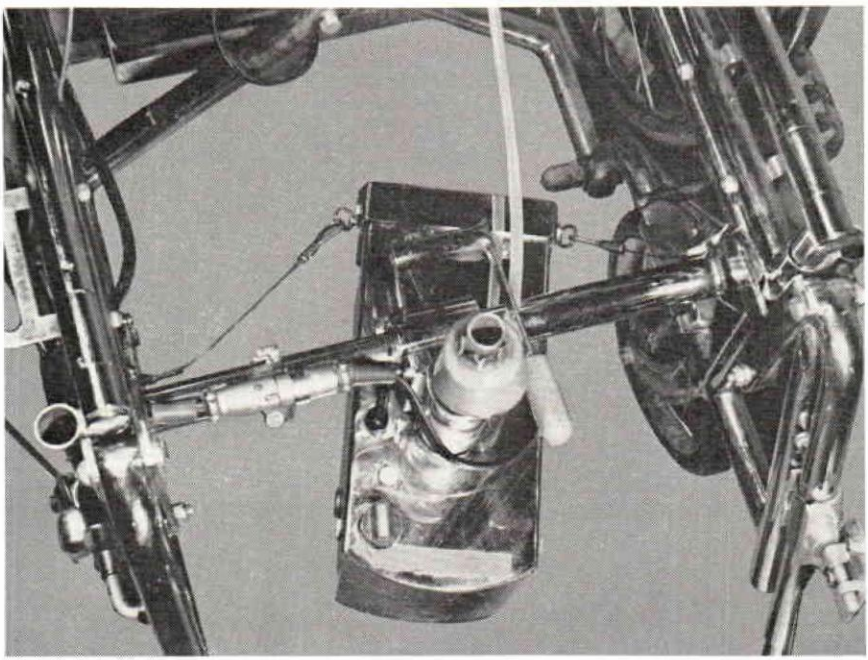


Figure 3

The unit which was developed is shown diagrammatically and pictorially in Figures 1 and 2 installed on the back of the chair. This mounting position is necessary on junior chairs. On adult chairs it can be mounted more conveniently under the seat. Two standard mounting brackets, with a round cross-bar, hold the entire unit in place. Rotary action of the 12 volt D.C. motor is converted mechanically into a linear motion by the screw thread.

Standard prosthetic cable is attached to the nut, then led through a housing and attached to a bracket which fits over the mono drive unit which is shown in Figure 3. Since the cable connection is a closed loop, bidirectional motion of the nut rotates the mono drive in either direction. A distinct advantage of the cable linkage is that it allows the mono drive unit to be retracted on the standard wheel chair.

The control system which works best is of a joystick type action and is illustrated in Figure 4. The horizontal forward and backward motions control the wheel chair mobility, while the vertical up and down action steers the mono drive. The additional short handle is a toggle switch which gives the low and high mobility drives. This control unit provides simultaneous or separate mobility and steering. Figure 5 is the schematic of the power unit control.

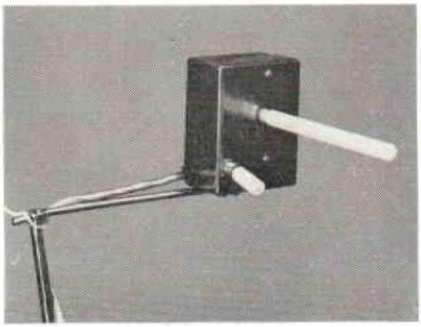


Figure 4

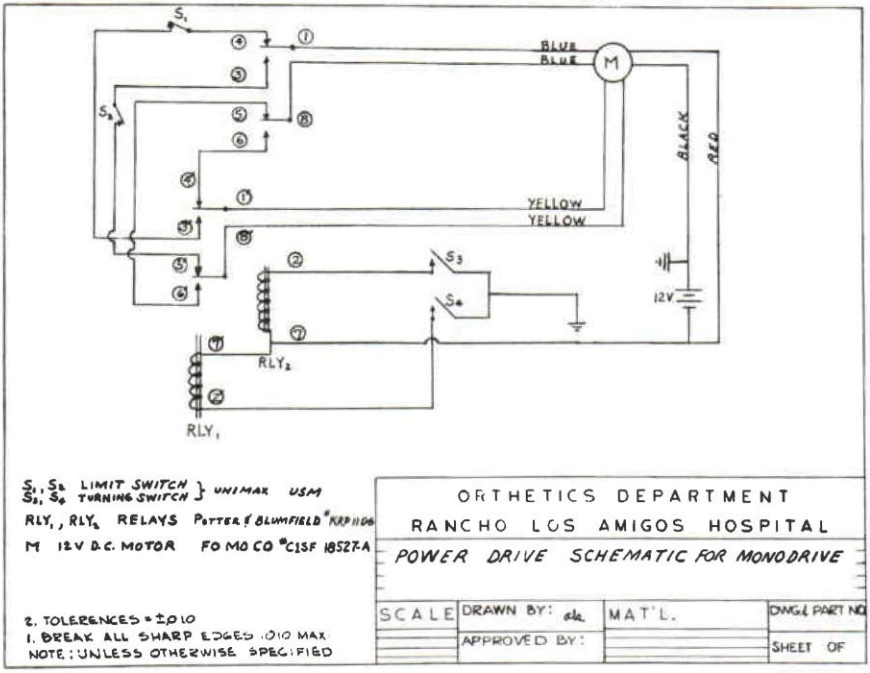


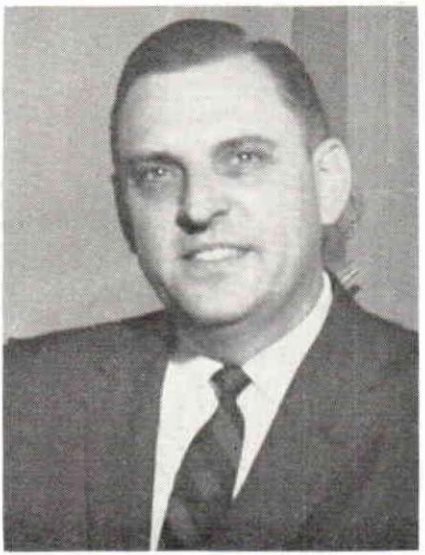
Figure 5

AOPA TECHNICAL MISSION TO EUROPE

A technical mission to Europe in June 1963, is being arranged by the American Orthotics and Prosthetics Association. Members of AOPA taking part in the Mission, will visit orthopedic and prosthetic centers in seven European countries, and will also inspect the exhibits at the International Congress for the Rehabilitation of the Disabled at Copenhagen, June 26 and 27.

Charles Yesalis, Vice-President of the S. H. Camp and Company, Jackson Michigan, has been named Chairman of the Technical Mission. Serving with him will be Bert Titus, Durham, N. C.; Ben Marsh of Sierra Engineering; William Tosberg, New York City; Marion Miller, Indianapolis; Robert Gruman, Minneapolis; Max Nader of the Otto Bock Company; Howard Thranhardt of Atlanta; Jay Greene of U. S. Mfg. Company; Ted W. Smith of Kansas City. President Fillauer is ex-officio member of the committee, and Les Smith will serve as Secretary. Mr. Anthony Staros of the VA Prosthetic Center will serve as Technical Advisor to the Committee.

Delegates on the Mission in addition to the Committee include, Mr. and Mrs. Basil Peters of Philadelphia, Mr. and Mrs. Donald Bohnenkamp of Omaha, Nebraska, Mr. and Mrs. Jack Schwarz of Brooklyn, Mr. and Mrs. Peter Paul Kraft of Ottawa, Canada (other members of the Mission will be announced in the May *Almanac*).



CHARLES YESALIS

The Mission has been arranged to give members opportunity to widen their scope of knowledge concerning orthotics and prosthetics in Europe. In addition, they will bring a report on late developments in the United States in orthotics and prosthetics to various physicians and rehabilitation agencies abroad.

The Mission will visit the U. S. Trade Centers in London and in Frankfurt, Germany. They will also inspect the Otto Bock Factory in Duderstadt.

The Mission which is being arranged with the cooperation of the various government agencies and the International Society will prepare a report for

publication in the *Journal* and to be submitted to members of the Association at the 1963 Assembly.

Travel arrangements for the Mission are being handled by American Express Company. Registration is limited to members of the Association.

Itinerary of AOPA Technical Mission to Europe

In Memoriam

DR. VULTEE

I felt very humble when Les Smith and Stockton Banks asked me to write a tribute for the *Journal* to the memory of Dr. Frederick E. Vultee—humble because there were so many of you who knew Fred as I did. It has been a difficult, vain search for the right words to adequately and sincerely express an appreciation for his medical contributions to prosthetics and orthotics—and in a larger sense to the field of rehabilitation.

Perhaps I can begin with the sequence of educational and professional experiences that contributed to the keen interest that he had in your fields. Fred received his undergraduate (1948) and his Doctor of Medicine (1950) degrees at Yale University, but it was during his residency in physical medicine and rehabilitation at Walter Reed General Hospital (1950-54), here in Washington, that he became so concerned with the unique medical problems of the physically handicapped.

Working his way up to the assistant chief's position in the physical medicine service (1956-57), he was in close contact with the Army Prosthetic Research Laboratory at nearby Forest Glen, was certified by the American Board of Physical Medicine and Rehabilitation (1956), and began his teach-

ing experiences as an instructor in PM&R at Georgetown Medical School (1956-57). The Medical College of Virginia, Richmond, enticed Fred to its campus as an assistant professor in PM&R and within a year he was associate professor on the staff (1957-58).

When he accepted the position as associate director of the Rehabilitation Institute of Chicago (1959-60), he was to become closely involved in planning the curriculum and teaching materials for the then new prosthetic-orthotic education program at Northwestern University Medical School. It was here that many members of your Association came to know him as a clinic team chief and as an instructor in the prosthetic courses. No one gave more willingly and freely of his experience, his effort, and his time to the development of specialized courses for physicians and therapists.

In 1961, Fred returned to Medical College of Virginia as professor and chairman of the Department of Physical Medicine and Rehabilitation, though he still retained his faculty responsibilities at Northwestern and returned regularly to participate in this program. All of us know that Fred was quite a speaker and some of us had the privilege of sharing programs with him on many occasions at your regional and national meetings.

At Medical College of Virginia, Fred became a pillar of strength in the medical supervision he gave to his own department and to the physical therapy curriculum, where his staff, residents and students were inspired, not only by his excellent instruction and clinical experience, but by his desire to try to be of personal assistance to everyone he met.

Just last summer, he was chairman of the program committee for the national meeting in New York City of the American Congress of Physical Medicine and Rehabilitation, and at the time of his death he was planning for the meeting of the project directors of all medical grants from my own office, the Vocational Rehabilitation Administration. He was the first representative of his medical specialty on the National Academy of Sciences' Committee on Prosthetic Education and Information.

But more important than all this was the quality of the man himself. Fred seemed to be motivated by a penchant for activity—an intensity and enthusiasm about everything he did. There was a need to make us smile and laugh with him, and I will never forget his infinite capacity to spontaneously tell a story to suit an event. It was through his use of wit and humor that he judged our personal responses. How well I recall his coming into my office at Northwestern University, falling dejectedly into a chair and saying, "Well, we've got a slow group this time—they didn't get my joke!" But underneath his use of humor, silently he observed.

With some of us, he shared the relaxed, warm atmosphere of his home and gave us the opportunity of knowing his lovely wife and wonderful children.

What more can be said but that in all avenues of his life—as physician, teacher, administrator, and friend—he made a deep and personal contribution. Those of you who knew him as a vibrant teacher and speaker are richer for the experience. Those of us who knew him well have been touched by his presence and will never forget him.

J. Warren Perry, Ph.D.
Assistant Chief
Division of Training
Vocational Rehabilitation Administration
Washington, D. C.

Below Knee Alignment Duplication — Recommended Modifications

By IVAN DILLEE, C.P., and BASIL PETERS, C.P.O.

Prosthetics and Orthotics, New York University Post-Graduate Medical School

Introduction

The usual procedure for alignment duplication of below-knee prostheses is outlined on pages 151 to 157 of the manual entitled "The Patellar-Tendon Bearing Below-Knee Prosthesis," by C. W. Radcliffe and J. Foort. In this shop guide, a simpler and more accurate technique is described which is substituted for the recommended system, and which is now being taught in our courses for prosthetists at New York University.

The earlier method relied primarily on the prosthetist's visual judgment in final determination of toe out. This often led to inaccuracies. The new procedure, if properly followed, will assure accurate retention of the established toe out relationship between the socket and the foot.

A. Modifications of Equipment

It is necessary to make two modifications in the existing equipment before making use of the new procedure.

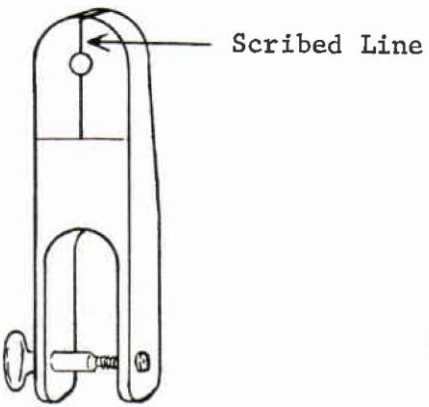


FIGURE 1

1. *Ankle Bracket Modification*
   Scribe a line on the ankle bracket parallel to its edges. The line must bisect the attachment hole and extend to and across the top of the bracket as in *Figure 1.*

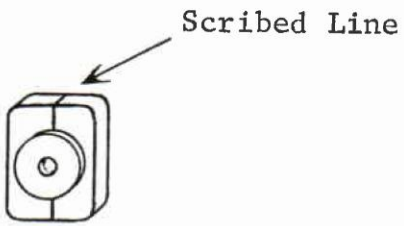


FIGURE 2

2. *Foot Attachment Plug Modification*
   Scribe a line on the long axis of the foot attachment plug. The line must bisect the bolt hole and be parallel to the edges of the plug. Extend the line over both ends of the plug as in *Figure 2.*

B. Procedure During Bench Alignment

When the equipment is ready, the first two steps must be initiated during bench alignment.

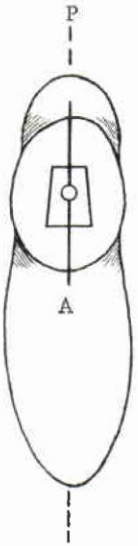


FIGURE 3

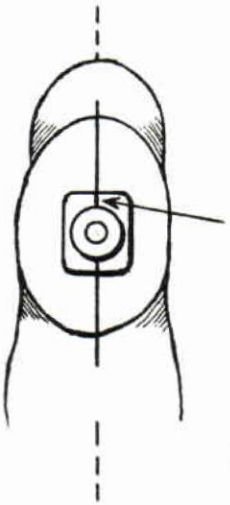


FIGURE 4

1. As illustrated in *Figure 3* draw line A-P which will serve as a reference line. Line A-P must bisect the wood keel bolt hole on the SACH foot and be perpendicular to the anterior edge of the top of the keel.

2. Attach the ankle plug to the SACH foot. The bisecting line scribed on the ankle plug during the modification procedure must coincide with the reference line of the foot. See *Figure 4*. Be sure that these lines coincide throughout the dynamic alignment procedure.

C. Procedure After Dynamic Alignment

Bench alignment, static alignment, and dynamic alignment are carried out in a routine manner. When dynamic alignment is completed, the procedure continues as follows:

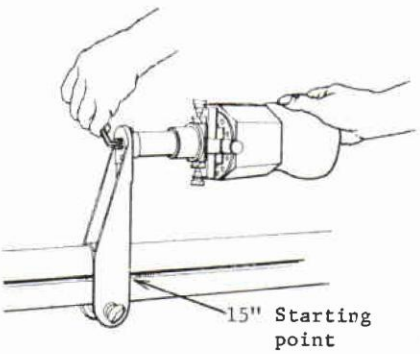


FIGURE 5

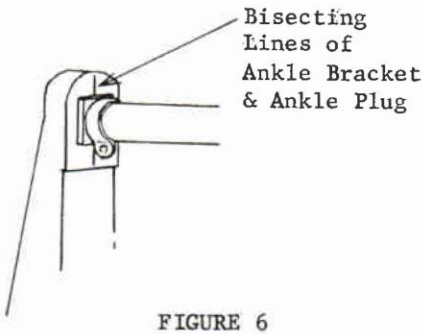


FIGURE 6

1. Remove SACH foot from adjustable shank by unscrewing the bolt through the bottom of the foot.
2. Using the base tube tape measure for reference, lock the ankle bracket at position 15″, reading from the right side of bracket. *See Figure 5.*
3. Attach the adjustable shank and socket to the ankle bracket with bisecting scribe line of the ankle plug coinciding with the bisecting scribe line on the ankle bracket. *See Figure 6.*
4. Slide socket clamps into position and lock on base tubes. Then secure socket with post clamps. *See Figure 7.*
5. Remove the adjustable shank by unfastening from the ankle bracket and removing screws in socket extension block.
6. Set saw guide on jig without moving the socket assembly and make a cut with the saw on the socket extension block. The cut should be about ¼″ from the end of the socket. CAUTION: *The saw guide should not be moved on the base tubes at any time during duplication.*
7. Slide socket assembly out of the way by moving it to the right.
8. Bring ankle bracket back to position 15″. Attach shin block to ankle bracket. Correction for wood removed in saw kerfs may be made by setting the ankle bracket at position 14⅞″.
9. Make vertical cut on shin block.
10. Remove saw guide.
11. Bring components into firm contact and index for glueing.

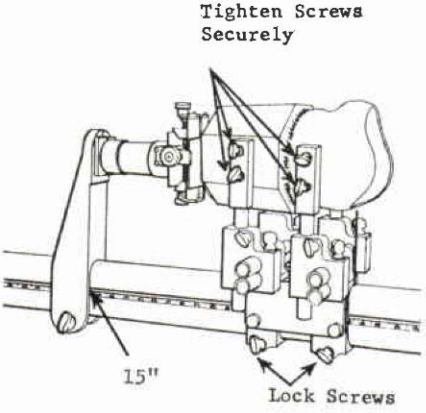


FIGURE 7

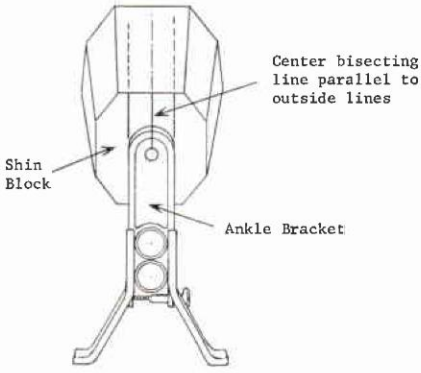


FIGURE 8

12. Index the distal end of the shin block with three lines. Two lines must be parallel to the lateral sides of the ankle bracket. The center line must correspond to the bisecting line scribed on the ankle bracket and also be parallel to the two lateral lines. *See Figure 8.*
13. Remove components from the jig and glue together. When the glue is set attach the foot to the shin block so that the center line at the end of the shin block corresponds with the reference line of the foot. The leg is now ready for shaping and finishing.

Physiological Considerations in Bracing of the Spine[1]

By JAMES M. MORRIS, M.D., and DONALD B. LUCAS, M.D.

Biomechanics Laboratory and Department of Orthopaedic Surgery, University of California School of Medicine, San Francisco

It is well recognized that braces in current use cannot produce complete immobilization of the spine, especially in the lumbosacral region. In fact, it has been shown that motion at the lumbosacral joint may be increased during trunk flexion when a long spinal brace is worn, since there is compensation for decreased motion of the thoracolumbar region.[1]

Clinically, however, despite the obvious incompleteness of immobilization, bracing frequently results in symptomatic improvement of low-back disorders. Apparently, either partial immobilization or the support provided, in some manner, to this region brings about the improvement. In this regard, it has been observed that in certain cases of low-back pain caused by disc degeneration or so-called mechanical instability, compression of the abdominal viscera often relieves the pain. This compression may be accomplished by use of a circumferential bandage, a well-fitting corset, a brace with an abdominal pad which can be tightened, or a snug plaster body jacket.

In an effort to expand our understanding of the physiological factors in support of the spine and their possible application to orthotics, a study of the mechanics of stability and support of the spine was undertaken at the Biomechanics Laboratory. In particular, the role of the compartments of the trunk (thorax and abdomen) in helping to provide stability of the spine was investigated.

The spinal column, which serves as a sustaining rod for the maintenance of the upright position of the body, may be considered to have both an intrinsic and an extrinsic stability. Intrinsic stability is provided by the alternating rigid and elastic components of the spine which are bound together by ligaments, while extrinsic stability is provided by the paraspinal and trunk muscles. The trunk muscles, especially those of the abdomen, form a contractile muscular wall about the body compartments which is capable of compressing the viscera. With the contraction of these muscles, the intracavitary pressures are increased, aiding in many bodily functions such as childbirth, respiration, return of venous blood, and, as will be shown, stabilization or support of the spine.

The isolated ligamentous spine behaves like a modified elastic rod.[2] When it is fixed at the base, its critical load—i.e., the greatest load it can sustain without buckling—is approximately 4½ pounds, or much less than the body weight alone.[2] The stability of the spine in the living is therefore dependent largely on the extrinsic support provided by the trunk muscula-

[1] This work was supported by Veterans Administration Contract V1005M-2075.

EDITOR'S NOTE: Part of this material has previously appeared in the *Journal of Bone and Joint Surgery (Amer.)*. This paper was presented at the 1962 Assembly of the Association, in Phoenix, Arizona.

ture. The lack of inherent or intrinsic stability of the vertebral column and the importance of the trunk muscles are clearly demonstrated if one tries to hold an unconscious person upright.

The maintenance of the upright position, however, depends upon a finely balanced and co-ordinated mechanism that requires a minimal amount of muscular effort. This has been demonstrated by basal metabolic studies in which the metabolic rate was found to be only slightly greater during standing [3] than the standard rate in the recumbent position (about 1200 cal/min). The same conclusion has been reached on the basis of electromyographic studies of the intrinsic back muscles,[4] in which slight activity has consistently been found in only one muscle, the longissimus, which is the largest of the back muscles. Activity in other back muscles is sporadic and occurs only with shifting of the body weight.

During the act of lifting a heavy weight with the hands, the nucleus of the lumbosacral disc may be considered as a fulcrum of movement and the arms and trunk as a long anterior lever. The weight being lifted and the weight of the upper part of the body are balanced by the contraction of the deep muscles of the back and the glutei maximi acting through a much shorter lever arm, the distance from the center of the lumbosacral disc to the center of the adjacent spinous process. If a 200-pound weight is lifted by a male of average size, the theoretical force on the lumbosacral disc—with the body weight also taken into consideration—can be calculated to be 2,071 pounds (Fig. 1).[5]

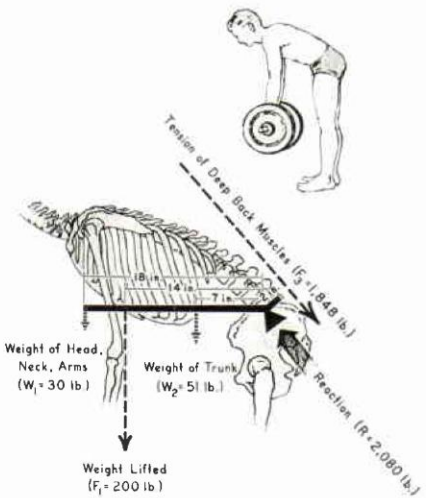


Fig. 1. Theoretical force on lower lumbar part of spine, with role of trunk omitted.

Experimental studies of the isolated ligamentous spine [6,7] and investigation of injuries sustained by catapult ejection of jet pilots [8] have shown that such great forces cannot be tolerated. Compression tests on two vertebral bodies and intervening disc have indicated that failure occurs in specimens from young subjects at compressive loads ranging from 1,000 to 1,700 pounds.[6,7] In specimens from older subjects the critical level was sometimes reduced to as little as 300 pounds. Catapult ejection of young jet fliers with a force of 20 G, or less than 2,000 pounds, has resulted in vertebral compression fractures in 27 per cent of the cases.[8] Evidence of failure is often difficult to see either on gross examination or by x-ray. It may consist of compression of a few spicules of bone, cracks in the end plate, or, sometimes, collapse of the plate. It is interesting to note that fracture of the vertebra always occurs before herniation of a normal disc.[7]

When one compares the force calculated earlier (2,071 lb.), to which the lumbosacral area is apparently subjected during heavy lifting, with the force that the isolated spine is able to tolerate experimentally, a discrepancy is evident. It is obvious that the lumbar vertebrae and discs alone are not able to withstand the amount of force that may be imposed during exertion; additional support of the spine is necessary.

This additional support may be provided by the thorax and abdomen. Let us consider the spine as a segmented elastic column supported by the paraspinal muscles. This column is attached to the sides of and within two chambers: the thoracic and abdominal cavities. The thoracic cavity is filled largely with air and the abdominal cavity with a semifluid mass. The action of the trunk musculature converts these chambers into nearly rigid-walled cylinders containing (1) air and (2) liquid and semisolid material. Both these cylinders are capable of resisting a part of the force generated in loading the trunk and thereby of relieving the load on the spine itself.

Experimental Procedure

To test this hypothesis, the action and effects of the musculature of the thorax and abdomen were investigated in 10 healthy male subjects under various conditions of loading of the trunk.

The intrathoracic pressure was obtained by means of an open-tip polyethylene catheter placed within the esophagus and the intra-abdominal pressure by means of a similar catheter placed within the stomach.

Copper-wire electrodes were embedded in the trunk muscles—specifically, the intercostals, the abdominal obliques, the rectus abdominis, and the deep muscles of the back—and the electrical activity of these muscles was recorded simultaneously with the pressures.

Loading of the trunk was accomplished by two methods. In the first (dynamic), the subject lifted from 0 to 200 pounds, in increments of 50 pounds. The weights were lifted from the floor to the height of the freely-hanging hand with the subject in the erect position.

In the second (static) method of loading the trunk, the subject pulled against a measurable fixed resistance (strain ring) up to a maximum of 200 pounds. This was done with the trunk of the subject in four positions: vertical, then flexed at 30, 60, and 90 degrees. The amount of pull or tension

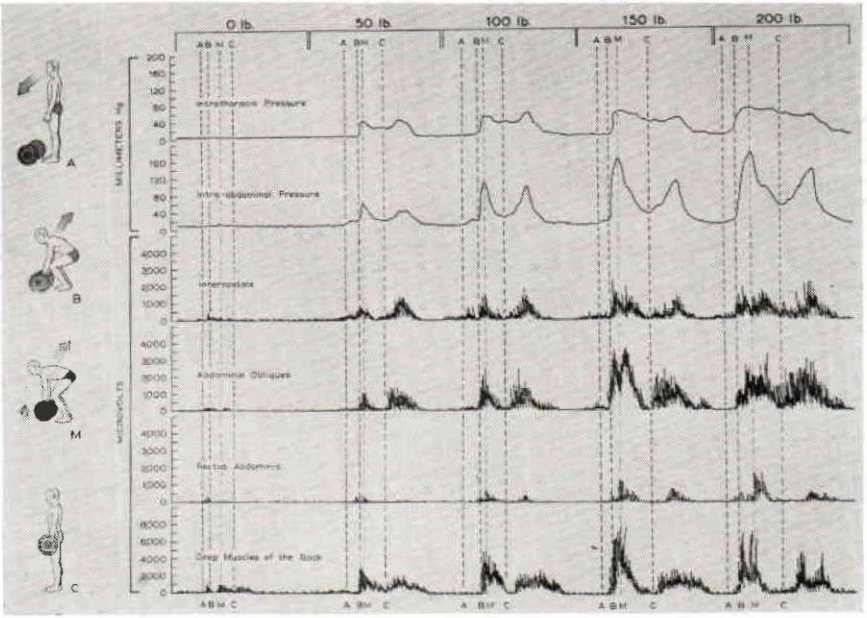


Fig. 2. Dynamic loading of the spine.

exerted on the strain ring was recorded simultaneously with the intracavitary pressures and electromyographic activity.

Results

Figure 2 illustrates the data obtained. It can be seen that when the subject bends over but lifts no weight there is little increase in the intracavitary pressures. As heavier weights are lifted, the maximum pressures in both abdomen and thorax are progressively increased. The intra-abdominal pressure rises more than the intrathoracic, but the latter is more sustained and fluctuates less during lifting. Apparently the rib cage becomes "fixed" by inspiration and muscle activity and remains so throughout the loading.

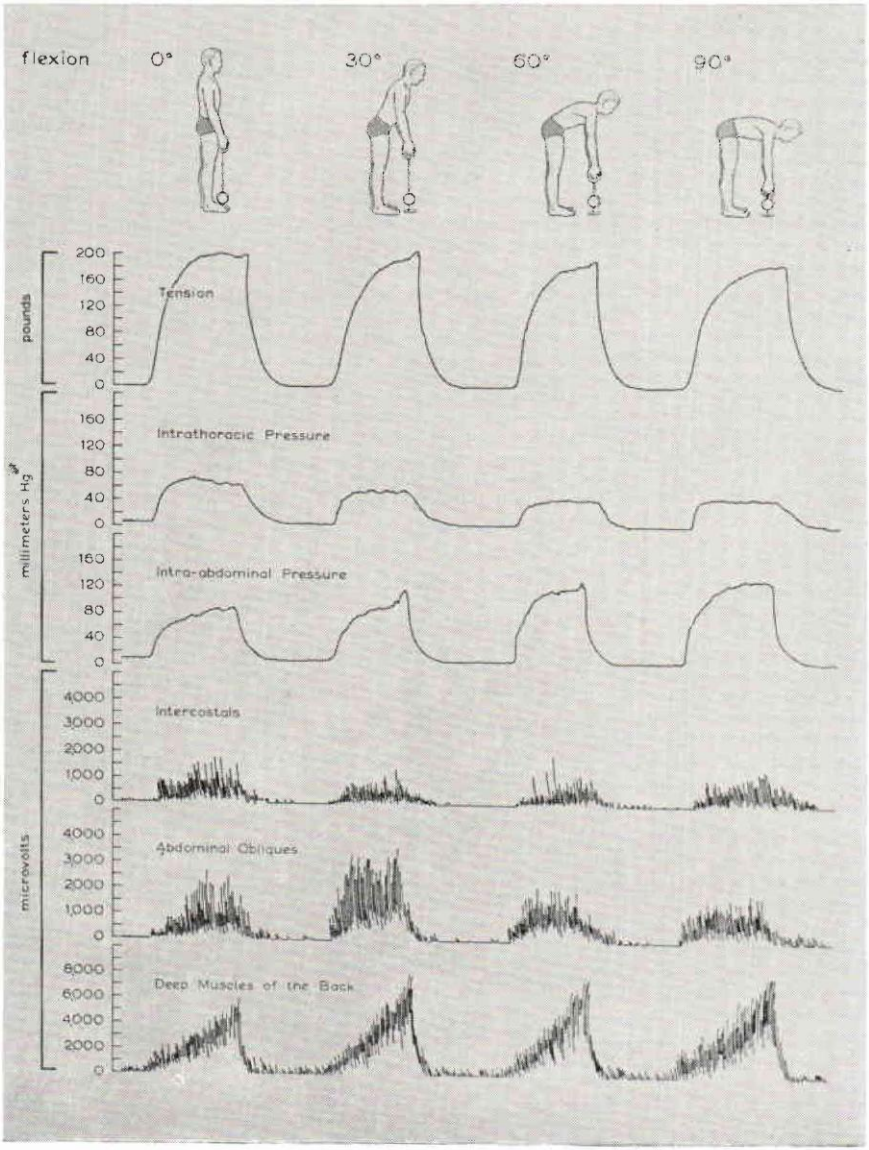


Fig. 3. Static loading of the spine.

Motion pictures taken to correlate the subject's position with pressures and electromyographic activity demonstrate (Fig. 2) that there is little increase of pressure or muscle activity as the subject bends forward (position *A*). The pressures rise rapidly as the subject begins to strain to lift the weight (position *B*), and the maximum peak of pressure occurs at the moment the inertia of the weight is overcome and it is lifted from the floor (position *M*). With the subject in the upright position the pressures again drop toward resting levels (position *C*). The second peak of pressure occurs as the weight is set down.

As is also shown, the trunk musculature becomes active simultaneously with the elevation of pressure and obviously is important in the generation of these pressures. As the weights and the force on the spine are increased, the activity of these muscles is increased.

Tension imposed on a strain ring with the trunk vertical or in various degrees of flexion was recorded simultaneously with the intracavitary pressures and the electromyographic activity of the muscles (Fig. 3). It can be seen that as the tension on the ring is increased the pressures and electromyographic activity are increased proportionately.

When the subject pulled on the ring while he was in the upright position, the intra-abdominal and intrathoracic pressures were, in general, identical or nearly so. Evidently, equilibrium of pressures was established across the diaphragm with the subject in this position. As the subject progressively flexed the trunk on the thighs, the pressure in the abdomen tended to increase when any specific tension on the ring was maintained. The pressure in the thorax, however, remained the same or tended to decrease with progressive flexion of the trunk.

It was apparent from preliminary runs that the intracavitary pressure produced by loading the trunk played an important part in the stability of the spine. It was therefore decided to evaluate the effects of increasing the intra-abdominal pressure by means of externally applied pressure. For this purpose, a rubber bladder surrounding the abdomen was placed within a nonelastic lumbosacral corset and inflated to the limit of comfort.

The resting abdominal pressure was elevated from 5 to 25 mm Hg. The intrathoracic pressure was elevated only slightly (Fig. 4).

It is interesting to note that, while the resting intra-abdominal pressure was considerably elevated by the corset, the maximum intra-abdominal pressures generated in loading of the spine were quite comparable with those obtained without the corset.

However, when the activity of the trunk musculature is compared during loading with and without the corset, a marked difference is obvious. The activity of the abdominal muscles was consistently and considerably decreased when the corset was worn, despite the fact that the intra-abdominal pressures might be the same. The intercostal activity was also noted to be decreased if the corset came high up on the chest over the intercostal muscles being studied. It appears, therefore, that the contracted muscles of the abdominal wall or the rigid external-pressure apparatus acts to contain the abdominal contents in a compressed state capable of transmitting force. When the compression or restraint is accomplished by an external apparatus, there is little need for contraction of the abdominal muscles.

To illustrate the role of the trunk in the support of the spine, it is possible, using the data obtained in this study, to calculate the approximate forces on the lower thoracic and lumbar spine in the living subject when a weight of 200 pounds is lifted.[5]

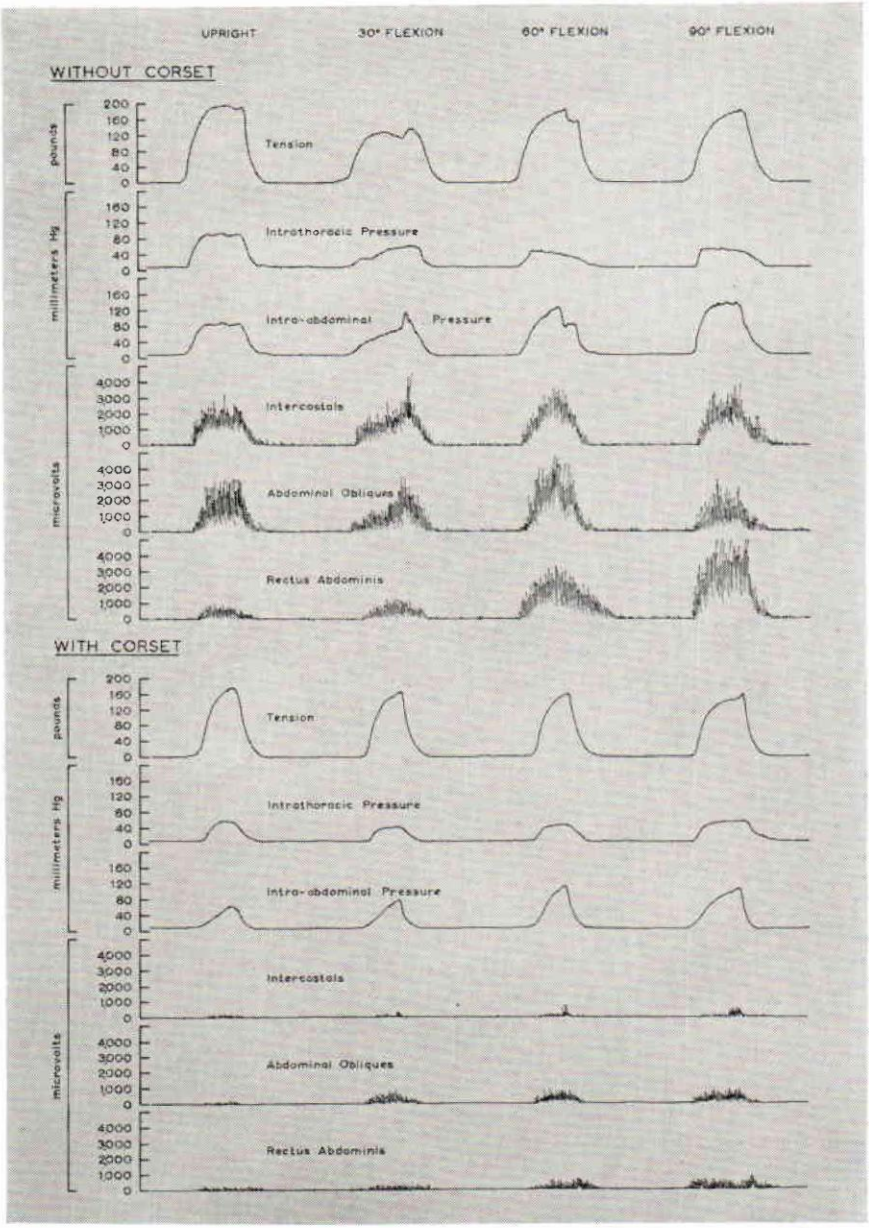


Fig. 4. Effect on muscle activity of external compression of abdomen by inflatable corset.

The spinal column may be considered as a flexible beam fixed at its base (the pelvis) and eccentrically loaded at its free end. The thoracic and abdominal cavities may be considered as modified inflatable supporting structures for the beam.

With use of basic mechanical principles, the amount of force at the base (lumbosacral junction) of this beam can be calculated (Fig. 5). For purposes of computation, we may consider a section just above the brim of the pelvis. The forces acting at this level include the weight lifted, the body

weight, the tension of the deep muscles of the back and posterior thigh muscles acting on the back, and the net upward force exerted by the pelvis to counteract the net downward force of the intra-abdominal pressure. The last value is obtained by multiplying the average intra-abdominal pressure recorded during the lifting of 200 pounds (3 pounds per square inch) by the cross-sectional area of the abdomen at this level, and subtracting the longitudinal component of the tension of the abdominal muscles.

When all the forces, their directions, and the distances from the fulcrum are determined, the reaction at the lumbosacral disc can be calculated. Thus, instead of the theoretical force, calculated earlier, of approximately 2,071 pounds at the base of the beam, there is, if one takes into account what might be called the "inflatable support" of the trunk, a force of about 1,483 pounds—a reduction of about 600 pounds.

The theoretical force on the lower thoracic region of the spine, omitting the effect of the intracavitary pressure, may also be calculated as it was for that at the base of the spine; it is found to be 1,568 pounds. However, by the relatively simple mechanism of the upward push on the diaphragm by the increased intra-abdominal pressure acting through a lever system, the force on the lower thoracic and lumbar spine is reduced to only 791 pounds (Fig. 6).

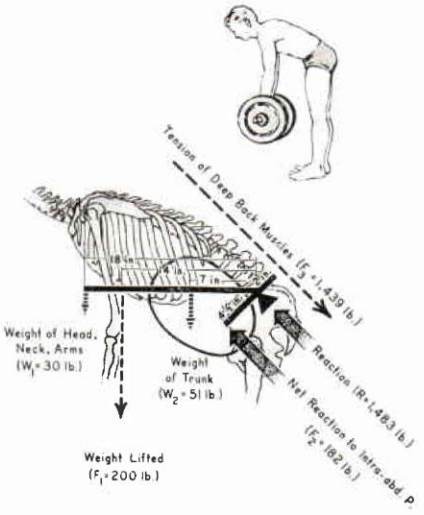


Fig. 5. Force on lower lumbar part of spine, with role of trunk included.

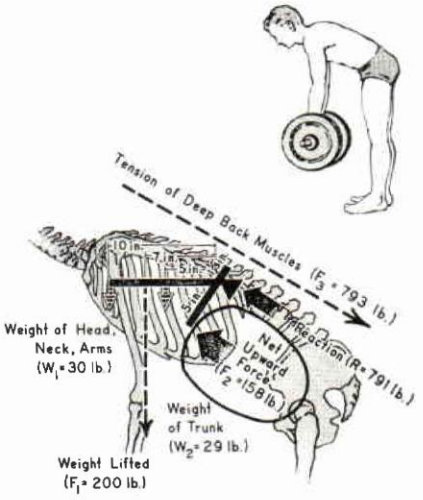


Fig. 6. Force on lower thoracic part of spine, with role of trunk included.

Discussion

The answer to the question of how the vertebral column in a living subject is able to withstand a far greater force than can the isolated spine must be found by consideration of the extrinsic supporting structures of the trunk.

These studies have substantiated the hypothesis that the additional support is provided as follows: The spinal column is attached to the sides of and within two chambers, the abdominal and thoracic cavities; the action of the trunk musculature converts these chambers into nearly rigid-walled cylinders capable of transmitting part of the forces generated in loading the trunk and thereby of relieving the load on the spine itself.

It should be emphasized that what occurs here is the result of a reflex mechanism. When a load is placed on the spine, the trunk musculature is involuntarily called into action to "fix" the rib cage and to restrain or compress the abdominal contents. The intracavitary pressures are thereby increased, aiding in support of the spine.

It may be concluded, from the calculations presented, that the actual force on the spine is much less than that considered to be present when support by the trunk, or the effect of the intracavitary pressures, is omitted. The actual force on the lumbosacral disc is approximately 30 per cent less, and that on the lower thoracic portion of the spine is about 50 per cent less than would be present without support by the trunk.

In addition to contributing to support of the spine, the increased intra-abdominal pressure may well produce an analgesic effect, since, as was mentioned earlier, it has been observed clinically that patients with low-back pain may be relieved by abdominal compression. Orthopedic surgeons regularly rely on abdominal strengthening exercises as a means of pain control for lumbosacral arthralgia. From the orthotist's viewpoint, abdominal compression is a built-in feature in most conventional low-back supports.

Studies are currently under way on the effects of air-pressure bracing which provides, in addition to the compression, partial immobilization by the rigidity of the apparatus. Obvious advantages include comfort, adequate distribution of pressure, variability of pressure, and consequent rigidity and ease of fitting because of lack of localized pressure areas.

Disadvantages are present also, such as heat-transfer problems and potential muscle atrophy resulting from disuse. Only extensive clinical trials and modification of apparatus will determine the value of and specific indications for this type of bracing.

REFERENCES

1. Norton, Paul L., and Brown, Thornton: The immobilizing efficiency of back braces; their effect on the posture and motion of the lumbosacral spine. J. Bone Joint Surg. [Amer.], 39-A:111-139, 1957.
2. Lucas, D. B., and Bresler, Boris: Stability of the Ligamentous Spine. Technical Report no. 40. Biomechanics Laboratory, University of California, Berkeley and San Francisco. The Laboratory, December 1960.
3. Ralston, H. J.: Energy-speed relation and optimal speed during level walking. Int. Z. angew. Physiol., 17:277-283, 1958.
4. Morris, J. M.; Benner, Gordon; and Lucas, D. B.: An electromyographic study of the intrinsic muscles of the back in man. J. Anat., Lond., 96:509-520, 1962.
5. Morris, J. M.; Lucas, D. B.; and Bresler, Boris: Role of the trunk in stability of the spine. J. Bone Joint Surg. [Amer.], 43-A:327-351, April 1961.
6. Brown, Thornton; Hansen, R. J.; and Yorra, A. J.: Some mechanical tests on the lumbosacral spine with particular reference to the intervertebral discs. A preliminary report. J. Bone Joint Surg. [Amer.], 39-A:1135-1164, Oct. 1957.
7. Perey, Olof: Fracture of the vertebral end-plate in the lumbar spine; an experimental biomechanical investigation. Acta Orthop. Scandinav., supplementum 25, 1957.
8. Hirsch, Carl, and Nachemson, Alf: Clinical observations on the spine in ejected pilots. Acta Orthop. Scand., vol. 31, fasc. 2, 1961, pp. 135-145.

Final Report:

The Above Knee Study Committee

University Council on Orthotic and Prosthetic Education

Introduction

The first report of the Above Knee Study Committee was published in the June, 1962 *Orthopedic and Prosthetic Appliance Journal*, pp. 157-159. It will be recalled that the Study Committee was appointed by the University Council on Orthotic and Prosthetic Education (UCOPE) because of the recognition of a need for closer cooperation and coordination between the three University Teaching Centers which make up the Prosthetic and Orthotic Education Program in the United States. The mission assigned to the Committee was to analyze and compare the principles and techniques taught at each university with regard to wood socket above-knee prosthetics so that differences could be isolated, discussed, and if possible reconciled.

In carrying out this assigned responsibility, the Committee has met three times. The first meeting was held in Los Angeles in February, 1962, and the second and third meetings took place at New York University in July and September of 1962. These meetings, each of which occupied several long working days, resulted in a final report which we believe will be of interest to every prosthetist engaged in the fitting of above-knee amputees.

Socket Planning

It will be recalled from the earlier report that there are two different methods currently being taught for preparing a socket pattern at ischial level. These can be called the "pattern modification" method which is used at New York University and the "pattern construction" method which is used at Northwestern University and at the University of California at Los Angeles. Many hours of discussion and practical work with both methods led to the findings that:

1. The M-L Dimension

a. *Difference.*—Patterns made according to the instructions of the "pattern construction" procedure tend to be wider in the M-L dimension than patterns for the same amputee made in accordance with "pattern modification" procedures.

b. *Reconciliation.*—The Committee agreed that the "pattern construction" procedures would be altered so as to produce a pattern 3/16" smaller from medial to lateral sides.

2. The Rectus Femoris Channel

a. *Difference.*—The constructed patterns tend to have a shallower rectus femoris channel than the modified patterns.

b. *Reconciliation.*—Once again, agreement was reached that the construction procedure would be altered so as to deepen the rectus femoris channel by 1/8" increments.

3. Posterior Wall Angulation

a. *Difference.*—Depending on stump musculature, the constructed patterns have an angle between the medial and posterior walls that varies from 6 to 10 degrees. In contrast, the modified patterns used by NYU have maintained a constant angle of 7 degrees.

b. *Reconciliation.*—A partial agreement was reached on this point with the understanding that the NYU faculty does not consider this angle as unchangeable. If needed for a particular patient, pattern modification procedures now permit changing this angle for the purpose of obtaining proper pattern perimeter.

Given the above agreements, patterns for the same amputee made at any of the three Universities will be considerably more similar than they would have been a year or two ago. It should be pointed out, however, that none of the Universities are willing to discard the approach to pattern making currently being taught. NYU plans to continue arriving at the final pattern with a pattern modification approach and NU and UCLA will continue to teach a pattern construction approach.

Socket Layout

1. Adduction and Flexion Angles

a. *Difference.*—For some years, NU and UCLA have laid out on the socket block the adduction and flexion angles derived from measurements on the amputee. In contrast, NYU has not been preparing the socket block to reflect these angular measurements because of the feeling that these angles could be determined only with the amputee walking on the socket and an adjustable leg.

b. *Reconciliation.*—The Committee learned during the discussion of this point that for the past year NYU has been measuring adduction and flexion of the amputee's stump and preparing the socket block in accord with the measured angles. Consequently, at the present time there is no difference with regard to this procedure.

2. Lateral Wall Undercut

a. *Difference.*—To provide an undercut on the lateral wall above ischial seat level, the proximal pattern is moved medially on the socket block approximately ½" by NYU, ⅜" by NU and ¼" by UCLA. As a result the NYU sockets display the largest undercut and the UCLA sockets display the least amount of undercut.

b. *Reconciliation.*—Agreement on this point was achieved by an understanding that all schools will teach a standard ⅜" for pattern displacement. It is recognized by the Committee that this standard amount may have to be varied for a particular patient but it is felt that a ⅜" medial displacement of the pattern will provide the proper amount of undercut for most patients.

3. The Distal Pattern

a. *Difference.*—For the planning of the distal pattern, NU uses a perimeter that is 1" less than the most distal stump measurement, NYU uses 2" less than the most distal stump measurement and UCLA uses the tension value plus 1/16" at the most distal measured level. This distal pattern is used in the socket block by NU and UCLA at the level of the most distal stump measurement, whereas NYU uses this pattern 2" below the end of the stump on the bottom of the socket block.

b. *Reconciliation.*—While instructions for planning and locating the distal pattern obviously vary at each of the three Centers, it is important to point out that all three methods are designed to produce the same desired result, that is, a distal socket circumference in accord with the tension analysis chart. The Committee feels that any procedure in planning and locating the distal pattern is acceptable as long as it achieves this result.

Initial Shaping

In discussing the general approach to initial shaping as taught at the three University Centers, it was found that though there are some deviations in technique, the goal of the shaping procedure is the same at each University, that is, to produce a socket with appropriate contours and with measurements in accord with the tension analysis chart. The differences are considered simply individual preferences in going about the shaping process. For purposes of this report, therefore, the Committee wishes to describe two general approaches to initial shaping rather than listing differences and reconciliations.

The approach to initial shaping at NU and UCLA is to work on one socket wall at a time. The lateral, posterior, anterior, and medial walls are successively shaped. Throughout the shaping process great emphasis is placed on continual use of "devil level" goniometers to insure the maintenance of planned flexion and adduction angles in the posterior and lateral walls.

The approach at NYU is to first open the socket generally and then concentrate on each wall successively in the same order as mentioned above. There is less rigid insistence on the maintenance of flexion and adduction angles since it is assumed that these measurements, while useful, are only approximations and that final determination can be made only when the socket is worn by the amputee. NYU does, however, place both the distal pattern and the ischial level pattern at the same distance from the exterior surface of the lateral wall. Since as mentioned earlier the socket block incorporates the planned adduction angle, connecting the two patterns tends to maintain the adduction angle and produces a medial wall that is not vertical.

While the general approaches to initial shaping are quite similar, the Committee did isolate two specific differences which should be mentioned:

1. Shelves or Shoulders in the Distal Socket

a. *Difference.*—Placement of the distal pattern at the level of the most distal stump measurement enables NU and UCLA to have wood shelves curving in under the end of the stump. The socket thus maintains contact with distal stump tissues as completely as possible without being a total-contact closed end socket. In the case of NYU, placement of the distal pattern 2″ below the end of the stump means that the socket does not have shelves or shoulders curving in under the end of the stump.

b. *Reconciliation.*—No attempt was made to reconcile this difference since the Committee feels that current work with wood and plastic total-contact sockets will in all likelihood make the difference insignificant.

2. Posterior Wall Contour

a. *Difference.*—Underneath the ischial seat, the posterior walls of NYU sockets are usually contoured with a moderate radius both proximal-distal and medial-lateral. In other words, there is a shallow concavity in two planes.

In contrast to this, the posterior walls of NU and UCLA sockets tend to be flat in both planes.

b. *Reconciliation.*—In discussing this difference, it was found that UCLA feels strongly about maintaining the flatness of the posterior wall. NU feels less strongly about this and does, at times, permit a slight concavity on the medial side of the posterior wall. NYU feels strongly that contouring in this area is important for comfort and retention of the socket. The Committee felt that the middle position of NU offered a reasonable compromise. It was agreed, therefore, that if a concavity is needed to insure a comfortable fit for a particular patient, instruction at each University would permit this socket modification. The amount of emphasis placed on this point at each school is, of course, left to the judgment of the respective prosthetist faculties.

In concluding their report, the Committee wishes to state its feeling that:

a. There is, at this moment, considerably less divergence in teaching at the three University Centers than there has been for the past several years. There has been, over the years, a natural evolution in the theory and methods presented at each of the Universities. This evolution has tended to proceed along the same lines so that the current differences are primarily in the area of "how to do it" details rather than in basic principles. In fact, in the Committee's opinion the similarities are much more striking than the differences.

b. The Committee would welcome correspondence from readers of this report regarding any of the differences and reconciliations discussed, or regarding other differences which may have been overlooked. Such correspondence may be addressed to Norman Berger, 342 E. 26th Street, New York 10, N. Y.

c. The three meetings of the Committee have been of significant help in producing increased understanding of the teachings at each Center, and in providing an opportunity for cooperation and exchange of ideas among the prosthetist faculties.

d. It is the Committee's recommendation that all areas of instruction and problems be given the same continuing productive treatment as has the A/K situation. With this report, the Committee feels that it has discharged the responsibility assigned to it by UCOPE.

Submitted by:

NORMAN BERGER, *Chairman*
JOHN BRAY, UCLA
IVAN DILLEE, NYU
H. BLAIR HANGER, NU

Report on Design and Fitting A/K Prosthesis For Geriatric Amputee

BY PETER A. OCKENFELS, C.P.
Columbus Orthopaedic Appliance Company
Columbus, Ohio

EDITOR'S NOTE: *The following is taken from a report to the referring physician on the prescription and fitting of an A/K prosthesis for a geriatric amputee. Entire responsibility for the prescription was given to the limb shop by the physician. Because of the patient's age, the prosthetist was doubtful that a successful fitting could be made. However, the final prosthesis was completely satisfactory to the patient, the prosthetist, and the physician.*

This is a report on a patient, an 84-year-old woman, regarding preparation and use of an A/K prosthesis. With geriatric patients of this advanced age, we must proceed with caution.

Our first contact with the patient was on February 24, 1962, when, at her home, we examined and evaluated her for the use of a prosthesis. We instructed the patient to wrap her stump with an elastic bandage to obtain atrophy and to get the stump used to constant pressure similar to that of the fairly compact-fitting prosthetic socket.

On March 10, 1962, we again visited the patient. Results of her using the elastic bandage were already evident. After examining the patient we recommended that a prosthesis with the following components would be most advantageous for her:

A right above-knee prosthesis with conventional quadrilateral shaped socket, rigid pelvic joint suspension with a light pelvic belt, an Otto Bock safety knee model 3L5 in Abache light wood, and a SACH foot (solid Ankle Cushion Heel) with a soft heel for easy compression on heel strike.

On March 29 the patient was measured for the prosthesis. On April 11 the quadrilateral socket with pelvic joint and pelvic belt was fitted to the patient.

On April 20 the prosthesis was built up in the rough and fitted to the patient. She then practiced standing up and sitting down, and doing a few steps with the prosthesis.

On May 11 the patient received training in walking between parallel bars, with the artificial limb. She did rather well, and on May 15 she received walking training with a walker, and inspected our whole facility. When asked if she were tired, she replied, "Oh, no! It feels so good to walk on two legs again."

On May 21 she received additional walking training and was shown how to put on and take off the prosthesis. This was the most difficult part for her at first. It should be added that for all visits to our facility, we picked up the patient and returned her to her home.

On June 7, 1962, we delivered the finished prosthesis, with additional walking training, to the patient at our facility. We also called on her twice at her home in order to teach her husband how to aid the patient in putting the prosthesis on and taking it off. After this there seemed to be no further difficulties in this respect. We asked the patient to call us every day for

a week and give us a report on her walking activities. The only mild complaint we received was that the prosthesis was so heavy. This is a usual complaint with older patients, and the prosthesis was kept as light as possible in relation to strength.

The fit of the prosthesis is as follows:

The ischial tuberosity is well placed on the ischial seat shelf of the prosthetic socket. The trochanter plumb line is well anterior to the knee center for additional stability; and the prosthesis is kept approximately one inch short, since the patient had difficulties during walking training in elevating her hip as much as necessary to clear the ground with the prosthetic foot during swing phase. In a sitting position, the prosthetic knee extends approximately one inch compared to the sound knee. This is a normal condition with a rather long stump fitted with a pelvic type suspension prosthesis.

In closing, may we add that at first we were not very enthusiastic about fitting a prosthesis for a lady of this advanced age. However, we now are glad that we did, and are very happy with the results. The patient was rechecked at home in early October. She wears the limb daily in the house, but, due to lack of dependable assistance on steps, curbs, and getting in and out of cars, relies on a wheel chair if she leaves her home.

NELSON GADGETS NO. 8

THE PENDULUM TRAY

For a little change from "all business," this time I will give you a different type of gadget. The pendulum tray was designed to carry liquids, drinks of any kind, without spilling. One can carry it without extra care or swing it around; it will not spill, even though the glasses or cups may be filled to the top, as long as it is set down carefully and not jarred by bumping it into something.

The tray shown in the picture is ten inches in diameter; it is made of aluminum, covered with celastic. The three chains are twelve inches long. They are attached at the top to a metal ring and at the bottom to the rim of the tray at three points, equally spaced.

This is a practical gadget as well as a conversation piece and it would be well worth your time to make one.

Porous Laminated Protective Head Shield

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Walter Reed Army Medical Center
Washington 12, D. C.

Introduction

A 4-year-old female patient suffering from akinetic epilepsy and subject to falls which resulted in bruises and cuts of the head was referred to the laboratory by the Pediatric Clinic, Walter Reed Army Hospital, for a protective head shield.

The patient had previously been fitted with a football helmet which she found excessively heavy and warm. The problem was to design a head shield which would offer head protection, be light in weight and cool. It appeared that a shield constructed from a porous laminate, lined with foam rubber in strategic areas, would have the desired characteristics.

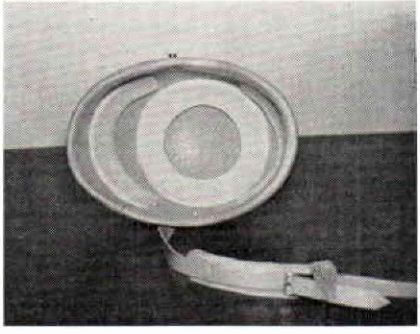
It is the purpose of this report to describe the design and fabrication of such a shield.

Design and Fabrication

It was not possible to obtain a plaster-of-Paris wrap of the patient's head. A mannikin head, 2 inches larger in circumference than the patient's head, was used instead as a model for preparing a nylon-reinforced wax check socket. The check socket was heated in warm water to make it pliable and then fitted over the patient's head and reshaped by hand to achieve the desired fit. The check socket was then trimmed to the contours of the patient's head around the forehead, ears, and the hairline.

A positive mold was prepared by pouring a mixture of plaster-of-Paris and water into the nylon wax check mold. After the plaster had set, the check mold was removed and the positive mold smoothed with wire gauze. Two layers of orthopedic stockinet were pulled down over the mold and tied off to increase the size of the head shield for a comfortable fit. Then, one layer of $\frac{3}{8}$ inch foam was form-fitted over the stockinet without stretching, as this thickness was used for padding in the final head shield. A polyvinyl alcohol (PVA) sheet was pulled down over the entire mold for separating the plastic resin from the foam rubber.

Five layers of nylon stockinet were pulled down over this layup and tied off. One layer of nylon Ban-Lon 100/2 200 needle stockinet[1] was applied on the outer surface for a smooth appearance.



[1] Wm. H. Horn Co., Philadelphia, Pa.

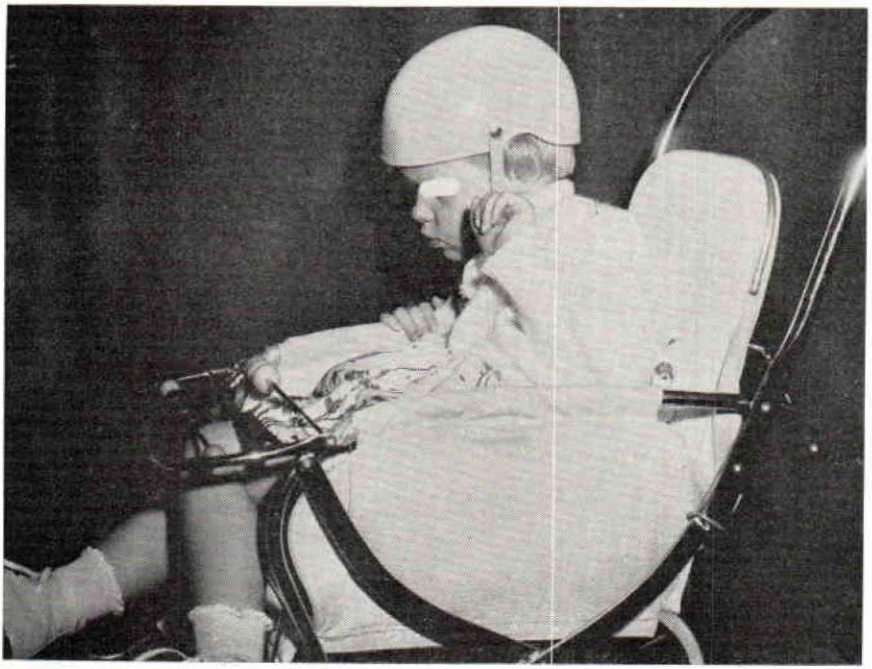
The resin used was 125 gms. of Laminac 4110[1] and 2.25 gms. of Luperco ATC[2]. It was mixed thoroughly and color paste was added to give a pleasing flesh tone. Trichloroethylene[3], 54 gms., and Naugatuck's Promoter #3[4], (6 drops per 100 gms. of resin) were then added. The entire surface of the layup was brush-coated with this mixture and excess resin removed from the laminate by stringing down. This laminate was allowed to air-cure for approximately 30-45 minutes. A moist PVA sheet was stretched over the layup, the resin allowed to harden at room temperature, and then placed in a 100°C. oven for an additional 45-60 minutes. The cured laminate was cut off the mold, trimmed, and the foam rubber removed. The first two layers of stockinet were left in place.

A strip of foam rubber, 1¼ inches wide and ⅜ inch thick, was fastened to the inner surface of the front part of the helmet to form a sweat band, and this was covered with horsehide to prevent chipping and peeling of the foam. Other foam strips were placed 1 inch apart around the inner circumference of the shield. A chin strap was riveted into place just in front of the ears, and a foam piece covered with horsehide for use as a chin rest, with buckle for adjustment, was incorporated in the chin strap.

Photographs of the fabricated head shield and of the patient wearing it are shown in Figures 1 and 2.

Comment

The patient has been wearing the helmet for approximately five months without incident. Comments by the patient and her mother are very favorable.



[1] Laminac 4110, Rohm & Haas Co., Philadelphia 5, Pa.

[2] Luperco ATC, Lucido Division, Wallace & Tiernan, Inc., Buffalo, N. Y.

[3] Trichloroethylene, Fisher Scientific Co., Silver Spring, Md.

[4] Promoter #3, Naugatuck Chem. Div., U.S. Rubber Co., Naugatuck, Conn.

Survey to Determine the State of Services Available to Amputees and Orthopedically Disabled Persons[1]

Report II—Orthotic Services USA—1962

By LeROY WM. NATTRESS, JR. and BERTRAM D. LITT

CHAPTER I—INTRODUCTION

Archaeological evidence demonstrates that musculo-skeletal injuries were treated during the stone age (1). The earliest treatment was for sprains, strains and fractures which were an aftermath of the pursuit of the necessities of life. Somewhere in this pre-recorded history an imaginative mind conceived the idea of splinting the injured extremity and, thus, the science of orthotics had its beginning. Some historians date this as early as 13,500 B.C.

Despite these early beginnings the evolution of orthotics has been slow and spasmodic depending upon the inventive genius of isolated individuals. This pattern of development was equally true of all arts and sciences until relatively recently. Since the advent of the twentieth century the rate of technological advance has accelerated greatly. Perhaps of even greater import has been the coordinated interdisciplinary efforts which have been focused upon specific areas of knowledge, production methods and science. The survey of prosthetic services (2) demonstrated the impact of research and education on practice in that field. However, as recently as the inauguration of this survey, the status of research, development and education in orthotics could be characterized as:

1. Representing the ideas of the individual physician and/or the orthotist working closely with him.
2. Lacking organizations for the exchange of knowledge, except on the local level, prior to 1946.
3. Lacking formal courses of instruction in orthotics.
4. Lacking a coordinated research program.

Research in orthotics had its beginning about 1927 with the efforts of Mr. Henry Pope which subsequently led to the establishment of the Pope Foundation (3). Closely allied with this was the formation of the Warm Springs Foundation and the National Foundation for Infantile Paralysis. During World War II, the U. S. Army became interested in orthotics. Later the Mellon Institute established a research program on materials and their application to orthotics. In this connection, three symposia were presented in

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conjunction with the University of Pittsburgh. The first, in 1948, marked the beginning of formal education in orthotics (4).

The first positive step toward providing a means for exchanging information in orthotics was taken in 1946 when the Orthopedic Appliance and Limb Manufacturers Association was formed. This association, with headquarters in Washington, D. C., has served to bring the allied professions of prosthetics and orthotics together in order to benefit both through the publication of a journal, the conducting of national and regional meetings, and the encouragement of the exchange of ideas.

In 1948, a board for certifying the competency of individual orthotists and the adequacy of orthotic facilities was established. This board, now known as the American Board for Certification in Orthotics and Prosthetics, Inc., has worked closely with the American Academy of Orthopaedic Surgeons and the American Orthotics and Prosthetics Association in discharging its responsibility of setting and maintaining standards of professional practice.

The National Academy of Sciences—National Research Council, through its Prosthetics Research Board, voted to expand the definition of Prosthetics to include Orthotics at its meeting in March 1957. Since that time, numerous research projects have been undertaken at the University of California at San Francisco, the University of Michigan, Baylor University, Rancho Los Amigos Hospital, the Veterans Administration Prosthetics Center, the University of California at Los Angeles, and New York University. Funds for these projects have come from the Federal Government through the Office of Vocational Rehabilitation and Veteran's Administration, and foundations, such as the National Foundation, Easter Seal Research Foundation and the Orthopaedic Research and Education Foundation.

The experience of the prosthetic research program indicated the need for an integrated educational program to disseminate the new information and procedures. The structure for this was already available through the Prosthetic Education facilities at the University of California at Los Angeles, New York University, and Northwestern University. In 1958, UCLA led the way by introducing a short term residence course for orthotists, physicians and therapists entitled "Functional Bracing of the Upper Extremities." The development of additional curricula was slow, but in September 1961, NYU launched a course in "Lower Extremity Orthotics" which was followed in December 1961, by UCLA's course in "Functional Bracing of the Lower Extremities." The field is now awaiting a course in bracing the trunk and spine being prepared by Northwestern University.

This survey project was conceived in 1958 by Glenn E. Jackson, then the Executive Director of the American Orthotics and Prosthetics Association, who with members of the Association's Committee on Advances in Prosthetics (Carlton Fillauer, *Chairman*, M. P. Cestaro, Fred Eschen, Charles Hennessy, and Howard Thranhardt) presented a proposal to the Office of Vocational Rehabilitation, Department of Health, Education, and Welfare. The proposal was approved in 1959.

A Survey Advisory Committee, composed of M. P. Cestaro, *Chairman*, Dr. Robert Mann and D. A. McKeever, reviewed all phases of the survey plan, the sampling procedure, the administration of funds and the completion of the report. Three men were selected by the Association's Committee on Advances in Prosthetics—John Glancy, John DeBender and Clarence Medcalf—to form a Survey Content Committee. Lester A. Smith, Executive Director of the American Orthotics and Prosthetics Association; Past Presidents Paul Leimkuehler, Ralph Storrs, and Fred Quisenberry; and

AOPA's Regional Directors, participated in the numerous meetings of the Survey Advisory Committee and also were active in enlisting the cooperation of orthotic facilities in the survey.

In addition to the 198 facilities which participated by answering the questionnaires, there were a number of individuals who were particularly helpful in suggesting material for the questionnaires and sketches of brace designs for the illustrations. Notable contributions were made by: Carlton Fillauer, Alfons Glaubitz, Erich Hanicke, Frank Harmon, Herman Hittenberger, Matt Laurence, Charles Rosenquist, Charles Ross, Roy Snelson, E. W. Snygg and Ted Smith. A number of suppliers and their representatives furnished information, illustrations, etc.

A special vote of thanks is due to the individuals who participated in this survey as interviewers: William E. Anderson, Steve Andrusky, Robert C. Apitzsch, Thomas N. Bidwell, Ross L. Bremer, James R. Fenton, Alan R. Finnieston, Richard A. Fitzgerald, Jerald D. Gillespie, Charles Richard Greene, Loren D. Jouett, Thomas G. Powell, Jr., Robert B. Reid, and William B. Smith.

The need for professional orthotic service throughout the United States is evident from the statistics of the United States National Health Survey estimates (5).

"The average prevalence of cases of paralysis in the noninstitutional population of the United States during the 2-year period, July 1959-June 1961 is 946,000—a rate of 5.4 per 1,000 population."

"Of the total cases of paralysis, 600,000 or 63.4 percent, occurred among persons over the age of 45. For persons of all ages 526,000 cases, or 55.6 percent, were among males."

With such a large demand for orthopedic appliances it became obvious that the following types of information were needed to report on orthotic services:

1. Distribution of facilities as related to patient needs.
2. Systems of patient management and referrals employed in different areas of the country.
3. Types of equipment and devices supplied to patients.
4. Techniques and devices used under local conditions, but which have not found widespread use.
5. Extent to which output could be increased in case of a national emergency.

The purposes of the Survey were to find this information, to describe the status quo, and to establish a feed-back system between the Research and Education Programs and the field. A pilot study of all facilities in Ohio, conducted in 1960 by A. Bennett Wilson, Jr. and LeRoy Wm. Nattress, Jr. (6), revealed wide variations in orthotic practice even within the boundaries of that single state, and pointed up the empirical nature of the brace prescription. It suggested, however, that orthopedic appliances could be classified by design and/or function. The validity of such a classification system would have to be established by subsequent research programs. However, it was felt that such a system could be used to establish a base-line of current practices for future research, education and service programs.

To satisfy the purposes of this survey it was necessary to describe the braces and surgical garments being furnished, the conditions for which they are prescribed, the geographic distribution of facilities providing these devices, as well as those aspects of the treatment program concerned with the prescription, application and check-out of appliances.

These goals have been tailored to seek the lowest common denominator in bracing problems. A bracing problem, as here defined, is the manifestation of a symptom, or group of symptoms, which may be caused by any number of syndromes. Placing the emphasis on bracing problems rather than on neuro-muscular and orthopaedic syndromes simplified the survey planning task. This approach led to the assumption that two or more syndromes which produce similar dysfunctions of a particular body member may be, in part, treated by the application of the same type of orthopedic appliance. In this connection it should be recognized that the majority of individuals who are fitted with orthotic devices are in the process of a medical treatment program of which the orthotic device is but one aspect. Accordingly, it was anticipated that almost all initial fittings are ordered by prescription, regardless of the kind of device or where it is being fitted.

The present report is concerned with the survey of orthotic services and practices. It describes the availability of these services; types of procedures being followed and the extent of their application; individual variations; and opinions of orthotists related to the procedures which they employ.

CHAPTER II—METHOD

A survey of services is usually a descriptive study which is undertaken to provide information for the use of a single interested group. In this instance, the survey of orthotic services available to orthopedically disabled persons, the staff and advisory committee felt that the results should be useful to governmental and other agencies which are sponsoring research and education programs; to personnel engaged in these programs; and to orthotists, practicing physicians and others directly concerned with the treatment and rehabilitation of orthopedically disabled persons. As the survey was aimed at this broad audience it became necessary to investigate the full spectrum of services offered and to identify all pertinent facets of these services.

The first procedure was to define the basic problems on which the study could be built. These were: 1. What services are being offered? 2. To whom are services provided? 3. Why are services provided? 4. How are services provided? 5. Who provides the services?

Although some of this information is available in the literature, almost none of it is presented in a way that is directly applicable to the purposes of this survey. Consequently, it was felt that some systematic organization should be developed so that the material could be investigated in an orderly way. This organization, derived from the empirical findings reported in the literature and the experience of various consultants and committees of experts, defined the basic problems in the following manner:

1) *What services are being offered?* Generally speaking orthoses may be defined as any device which is used to straighten a distorted part and/or prevent distortion of any part. This definition would include plaster casts, bone nails and a variety of surgically implanted devices; as well as exoskeletal braces, corsets, collars, and splints. For the purposes of this survey the definition of orthoses was limited to the category of exoskeletal devices other than plaster casts. Reference to the *Orthopaedic Appliances Atlas* (7), *The Journal of Bone and Joint Surgery, Archives of Physical Medicine* and other sources reveal that a kaleidoscope of devices are being fitted. Little evidence of systematization or effort to standardize procedures have been published. (Von Werssowetz's recent article (8) on lower extremity bracing

is a notable exception.) Separate types of devices are being applied for cervical, trunk and spinal, lower extremity, and upper extremity problems.

A. Classification of cervical braces can be developed from the basic structural materials used in each brace class or type: leather collars, plastic collars, cotton wrap-around collars, wire and tubular frame collars or braces, and metal braces with varying numbers of posts. A second system could be developed from the type of body contact used in each brace type: a) two rings of total contact (along the jaw and base of the skull and along shoulders, chest and back); b) plates contoured to fit selected areas of the jaw and skull connected to chest plates by supporting beams; c) head supports at the jaw and/or forehead cantilevered from a dorsal bar extending from a back brace or wheel chair. A third system could be developed from analysis of the major structural components of each brace type. The third classification system was found to consist of six types of brace designs which are known to be in general use. They include:

1. Collars made of a single strip of plastic, leather, metal and cotton or wool, and/or felt. They are fastened or wrapped around the neck. Some are custom made and others are prefabricated and come in a variety of sizes. These collars are characterized by having no provision for height adjustment (Plate I—Illustration J, page 75).
2. Solid two or three piece plastic collars similar to the above, but with provision for height adjustment. These collars are usually purchased from a central manufacturer in a variety of sizes, adjustable to the contours of the individual patient (Plate I—Illustration K).
3. Molded Collars. Leather or plastic is molded to a plaster cast of the patient who is to be fitted. The dry and stable collar is cut laterally on either one side or both sides, and is held in position by lacing or straps (Plate I—Illustration P).
4. Open-cushioned wire frame collars consist of two horseshoe-like components, shaped to conform to the contours of the mandibles and base of the neck. These are supported by two, three, or four solid and/or adjustable type posts. The collars are strapped in position posteriorly (Plate I—Illustration L). These devices are usually purchased from central manufacturers. The rigid supporting members of these devices are similar to those used in the two and four poster braces. The total contact afforded by the padded wire frames at the base of the neck and along the mandibles is very similar to that offered by the collars.
5. Two-poster braces are characterized by two rigid metal supports for the mandibles and occiput. The forces may be applied either anteriorly and posteriorly or laterally. The posts may be anchored to the body in a variety of ways, one of which is illustrated in Plate I—Illustration M. Parts for these units may be purchased, as may prefabricated units. In many instances all parts are assembled and/or fabricated at the orthotic facility.
6. Four-poster braces are essentially identical to the two-poster braces. The two additional posts are frequently used with smaller body plates (Plate I—Illustration N).
7. Other appliances were lumped into a single category which included:
   a. Three-poster braces which may have a single anterior and double posterior bar or two posts in front and one at the back.
   b. Jury Masts are usually characterized by a mandibular support which is either cantilevered or suspended from a rigid posterior post. Some varieties permit motion in one plane.

c. A metal ring or halo supporting the top of the head which is attached posteriorly to a rigid supporting rod. This device may or may not incorporate a variety of additional features.

d. Zygoma supporting braces which permit jaw motion while stabilizing the head. They are supported by a single posterior rod terminating in a fairly large occipital pad with metal processes for stabilization at the zygomatic arch and secured by a strap around the forehead (9).

Auxiliary equipment such as traction and wheel chair supports, casts, and Skeletal Fixation Halos (10) and other similar devices have not been included in this study as the application of these devices rarely utilize the services of an orthotist.

B. Spinal devices are found to include a large variety of surgical garments, corsets, and braces. The distinction between these three categories was not defined and considerable overlap in terminology was noted. A number of plastic, Celastic and/or glass body jackets, which are also referred to as corsets by some authors, have been described as being used for various conditions of the spine and trunk. As no classification of these units existed it was clear that one would have to be developed if the survey was to study this area in the allotted time.

C. Lower extremity devices fall into three clear-cut categories: night splints, shoe modifications and braces. It was found that these devices overlapped somewhat and that any one or all three methods of treatment were recommended by different authors for identical problems. Generally speaking, lower extremity braces were noted as consisting of an armamentarium of standardized components which are available as prefabricated units. The components are then assembled and fitted with beam support on one side of the limb, both sides or dorsally. The braces are usually described by enumerating all of the major components, noting only the type of vertical supporting elements, or by a name which may have either local or widespread acceptance. The lower extremity brace components include: shoe attachments, ankle units, upright components, knee components, pelvic joints and belts, a variety of bands, slings, lacers and auxiliary components.

D. Upper Extremity Devices presented a different class of problem. The complex nature of the upper extremity neuro-muscular systems provides for a broad spectrum of specific disabilities. The literature revealed several different approaches to these problems:

Bunnells	Robin-Aids
Georgia Warm Springs	Baylor University
Rancho Los Amigos	

A variety of traditional splints are also used. More recently, several development centers have been working on externally powered devices.

The alternative was to study the application of these systems to specific upper extremity disability problems, or to identify the facilities providing upper extremity devices and how frequently they are called on to make them.

2. *To Whom Are Services Provided?* The population of individuals being fitted with orthotic devices includes those persons with a broad variety of orthopedic disabilities resulting from disease entities, trauma and congenital conditions; psychosomatic conditions; and those resulting from internal conditions which require orthotic support.

3. *Why Are Services Provided?* Orthotic devices are prescribed and provided as a part of the medical treatment process. The criteria for selection of a device seems largely based on the formal education, training and experience of the individual physician prescribing a particular device for a

particular patient. Depending upon the attitudes and habits of the individual physician he may (or may not) consult with an orthotist, a therapist or others.

4. *How Are Services Provided?* Following expectations derived from the results of the prosthetic survey it was anticipated that patients being treated at hospitals or other institutions and those being treated with the support of Bureaus of Vocational Rehabilitation, the Veterans Administration or other institutions might always be expected to be provided with an orthotic device ordered by a physician's prescription. Similarly, private patients were expected to be fitted according to a medical prescription for their first orthotic device; but not necessarily for the replacement of a worn-out device.

Referring to the clinic treatment procedures followed in prosthetics, it was anticipated that the physician and auxiliary personnel might perform a checkout immediately following final application of the completed device to determine whether the fit and function are adequate.

In the instance of a variety of devices which are furnished by drug stores, department stores and mail order houses, the question was posed as to what types of devices are used and to what extent they are provided without benefit of medical prescription.

5. *Who Provides the Services?* A. Orthotists are primarily responsible for fabricating and fitting orthotic devices. Devices are also fitted by corsettieres, surgical garment fitters and others.

B. Physicians are responsible for the treatment program of their patients. In this capacity they are expected to prescribe and checkout orthotic devices. In a limited number of cases they are known to fit and/or fabricate devices directly for patients.

C. Nurses and therapists are directly concerned with instructing patients in how to use, don and remove these devices. They may also participate in prescription and occasionally checkout. There are a small number of therapists who fit and fabricate orthotic devices.

D. Social workers, psychologists, rehabilitation personnel, family members and others may also be involved in various aspects of the treatment program dealing either directly or indirectly with the orthotic phases of treatment.

Orthotists have been defined as being responsible for fabricating and fitting orthotic devices. Their services reflect the practice of the physicians whom they serve. As each orthotist usually works with a number of physicians, any sample of responses from orthotists relating to observable facts, though not necessarily to opinions, would also represent the responses of a considerably larger sample of physicians. The problems selected for investigation in this survey were, therefore, limited to those which could reasonably be answered by orthotists. This approach meant that the data to be collected would have to be in terms of the first four questions—who? how? to whom? and what services are offered? However, it was hypothesized that the last question, why?, would be answered by the results of the first four, i.e., uniformity of prescription practice, or selection of a single brace type throughout the country for an individual problem would indicate the presence of firm criteria, without actually describing them; conversely conflicting practice would indicate the lack of criteria.

In discussing the purposes of the survey of orthotic service it was established that the information to be sought should include data describing:

1. Types of personnel and facilities providing orthotic services;
2. Ways in which services are provided (treatment system);
3. Types of conditions fitted;
4. Types and frequency of application of orthotic devices;

5. Reasons for orthotic device selection;
6. Orthotic areas in which additional research and education is indicated.

From the experience with the pilot study and the survey of prosthetic services, it was felt that the orthotic material could be collected in much the same manner.

Collection of information was largely limited to orthotists as they had been identified as the individuals who could most efficiently provide the greatest quantity of descriptive data on orthotic devices and their application. However, as a considerable number of non-orthotists also fit orthotic devices, it was felt that personnel in drug stores and surgical supply houses should be interviewed in all cities and towns where time permitted. A special short form was used for these facilities to determine the extent of services rendered. Mail order houses and department stores were omitted from the study because of the lack of time available in any given city and the extensive time required to obtain permission and cooperation from these facilities.

The collection of this information required that certain procedures be developed to standardize nomenclature. The first step was to distinguish between spinal corsets and braces—surgical garments were here considered as devices other than corsets and braces, i.e., trusses, athletic supports for the knee and ankle, colostomy appliances, etc. In as much as spinal braces may be applied to the trunk with corsets and corsets may have metal supports, the definition was drawn in terms of the rigid supporting members. It was established that for the purposes of this survey, the following definitions would be used when considering spinal appliances:

BRACES—All devices which contain a rigid frame of support including both vertical and horizontal metal bars.

CORSETS—All devices which may or may not contain rigid vertical or horizontal metal bars or supports, but *not* both.

A preliminary questionnaire was developed illustrating the metal parts of 18 spinal braces. The purpose was to find out whether medical syndromes could form the basis for a classification system for spinal bracing. A large number of conditions were reported for each brace type and a variety of braces for each syndrome.

The survey committees, numerous consultants and a group of orthopedic surgeons and physiatrists agreed to the assumption that any two or more syndromes which produce similar dysfunction of a body member could be considered as a bracing problem. Using this theory as a point of departure, a number of bracing problems immediately became apparent. These included:

Cervical Disc Rupture, Lesion, or Reduction of the Foramina, Postoperative Fixation, or Dislocation in the low Cervical area.

Torticollis, or Wry Neck

Cervical Spinal Strain or Injury, or Whiplash

Spinal Curvature:
- Kyphosis (Dorsal Spine)
- Lordosis (Lumbar Spine)
- Scoliosis (Non-specific)

Fractures or Postoperative Conditions:
- Low Cervical and High Dorsal Spine
- Mid-low Dorsal and Upper Lumbar Spine
- Low Lumbar or Sacral Region

Low Back Pain or Strain, with or without Disc Complications

- Paraplegia
- Hemiplegia
- Poliomyelitis
- Cerebral Palsy
- Pes Varum and/or Valgum
- Tibial Torsion
- Genu Valgum and/or Varum
- Genu Recurvatum
- Knee Flexion Contracture
- Legg-Perthes

Upper Extremity Disabilities

The validity of this approach and completeness of this list was further discussed with a number of orthopedic surgeons and physiatrists. Their consensus was that the list could also include: Congenital muscular weakness and muscular dystrophy, Non-union of long bones, Spina bifida vera, Breakdown of upper extremity conditions. However, they indicated that the frequency of occurrence of these additional categories did not warrant their inclusion in this survey unless specific reasons for doing so arose. (They were accordingly omitted.)

The advisability of collecting data describing the purposes underlying individual brace applications (i.e., supportive, corrective, etc.) was also considered. This type of material was not included as it was felt to be based on value judgments, frequently second hand, rather than statement of fact, and did not seem to be germane to the broad purposes of the study. It was felt that this type of information might better apply to a medical follow-up study of a particular condition in which the relative efficacy of various treatment procedures were being evaluated. Examination of the list of bracing problems revealed four major categories:

1. Spinal (Including the Neck and/or the Trunk)
2. Lower Extremity
3. Upper Extremity
4. Major debilitating neuro-muscular syndromes which may effect more than one of the preceding categories.

Description of spinal braces for the neck and trunk are usually based on one or more bony landmarks and a formula for fitting the device with one or more variations suggested for persons of different body builds. Frequently, different bony land marks may be used by authors describing very similar devices. Thus, for the survey to describe these devices it was first necessary to develop a system of reference which would be acceptable and meaningful to all of the orthotists to be interviewed. It was felt that this could be accomplished by using illustrations of basic brace design.

Respondents were asked the names of the devices which they were called on to furnish for each of the spinal bracing problems enumerated above. For each condition they were asked to identify the illustration (see Plates I-IX) which most closely resembled the device which they fitted. They were then asked to identify the ways in which their spinal or cervical device differed from the illustrated device.

The brace patterns, which are illustrated, were selected on the basis of apparent major differences in design and function. The approach to cervical bracing was detailed above (pages 57-58). It was felt that the majority of spinal braces in use today are modifications of a limited number of basic appliances. The array of basic patterns for the trunk were hypothesized as including:

1. Low back posture type support similar to that designed by Goldthwait (11) for the sacro-iliac (Plate III);
2. A low back type of brace frequently called a chair back or Knight spinal brace (7) (Plate II);
3. A low back design which applies pressure to the back by lever action of the Williams type (12) (Plate IV);
4. A high back brace with paravertebral bars supporting the lumbar and dorsal spine of the Taylor type (7) (Plate V);
5. An anterior hyperextension brace which applies pressure anteriorly at the sternum and pubis, and posteriorly at the affected area of the spine of the Lennox Baker (13) or Jewett (14) types (Plate VI);

6. A Milwaukee type scoliosis brace (15) (Plate VII);
7. A molded body jacket (Plate VIII).

The major debilitating syndromes (paraplegia, hemiplegia, poliomyelitis, cerebral palsy, etc.) present serious problems for both upper and lower extremity orthotics. The immediate problem in these areas seems to be the identification of number and types of facilities that are now providing services for these patients.

In lower extremity orthotics respondents were asked whether during the past twelve months they had fitted orthoses for each of the six lower extremity joint dysfunctions listed. The devices most frequently prescribed and fitted for each condition were then described by noting the components. An intensive armamentarium of lower extremity components was listed for this purpose.

In upper extremity orthotics, questions were restricted to asking how many devices of all varieties were fitted in the past twelve months; how they were provided locally; how the individual who did the fabricating learned to make them? Although some of these questions call for a value judgment, they were retained as the upper extremity is the one area of orthotics where research and education programs have been available for the past four years.

The survey of orthotic services was designed so that the findings would parallel those of the prosthetic services in so far as the similarities and dissimilarities in the material would permit. The questionnaires consisted of four units.

The first, Questionnaire A, was a mail form, which was sent to approximately 1100 facilities. It was designed to gather information on the different names applied to identical appliances in different parts of the country.

The second part was designed to collect information on the types of services rendered; number; background and responsibilities of employees; area served; ability to increase production in case of national emergency and types of help that might be needed for this purpose. This questionnaire was mailed to the facilities before they were interviewed so that the information could be used to facilitate the interview.

The last two parts, administered during personal interviews, were designed to determine; who participated in the various stages of the orthotic treatment program (prescription, trial fitting, checkout and final application); how this was done (in a formal group or serially); the frequency that prescriptions were required for replacement of appliances in the major areas of disability, i.e., cervical, spinal, lower extremity and upper extremity; the orthotic devices being used for each of the bracing problems enumerated above; and the frequency with which they were applied to each of the bracing problems.

The questionnaires were field tested and reviewed by the Advisory and Content Committees before final printing. These questionnaires were administered by seven two-man teams of orthotist-interviewers in the field.

The rationale for the selection of interviewers and training procedure followed in the prosthetic services survey had proven sufficiently successful so that it was used in the present study. A group of fourteen orthotists were selected on the basis of interest, background and age. All were well established in a family business; and either were Certified by the American Board for Certification in Orthotics and Prosthetics, Inc., or were prepared to become certified in the near future. They were brought to Washington in the third week in April to attend a training course in the use of the survey forms.

The training course was given by the Project Director, the Associate

Project Director and two members of the Survey Content Committee. Because of the nebulous nature of the orthotic data to be collected, special emphasis was placed on a thorough training course. A complete set of forms was administered to each of the trainees so that they were able to appreciate the problems of both the interviewer and the respondent in a typical interview situation. Although this initial experience was partially a role-playing experience, the trial interviews were made as realistic as possible by emphasizing that these questionnaires were to be included with the data collected in the field.

As in the prosthetics survey, interviewers were sent out in two-man teams to expedite the interviews, minimize the personal bias and help maintain adherence to the presentation system taught in the training course. The interviewers were sent to areas in which they were not acquainted. Trips were limited to two weeks because of the difficulty in maintaining the desired level of performance for longer periods.

Questionnaire A was mailed in November and December 1961, alerting the field to the forthcoming survey. Trip itineraries were planned in April and appointments at the orthotic facilities were scheduled by telephone. A follow-up letter was sent to remind the facility of the survey interview and its purpose and enclosing a copy of Questionnaire Part I which was to be completed before the interview. The interviewers called the facility a day in advance to finalize the appointments.

The data for the Orthotics Survey were collected in seven two-week trips conducted during the last few days of April and the month of May, 1962. The trips were scheduled so that the Project Director or Associate Project Director could accompany the team during the initial experience in the field. Thus, problems which arose during the first interviews were clarified and adjustments in procedures provided. During the trips, telephone communication was maintained in order to follow progress and to solve any additional problems as they arose.

Completed forms were mailed to Washington where they were checked for completeness and accuracy. Facilities were contacted for additional information where necessary. The questionnaires were then edited, tabulated and analyzed.

In preceding paragraphs it was established that the total population or universe of facilities which are engaged in the fitting and/or fabrication of orthotic devices includes: orthotic facilities (both private and institutional), surgical supply houses, drug stores, department stores, mail-order houses, physicians and therapists. It was also established that this survey would be conducted primarily with orthotists, with a fragmentary representation of drug stores and surgical supply houses. The rationale for the selection of this limited population was the observation that although all seven groups were engaged in fitting orthotic devices, only the orthotic facilities are directly responsible for both fabrication and fitting.

The prosthetics survey (2) sampling procedure began with the construction of a comprehensive list of facilities that fit or fabricate artificial limbs and/or braces. This list of approximately 1145 facilities was assembled in the following way:

a) During the summer of 1960, a search of telephone directory "Yellow Pages" of all cities of 7,000 population or more was conducted and a card file compiled.
b) During the subsequent fall and winter this file was cross checked with all of the files available in the Association Office.
c) The file was organized by states and the state lists were sent to

Regional Directors of the American Orthotics and Prosthetics Association and to knowledgeable prosthetists and/or orthotists in each state for review and revision.

The report qualified this population figure by stating "the number of . . . semi-retired individuals who conduct small practices, surgical houses and drug stores that also measure and fit appliances [make it] impossible to be certain that an exact tally has been compiled" (2). Examination of this list revealed that approximately 500 of the facilities were concerned with prosthetics. During the prosthetic survey 40% of the sample stated that they were engaged in the fabrication and fitting of prosthetic devices only. If the figure for that sample can be accurately extended to cover the population estimate of 500 prosthetic facilities, then the rough population estimate should include 300 facilities that fit and/or fabricate both prosthetic and orthotic devices and 650 that fit only orthotic devices, leaving 200 facilities which fit only prosthetic devices.

The sampling procedure was designed so that the findings of the present orthotic survey could be compared to those of the prosthetic survey. Thus, the selection of the sample had to include facilities with the following characteristics:

1. Facilities of All Sizes
2. Private and Institutional
3. Association Membership and Non-membership
4. Certified and Non-Certified Facilities
5. Comparable geographic and city size representation

The geographic division used in the prosthetic survey (2) was used again in designing the orthotic services survey. This division is illustrated above (See map). It was developed by modifying the geographic distribution used by the United States National Health Survey (16) to conform to characteristics peculiar to prosthetic services and practices. However, whereas the prosthetics survey sample was planned on the basis of selected controls with the aim of representing the entire population, the orthotic survey selected two or three facilities in each area which had been generally acclaimed by their peers as representative of best practices. The balance of the facilities were selected at random within the large, middle and small size cities in each area.

As the prosthetic services survey sample was a quota sample, facilities were chosen in specific cities to represent pre-defined population sizes. Because of the larger number of facilities engaged in orthotics and the plan adopted, the city population sizes in the orthotics survey are less clearly defined:

City Size in the Prosthetic Survey		*City Size in the Orthotics Survey*	
Metropolitan Area	750,000 or more	Large City	400,000 or more
Large City	150-250,000	Medium Sized City	110-350,000
Small City	70,000 or less	Small City	100,000 or less

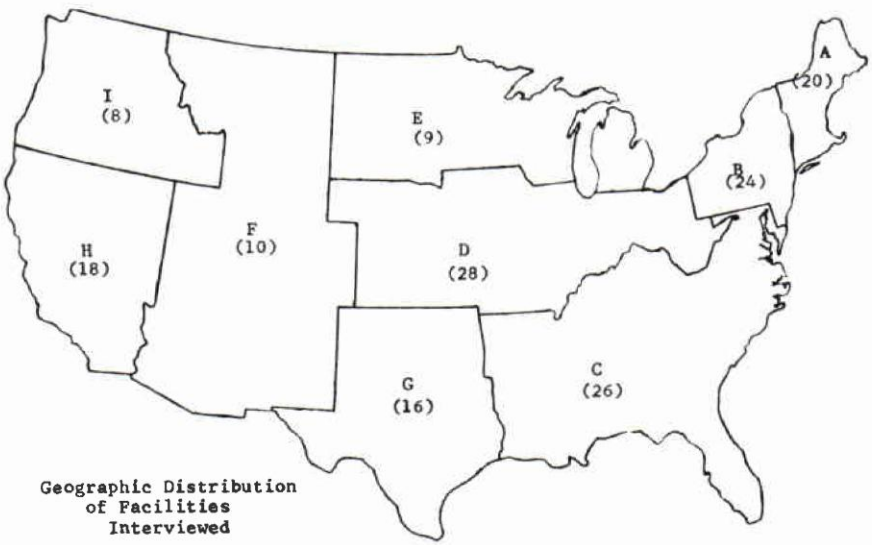
The plan called for interviews with approximately 160 orthotic facilities and from 25-50 drug stores and surgical supply houses. The sample from which the findings were drawn came from 159 facilities: 143 were interviewed during the field trips, 14 during the training course and two were collected while field testing the forms. In addition, 36 short form interviews were collected in drug stores and surgical supply houses.

The facilities who furnished interview data for this survey are located in 81 cities throughout the country. Their distribution by geographic area is shown on the following map. It is clear that approximately half of the sample was drawn from the Mid-Atlantic, Southern, and Midwestern areas while the

North Central, Rocky Mountain and Pacific Northwestern areas are the most sparsely represented. Comparison with the census figures (12) shows that this sample distribution of orthotic facilities parallels the national census figures for the population of people. With respect to city size, 41% of the sample was drawn from the larger cities, 33% from the medium sized cities and 26% from the small cities. Complete data was contributed by 90% of the facilities.

Twenty-one of the 159 are classed as institutional facilities in that they are located in institutions such as public and private hospitals, children's hospitals, and rehabilitation centers.

Eighty-seven of the facilities are association members. Eighty-six are certified. Forty-three are neither certified nor association members.



Geographic Distribution of Facilities Interviewed

CHAPTER III—FINDINGS

A. Facilities

It was stated above that the facilities interviewed were selected at random in each of the geographic areas: certification, association membership, private or institutional operation and size were also mentioned as criteria, but they were actually left to chance distribution. The problem of defining facility size was such that this factor is discussed below with the other findings describing the sample of facilities. These other factors are: area served, ability to increase production in the event of national emergency, education of personnel, and influence of drug stores.

Facility size may be measured by the total of the services offered or by number of employees. In the field of orthotics neither indicator is clear.

Production figures vary from less than sixty units to more than five thousand units per facility per year. However, not only is it difficult to equate collars and corsets with double long leg braces and Milwaukee braces, but also production methods vary from facilities that fabricate all their components from metal stock and bolts of cloth, to those who fit preassembled braces. Production per man hour is obscured partially by this same factor

and partially by the variability in the time required to fit any two patients with the same type of orthotic device. Production totals and rates of production may therefore be considered as an unreliable indicator of shop size.

Private orthotic facilities offer a broad spectrum of services. The most frequent items mentioned, in addition to braces, collars and corsets, are trusses, surgical garments, shoes, hospital supplies and prosthetic devices.

As illustrated by the data in Table 1, approximately 46% of the facilities offer prosthetic services. These data suggest that, relatively speaking, more orthotic facilities offer prosthetic services in less densely populated areas than in the larger metropolitan areas. This should, however, be weighted by two additional factors:

(1) Fewer facilities were interviewed in the smaller cities than were interviewed in the larger cities.

(2) Many of the facilities interviewed in the smaller cities were institutional shops in which the usual practice was to provide orthotic devices for specific types of patients.

Table 1.—Percent of 146 Facilities Offering Prosthetic Services as Related to the Total of All Services Offered

City Size	More than 50% Prosthetic Service	Less than 50% Prosthetic Service	No Prosthetic Service
Large—60 Facilities	3%	10%	27%
Middle—48 Facilities	2%	14%	16%
Small—38 Facilities	1%	16%	10%
Total	6%	40%	53%

The range of facility sizes has been measured by the number of individuals who spend all or the major portion of their work day in fitting, fabricating or repairing orthotic appliances. These findings are illustrated in Table 2, where the number of orthotic production personnel in each facility are shown in city size and geographic distributions.

The pattern of these distributions indicates that there are small facilities having two to four orthotic employees; a middle group having between six and seven employees; and large facilities with more than ten employees. However, due to the presence of rehabilitation centers with large orthotic facilities in the small cities, the percentage of facilities of each size is approximately equal in each of the city size groups.

The geographic distribution demonstrates a preponderance of smaller facilities in all areas except the North Central States and California. Conversely the heaviest representation of middle-sized facilities occur in these two areas. The larger sized facilities seem most heavily represented in the Southern and Midwestern areas.

The distribution of facilities according to city size and geographic areas is summarized in Table 3. It is apparent that more than 73% of these orthotic facilities report that the majority of their patients reside within 50 miles. Approximately 9% of the small facilities report that most of their patients travel more than 200 miles to obtain orthotic services. This distribution is approximately the reverse of findings in the prosthetics services survey (2).

The data in Table 3 indicates that the extent of area served is directly related to the population density. Thus, the larger the city, the smaller radius usually served. This is further reinforced by the figures showing more facilities serving large areas in the South, Midwest, Rocky Mountains and Texas-Oklahoma.

Table 2.—Number of Orthotic Production Personnel at 137 Facilities

a) DISTRIBUTION BY CITY SIZE

	Number of Personnel																	
City Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17-20	21
Large (60 Facilities)	3	8	6	9	5	8	2	2	3	3	2	2	0	2	2	1	0	1
Middle (41 Facilities)	1	6	6	10	0	8	5	1	1	0	2	2	0	0	0	0	0	0
Small (36 Facilities)	4	4	4	6	3	1	3	4	4	0	2	0	0	0	0	1	0	0
Total	8	18	16	25	8	17	10	7	8	3	6	4	0	2	2	2	0	1

b) DISTRIBUTION BY GEOGRAPHIC AREAS

	Number of Personnel																	
City Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17-20	21
New England (16 Facilities)	2	1	3	1	1	3	0	1	2	0	1	0	0	0	0	1	0	0
Mid-Atlantic (19 Facilities)	2	1	4	2	2	3	3	0	0	0	1	0	0	0	1	0	0	0
South (18 Facilities)	1	2	2	4	1	2	0	2	0	0	1	1	0	0	1	1	0	0
Midwest (27 Facilities)	2	6	1	7	0	1	2	2	1	1	1	1	0	1	0	0	0	1
North Central (8 Facilities)	0	1	0	2	0	1	1	0	1	1	1	0	0	0	0	0	0	0
Rocky Mountain (9 Facilities)	1	4	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Texas-Oklahoma (16 Facilities)	0	0	4	5	1	4	0	1	0	1	0	0	0	0	0	0	0	0
California (16 Facilities)	0	0	0	3	2	2	2	1	3	0	1	1	0	1	0	0	0	0
Pacific Northwest (8 Facilities)	0	3	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Total	8	18	16	25	8	17	10	7	8	3	6	4	0	2	2	2	0	1

Table 3.—Distribution of 147 Facilities and Areas Which They Serve

a) CITY SIZE DISTRIBUTION

City Size	City Limits	Majority of Patients Residing Within: 50 Miles	100 Miles	200 Miles	Over 200 Miles
Large	21	21	10	2	5
Middle	9	18	15	5	2
Small	11	14	9	1	4
Total	41	53	34	8	11

b) GEOGRAPHIC REGIONS

Area	City Limits	Majority of Patients Residing Within: 50 Miles	100 Miles	200 Miles	Over 200 Miles
New England	5	6	3	0	1
Mid-Atlantic	7	7	7	0	1
South	4	8	10	1	2
Midwest	7	6	7	4	3
North Central	2	6	0	0	0
Rocky Mountain	4	3	1	0	2
Texas-Oklahoma	4	3	5	2	2
California	6	9	0	1	0
Pacific Northwest	2	5	1	0	0
Total	41	53	34	8	11

To estimate the possible increase in production which could be anticipated in the event of national emergency, facilities were asked what kind of help they would require. 133 of them gave the following information:

Additional Help Required	*Number of Facilities Reporting*
Additional Personnel Only	46
Personnel and Material	32
Personnel, Material and Equipment	16
Personnel and Equipment	13
Personnel, Equipment and Space	7
Personnel and Space	5
Personnel, Material and Space	4
Personnel, Equipment, Material and Space	1
Equipment Only	1
Material Only	1
Space Only	1

Fifty-nine of the 137 facilities responding felt that they could increase production about 25% with their present staff. Another 30 thought they could increase production from 34 to 200% without adding staff.

With staff doubled, 51% of the facilities thought they could increase their production by 51 to 150% and another 16% thought they could increase production by more than 150%. These estimates are, however, largely based on present production methods. A few facilities mentioned that if prefabricated components could be supplied (as done by the Army during World War II) the output could be increased by an incalculable amount.

The orthotist who works closely with the physician in the hospital setting is required to have more training and education than the orthotic technician who fabricates devices according to a pattern. The training and background of the individual who is essentially a business manager is still different. All three types of individuals are required in the average facility.

Facility owners and managers were asked to supply data describing the education of all personnel employed in each facility. One hundred and twenty-six facilities supplied statistical information on the education of 197 owners and managers, and one hundred and twenty-one of them furnished these data for 495 fitters, technicians, corsettieres, etc. The data in Table 4 clearly indicates the majority of individuals who fit and/or fabricate orthotic devices have completed high school. In addition, 20% of the owners and managers and 11% of their professional employees have attended college. However, approximately 10% of this latter group have only a grade school education.

Table 4.—Education Levels

Levels	Owners and Managers	Production Employees
Attend Elementary School	0	11
Graduate Elementary School	7	37
Attend High School	21	81
Graduate High School	108	317
Attend College	34	34
Graduate College	17	15
Post-Graduate Education	7	4
Total	197	495

The influence of drug stores, surgical supply houses, department stores, etc., is difficult to assess. Of the 35 such facilities interviewed, less than half had supplied braces (as defined by this survey) for any one of the twenty-four conditions for which information was sought.

A minimum of 24 of the 36 drug stores and surgical supply houses reported fitting devices for twelve of these twenty conditions. It is interesting to observe that Dorsolumbar, Low Back and Post-operative conditions were the only three which might be thought of as requiring orthopedic attention, whereas the other nine—abdominal general, ankle, hernia, knee, maternity, obesity, posture, ptosis, and sacro-iliac conditions—are more general medical problems.

Approximately half of these facilities, however, stated that they provide devices for individuals with kyphosis, lordosis, poliomyelitis, scoliosis and low cervical or high dorsal fractures.

Comments by interviewers indicated that most of these facilities furnish collars and braces only by medical prescription, although some surgical garments are provided on request. It was also reported by many of these facilities that they fitted only routine cases and referred more complicated fittings to a local orthotic facility.

For the Purposes of This Survey—

SURGICAL GARMENTS are defined as all devices which do not contain a rigid frame or support including both vertical and horizontal metal bars.

BRACES are defined as any device which contains a rigid frame or support including both vertical and horizontal metal bars.

Table 5.—Drug Store - Surgical Supply House Questionnaire
(Short Form D answered by 35 Facilities)

Question A: For which condition do you provide Surgical Garments or Braces?
(Answers noted in column: Check ones fitted)

Question B: Indicate the type of device usually furnished.
(Answers noted in columns: Surgical garments; Braces)

Conditions	Check Ones Fitted	Surgical Garments	Braces
Abdominal (general)	28	27	1
Ankle	28	26	11
Cardiac	17	17	11
Colostomy	22	18	1
Dorsolumbar	28	23	15
Hernia	27	25	8
Kyphosis	20	19	13
Knee	27	27	9
Lordosis	22	21	12
Low Back	30	28	10
Maternity	24	23	—
Obesity	26	24	1
Poliomyelitis	16	14	8
Post-natal	23	22	2
Post-operative	26	25	3
Posture	24	24	4
Ptosis	24	22	1
Respiratory	18	18	—
Sacro-iliac	30	27	8
Scoliosis	19	16	10
Fractures:			
Low cervical—High dorsal	18	13	16
Mid-low dorsal & lumbar	15	1	14
Low lumbar & sacral	17	15	15
Area unspecified	8	5	3

B. Patient Management Systems

Patients who are furnished with orthotic devices are usually in the process of a multifaceted course of treatment under the supervision of one or more physicians. Many of the procedures entail a clinic team approach.

The survey of Prosthetic Services (2) pointed out that the prosthetic research and education program developed and disseminated a specified clinic team approach. This was based on the theory that various experts engaged in the rehabilitation of the amputee could get maximal results by working together in the formal clinic setting. The report noted that, as the prosthetic clinic team operations became routinized, there was a tendency to dispense with formal clinic meetings when possible. A loosely defined clinic team operation was anticipated in orthotics as the physician-orthotist relationship has been one of long standing.

Inasmuch as prosthetics and orthotics are similar with respect to the procedures involved in prescribing, fitting, final application and medical follow-up of patients and devices, it seemed desirable to determine the ways in which these steps are actually conducted in the orthotic field. It was

obvious that patients whose treatment was being underwritten by institutional sources undergo more standardized treatment procedures than do privately financed patients.

Accordingly, data was collected separately for both of these groups. This information was collected for each of four major groups of orthotic devices: collars and corsets; spinal braces; lower extremity devices; and upper extremity devices.

One hundred and fifty orthotic facilities described the way in which the prescriptions they received had been written. These data are summarized in Table 6. As the physician is the key member of any prescription team, the number of physicians involved in the prescription process and the number of facilities reporting each category of brace are equal. However, as not every facility furnishes collars, corsets, spinal braces, lower extremity braces and upper extremity braces, the figures are different in each category. It is also true that not all facilities which performed a given service, provide it to both private and institutional patients.

It is clear that several disciplines are being consulted in the prescription of many of the orthotic devices prescribed today. It was also found that in many instances the patient is seen by the various members of the team on a serial basis, i.e., one person at a time, rather than in the formal clinic meeting. More formalized clinic meetings are reported approximately twice as frequently for institutional patients than for private patients (Table 6).

Table 6.—Persons Participating in Prescription
(Numbers refer to Facilities Reporting)

	Collars & Corsets (146 Facilities)		Spinal Braces (150 Facilities)		Lower Extremity Braces (149 Facilities)		Upper Extremity Braces (128 Facilities)	
	Pvt.	Inst.	Pvt.	Inst.	Pvt.	Inst.	Pvt.	Inst.
Physicians	146	140	150	148	149	149	128	120
Orthotists	47	75	65	90	56	103	77	89
Therapists	11	46	8	55	29	69	24	56
R.N.'s	4	8	2	2	2	3	1	1
V.A. & Rehabilitation Personnel	0	11	9	1	1	11	1	6
Social Workers	0	4	0	3	2	40	0	2
Family Workers	1	0	0	0	0	0	0	0
Corsettiere	0	1	0	0	0	0	0	0
Group Participation	25	55	36	85	40	82	44	77

The group consultation or clinic meeting referred to in Table 6 does not imply that several persons are present at prescription. It frequently refers to a situation where a physician is in telephone communication with the orthotist. The verbal prescription arrived at in this manner is later documented by a written note. The comments of the interview subjects pointed out that orthotic prescriptions are rarely written in full detail as a medical prescription, i.e., a brace name may be used to imply all of the detail which many years of mutual experience between physician and orthotist have made clear.

Although fewer facilities supply upper extremity orthoses than other types of devices, the percentage of facilities reporting group or multiple participation in prescription of these devices (94.5%) shows the highest frequency in Table 6. These data also reveal that multi-disciplinary groups are most frequently consulted in the prescription of lower extremity orthoses.

Analyzing these data for geographic variance revealed that multi-disciplinary participation in prescription of devices for institutionally sponsored

patients is most frequent in the Southern States (22-24 of 25 facilities reporting) and in Texas-Oklahoma (12-14 of 16 facilities reporting). When the figures relating only to braces are consulted, the New England, Rocky Mountain and California areas demonstrate participation in 50-67% of their prescriptions. The least amount of interdisciplinary consultation was noted in the North Central, Midwestern and Mid-Atlantic areas. In these areas less than 50% of the facilities reported taking part in prescription of spinal or upper extremity braces, although the majority of Midwestern and Mid-Atlantic States facilities reported that they were called on to participate in the prescription of lower extremity braces.

The fitting of a rough, unfinished device on the patient before final modification is here referred to as a trial fitting. This is a procedure in which the orthotist is always the most active participant, although a physician, therapist or nurse may also participate. Trial fittings are most frequently used for upper extremity devices and least frequently for collars and corsets. Other clinic members most frequently participated in the trial fitting of this latter group.

When the geographic distribution of these findings was examined it was found that this procedure is less frequently employed in the eastern half of the country and more frequently used in the western half, particularly with respect to braces.

Checkout of an orthosis is the evaluation of the appliance and its fit. Final application of an orthosis is, as the term suggests, the last fitting of the appliance before its wear or use by the patient. Checkout and final application are procedural steps which are thought of as reasonably close together in point of time.

The term "checkout" came from the prosthetic research and education programs where it had become an integral part of the team approach to fitting amputees. In this sense, it is an evaluation of the man-machine complex to determine the adequacy of function.

Preliminary investigation regarding checkout and final application in orthotics revealed that there were many instances in which devices were finally applied in the absence of a physician in the orthotic facility, at a hospital or in the patient's home. In these instances, the patient is seen by the physician as much as two weeks later as part of the ongoing treatment process or for routine follow-up.

Almost all of the facilities reported that physicians conduct "checkout" with the aid of few other consultants. Conversely, orthotists are usually the only individuals present at final application of orthotic devices.

The number of facilities which reported the same individuals as participating in both checkout and final application refer to situations where both physicians and orthotists, and occasionally others, participate. However, the small number of facilities reporting group participation at final application clearly indicates that checkout of orthotic devices occurs subsequent to final application.

Further analysis, according to geographic distribution, reveals that group participation is seldom resorted to in the final application and checkout of corsets and collars except for the checkout of institutional cases in the eastern third of the country. With respect to checkout of spinal braces, 6 of the 8 North Central and 10 of 19 of the Mid-Atlantic facilities reported group participation for institutional cases as did approximately one-third of the New England, Southern, Midwestern, Texas-Oklahoma and California facilities. A somewhat similar pattern was noted for lower extremity orthotics, except that fewer North Central and more of the California facilities reported group

participation. One-third of the facilities in the eastern half of the country also reported group participation in checkout for private patients as opposed to 15% of the western facilities.

Facilities that furnish upper extremity orthoses reported group participation in checkout with the highest relative frequency—50/115 for institutional cases and 24/121 for private patients. Approximately half of the New England, Mid-Atlantic, Midwestern, Texas-Oklahoma and California facilities reported this procedure, as did a third of the Southern facilities. Group participation was noted on a more scattered basis for private upper-extremity cases. This was observed primarily in large rehabilitation facilities.

Facilities were requested to furnish percentage estimates of the frequencies with which they required prescriptions for the replacement of orthotic devices for each of the eight categories defined above. The variation of the percentages estimated by the facilities was rather large. Typical answers include the following percentage figures: 1, 5, 50, 85, 90, 95 and 100. Although the figures reported by the facilities in a given area or city size group usually clustered about one extreme or the other, there were always a number of estimates of all sizes. To minimize the bias of these skewed variations while still considering a measure of the entire sample of responses, these data were reduced to arithmetic means.* The means of the estimated percents for each of the eight categories are presented in Table 7.

Table 7.—Average Frequency with Which Prescriptions are Required for Replacement of Orthotic Devices

(Arithmetic Means of the Percentage Estimates Reported by the Facilities) **

Orthotic Device	Privately Sponsored	Institutionally Sponsored	Number of Facilities Reporting
Collars and Corsets	53%	84%	(142:135)
Spinal Braces	69%	93%	(141:137)
Lower Extremity Braces	68%	95%	(147:145)
Upper Extremity	70%	92%	(110:103)

* The arithmetic mean was selected because it is the measure of central tendancy which:

a) is most reliable
b) usually varies least from sample to sample (drawn from the same population)
c) permits additional computations if desired
d) defines the "center of gravity" of a sample (16)

** The arithmetic mean figures used here and in subsequent sections represent estimated percentage figures for facilities with differing production figures. Thus shop (a) may have based its percentage figure from 5 units and shop(b) may have based its on 50 units. Both percentage figures are treated as if they have equal weight because this survey is considering the facility as the unit of service rather than the individual orthotic device.

The figures in Table 7 indicate that prescriptions are required for the replacement of almost all orthotic devices paid for by institutional facilities. The major exception occurs in the collar and corset category. Prescription of replacement devices for which payment is made seems markedly less frequent.

Unsolicited comments by the respondents indicated that replacement of devices for young children, geriatric, and other patients who were undergoing growth, or continual change, was always done by prescription. Conversely, replacements for stabilized adults were usually provided without prescription. It was further noted that the first type of replacement was usually

occasioned by change in body dimensions or neuro-muscular conditions, while the second type of replacement was necessitated by wear. Finally, the first type of replacement was most frequently institutionally sponsored, while the second type of replacement was more frequently privately financed.

Analysis of this material, according to city size, revealed no difference between the entire sample and any of the three city size sub-samples. The geographic distribution of these findings showed essentially the same pattern illustrated in Table 7 except that the average figures for the replacement of orthotic devices for institutionally financed patients was 100% in the Midwestern, North Central, Texas-Oklahoma and Pacific Northwestern areas. The pattern in New England and Mid-Atlantic states was correspondingly lower.

C. Cervical Orthotics

The findings of the Survey of Cervical Orthotics are based on a series of questions devised to seek descriptions of the braces which each facility furnished to patients with each of the major cervical bracing conditions. A description of brace variations follows the presentation of the findings enumerating the brace types prescribed and furnished to patients with each of the cervical conditions investigated. The geographic distribution of these variations is then given and a summary of production methods.

Consideration of medical syndromes in terms of resultant bracing requirements, as described above (pages 60-63) led to the identification of five major groups of bracing problems which relate to the cervical spine.

1. Cervical Disc Rupture, Lesion or Reduction of the Foramina, Post-operative Fixation or Dislocation in the Low Cervical area.
2. Torticollis (Wry Neck).
3. Cervical Spinal Strain or Injury or Whiplash.
4. Congenital Weakness, Muscular Dystrophy, etc.
5. Fractures of the Low Cervical Region.

The first four groups are discussed in this section and the problems of bracing cervical fractures will be presented in the section on spinal bracing.

Any or all of these medical conditions may be, in part, treated by the application of a cervical brace or collar. Examination of the medical literature and catalogues of manufacturers and wholesalers of surgical and orthotic supplies reveals a considerable armamentarium of devices suitable for bracing cervical conditions. Following the classification procedure detailed in pages 57-58 above, these devices were divided into seven categories based on the structural considerations and anticipated frequency of applications. Typical examples of the six most frequently anticipated brace types are illustrated in Plate 1.

The first four categories of devices are collars. For simplicity and convenience in this survey, they are referred to as:

Non Height Adjustable Collars (Plate I, Illustration J)

Height Adjustable Collars (Plate I, Illustration K)

Molded Collars (Plate I, Illustration P)

Open Wire Frame Collars (Plate I, Illustration L)

Illustrations J and K clearly demonstrate that these devices may be prefabricated while Illustration P clearly indicates that the device must be molded to a cast of the patient.

CERVICAL BRACE ILLUSTRATIONS

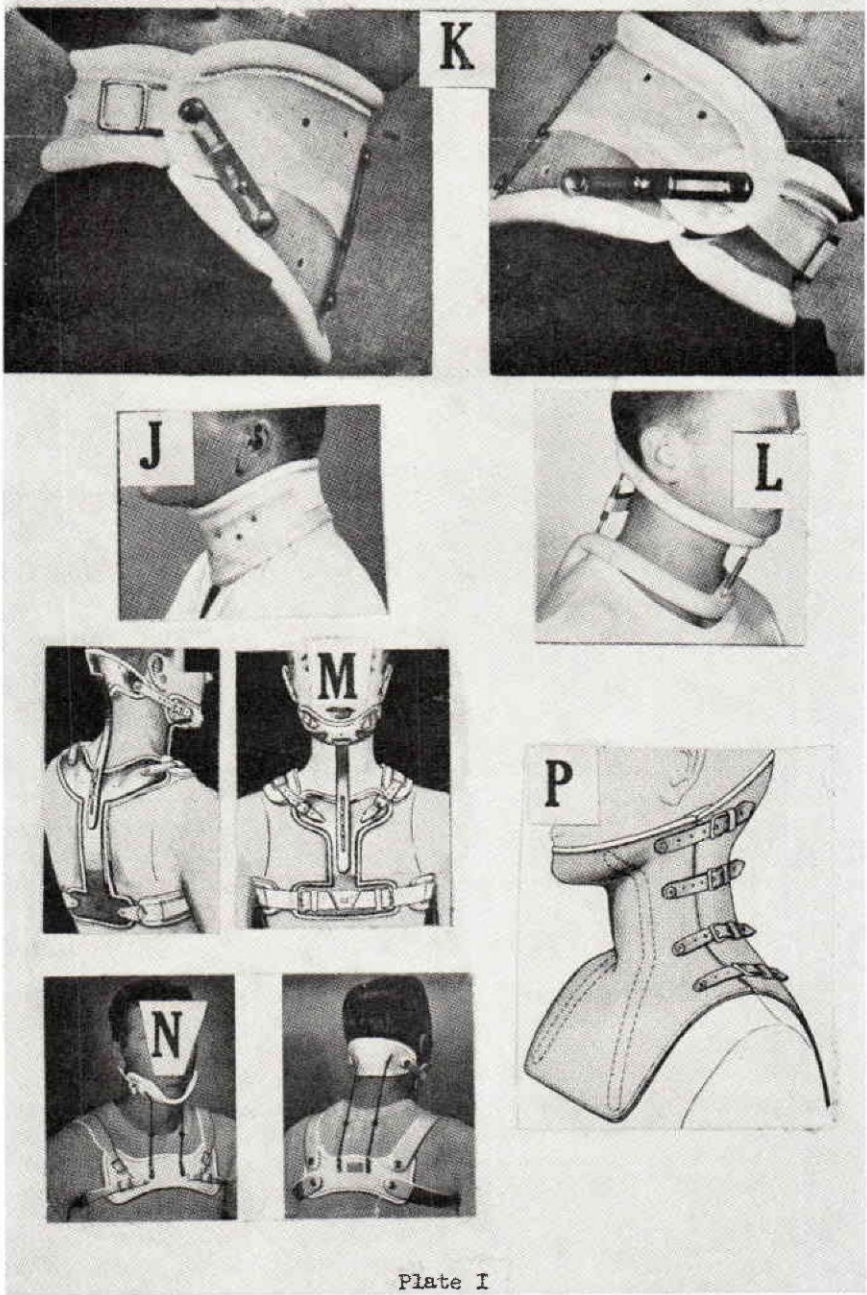


Plate I

The remaining collar is intermediate in design and lends itself to a variety of fabrication procedures. The structural features of the open wire frame collar are intermediate between collars and braces. The two rings of total contact at the head and trunk (of some varieties) resemble collars while the supporting posts are more characteristic of cervical braces.

The last two categories of devices are braces referred to as:
Two-Poster Braces (Plate I, Illustration M)
Four-Poster Braces (Plate I, Illustration N)

These devices have rigid metal posts that are braced against the head and trunk so that these body members will be stabilized in the desired position. The two-poster variety usually employs larger head and trunk plates to offset the reduced number of vertical elements. Two-poster braces may have laterally positioned uprights rather than anterior and posterior ones, (as illustrated). Cervical braces also include three and five post varieties but the anticipated frequency of use suggested that these be left to the "Other Devices" category.

The last category of devices has been referred to as "Other Devices." This is a catch-all categorv to include all other major variations of cervical orthotic devices.

There are 151 orthotic facilities which furnished information enumerating the devices fitted to patients for each of the four cervical bracing conditions. One hundred and forty-five of them also described these braces in so far as they differed from the Illustrations in Plate I.

1) One hundred and thirty-nine of the 151 facilities which reported fitting ten or more patients with cervical orthoses, during the preceding twelve months, provided them to patients with cervical disc rupture, lesion or reduction of the foramina, post-operative fixation or dislocation in the low cervical area. Devices of all of the major types were provided for patients with this type of condition (Table 8).

2) Thirty-four of the 151 facilities provided them to patients with torticollis. In most of these instances comparatively few prescriptions were received for this condition although the prescriptions called for all of the major brace types.

3) All of the 145 facilities which provided detailed information describing cervical devices had furnished collars or braces for patients with cervical strain, injury or whiplash. Although all six brace types illustrated in Plate I are described for this condition, no unusual or other variations are used.

4) Only 44 of the 151 facilities reported fitting cervical devices to patients with congenital weakness, muscular dystrophy, or related problems. Despite the comparatively modest number of prescriptions received for this condition, their variation was extensive.

Examination of Table 8, points out that the full spectrum of the presclected brace types are being applied for each and every one of cervical conditions. The "other" category is reported for only three of the four conditions and is clearly the smallest group reported. Four-poster braces are reported by more facilities than any other type for three of the four conditions: disc rupture (87%); torticollis (41%); congenital weakness (31%). Height adjustable collars are reported by the largest number of facilities for the remaining condition, cervical strain (77%). The non-height adjustable collar types were reported by the second largest number of facilities for three conditions: cervical strain (52%); congenital weakness (32%); and torticollis (38%).

Table 8.—Orthotic Devices Provided by 151 Facilities to Patients with Cervical Conditions

Device Type	Cervical Disc Rupture, Etc.	Torticollis	Cervical Strain or Injury	Congenital Weakness	Illust. # Plate 1
Collars:					
Non-Height Adjustable	18	9	87	14	J
Height Adjustable	28	7	112	9	K
Moulded	26	4	2	4	P
Open Wire Frame	11	2	23	3	L
Braces:					
Two-Poster	55	6	2	3	M
Four-Poster	121	14	19	16	N
Other Types of Devices	12	5	0	3	—
Number of Facilities Reporting	139	34	145	44	

Whereas the preceding section discussed the overall frequency of application of brace type by bracing condition, the present section analyzes the geographic variation of brace types prescribed and furnished for each of the four bracing conditions.

1) Patients with cervical disc rupture, lesion or reduction of the foramina, post-operative fixation, or dislocation of the low cervical region were most frequently fitted with four-poster braces. This is also the only device which is used by the majority of facilities in every geographic area of the country. The only sizeable exception to this finding is the observation that five of the Southern facilities fitted non-height adjustable collars (type J) to an average of 91% of their patients with these conditions while twenty-one fitted a mean average of 76.6% with four-poster braces.

Five of the forty-nine facilities located in the Western half of the country provided height adjustable (K) or non-height adjustable (J) collars to patients with these conditions. Nine of the sixteen providing non-height adjustable and eleven of the 28 providing height adjustable collars were located in the Middle Atlantic and Southern States.

None of the facilities in these two areas were called upon to provide cushioned wire frame collars (L) for these conditions. Very few of these (type L) devices are being prescribed for cervical disc rupture or related cervical problems. In the New England area the open wire frame designs are being furnished by a number of facilities where they seem to be replacing the solid plastic collars (J & K).

A small number of prescriptions call for the molded leather collars. One-fourth of the New England and Mid-Atlantic States facilities and approximately two-thirds of the California facilities provided them.

2) Patients with torticollis are most frequently provided with variations of the four-poster brace. These devices are used on a nation-wide basis. The next most broadly utilized device for this condition, non-height adjustable collars, were reported by none of the facilities west of Kansas and Nebraska.

Although 14 of the 27 facilities in the Midwest that fit cervical devices provide them to patients with torticollis, none of the facilities in the Pacific Northwest had been requested to provide them during the twelve month period.

3) Collars are obviously the most broadly prescribed group of devices for cervical spinal strain, injury or whiplash.

The height adjustable collars are used more frequently in the Western half of the country and are the second most frequent choice in the Eastern states. The non-height adjustable collars are the most frequent prescription

in the Eastern states and the second most frequent choice in the Western states.

Open wire cushioned collars are reported by more facilities for these conditions than for all of the other three bracing problems combined. Molded collars and two-poster braces were reported by two facilities in different areas of the country.

4) Medical practice in the treatment of conditions such as congenital weakness, muscular dystrophy, etc., in the larger and middle size cities rarely includes application of cervical orthoses (as defined in this survey). In these instances, particularly in large cities, the rigid two and four-poster braces are usually prescribed. As the city size becomes smaller there is a definite shift towards the use of collars of all types.

Examination of the geographic distribution of facilities furnishing devices for this class of problems reveals that approximately 30% of them are located in the Southern states. None of the facilities interviewed in the Pacific Northwest and only one in New England reported being called on to furnish cervical devices for these conditions.

Other types of devices were described by three facilities. One used only a posterior upright attached by straps to the chest and forehead. A second used only an occipital support similar to that shown in Illustration I-M without the chin piece. A third facility reported they were occasionally called on to provide a chin support, cantilevered from a posterior upright attached to a wheel chair.

Most of the cervical collars prescribed in the past year were furnished as centrally manufactured units. Eighty-nine percent of the facilities that furnished height adjustable collars to patients with cervical strain, etc., and 93% who furnished them for cervical disc lesions reported using prefabricated devices. A somewhat smaller percentage, 62 and 70% respectively, reported using prefabricated collars of the non-height adjustable variety. For the open wire cushioned collars 83% reported using prefabricated collars for cervical disc lesions, etc. All of the molded collars were fabricated at the facilities.

It was previously pointed out that two and four-poster braces differ only in the number of vertical structural elements used to stabilize the position of the head. The other, similar, components used in these braces are:

Mandibular and Occipital Supporting Plates
Straps used to attach these Plates
Breast and Back Plates, or Extensions of Spinal Braces
Over-the-Shoulder and Axilla or Thoracic Straps

A variety of these components are provided by central manufacturers as parts, kits and as prefabricated units. The use of facility fabricated and prefabricated devices are strikingly different for the two- and the four-poster braces which are prescribed and fitted to patients with cervical disc rupture. lesion or reduction of the foramina, post-operative fixation or dislocation in the low cervical area. Of 55 facilities which described the two-poster braces they had fitted for cervical disc lesion during the preceding twelve months, 38 reported fitting only devices fabricated at their facility, 15 fitted only prefabricated units and 2 furnished both. Thirty-eight of the 107 facilities describing their four-poster braces had fabricated them entirely at the facility while 74 had fitted only prefabricated units and 8 others had fitted both.

Differing trends in the use of prefabricated and facility fabricated two- and four-poster braces in different geographic areas are apparent:

1) In the Mid-Atlantic and Southern areas of the country the practice of prescribing and fitting two-poster braces is equally divided be-

tween prefabricated and facility fabricated units. Facility fabricated four-poster braces are reported by only 16% of the facilities.

2) a. In the Midwest 70% of the facilities reporting made their own two-poster braces while only 28% made their own four-poster units.
   b. In Texas and California two-poster braces were facility fabricated by 90% of those reporting while only 35% reported fabricating their four-poster braces.
3) In the New England, North Central, Rocky Mountain, and the Pacific Northwest areas approximately an equal number of facilities reported the use of facility fabricated and prefabricated four-poster braces. A similar pattern was reported for two-poster braces in New England. In the other three areas so few facilities reported using two-poster braces that no pattern may be inferred.

The majority of facilities use "cupped" chin pieces for two-poster braces and open chin patterns for four-poster types. Although either design may be used interchangeably, few exceptions were found.

Mandibular and Occipital Plates	*2-Posters*	*4-Posters*
Chin piece cupped (Illustration I, M)	46	9
Chin piece open anteriorly (Illustration I, N)	5	102
Lateral supports along Mandible & Base of Skull	—	1
Mandibular Plate Hinged to Occipital Plate	2	—
Lateral Extensions of Chin Piece Fitted to Occipital Plate	1	—

One modification of interest is the use of laterally placed supports by one facility.

The straps used to attach the mandibular and occipital plates were made of leather, or webbing in 97% of the cases. The four facilities using metal straps included three which used them for two-poster and one for four-poster braces.

Seventy-five percent of the facilities fitting two-poster and 29% of those making four-poster braces reported that they used yoke shaped chest and back plates similar to those shown in Illustration I, M. Dumbell or butterfly shaped plates (Illustration I, N) were reported by 9% of those furnishing two-poster and 67% of those fitting four-poster braces. Custom fabricated designs reported by facilities scattered throughout the country included full yokes, horizontal plates, double or paired extensions, spinal brace extensions and absence of extensions.

Chest or Back Pads	*2-Poster*	*4-Poster*
Yoke Shaped Plates (Illustration I, M)	33	31
Yoke Shaped Plates—Extension of Spinal Brace	5	1
Yoke Shaped Plates with Paired Chest & Back Extensions	3	—
Large ½-Yoke Pads	—	3
Dumbell or Butterfly Shaped Plates (Illustration I, N)	6	47
Horizontal Plates—Extension of Spinal Brace	3	1

The straps which attach these braces to the body and maintain the relative position of the chest and back components in a stable manner are usually made of leather and/or webbing. These materials were reported by 82% of the facilities describing their two-poster and 96% of those describing their four-poster braces.

	2-Poster	*4-Poster*
Webbing and/or Leather Over-the-Shoulder and Axilla or Thoracic Straps	41	60
Webbing and/or Leather Over-the-Shoulder Straps—No Axilla or Thoracic Straps	2	45
Metal Over-the-Shoulder, Leather and/or Webbing Axilla or Thoracic Straps	6	4
Metal Over-the-Shoulder Straps are Extensions of Taylor Back Brace	3	1

Fitting metal over-the-shoulder straps is always a highly individualized problem. In fitting cervical braces to patients with disc lesion or related problems, facilities may use these metal straps for either 2-poster braces or 4-poster designs, but not for both. Half of these facilities are located in California, three others are located in the Midwest and one in the North Central states. The most striking difference is that 82% of the facilities provide two-poster braces which cannot be modified for height or position without disassembling the brace into its component parts. This practice was reported by only one of the 121 facilities in fitting four-poster braces.

	2-Post	*4-Post*
Fixed Length Posts (Anterior & Posterior)	45	1
Posts with Height Adjustments	4	80
Adjustable Telescoping Post that Swivels	2	28
Flat Malleable Anterior & Posterior Uprights	4	—

Twelve facilities reported a variety of four additional brace types which they fitted to patients with these cervical problems. These facilities are distributed throughout the New England, Mid-Atlantic, Southern, Midwestern, North Central and California areas, with 7 of the 12 located in middle sized cities.

The other brace patterns reported included:

a) Six variations of three-poster braces

1. Similar to Illustration I, M but a single anterior post and two posts posteriorly
2. Taylor brace with cervical extension, similar to Illustration I, M. Metal over-the-shoulder straps are continuations of the Taylor uprights. The two dorsals bars originate from the Taylor dorsal cross-piece. A single post with a swivel is attached to the chin and breast plate.
3. Three molded metal pieces for the chin and angles of the mandible are soldered to a steel band which is supported by two lateral and one anterior post and welded to a horizontal chest plate and metal over the shoulder straps. The brace is padded and attached to the patient by a thoracic strap and an occipital pad and strap.
4. A molded chin piece is welded or brazed to two metal straps which are contoured to fit along the mandible. A similarly contoured horseshoe shaped piece is fitted to the chest extending from just below the sternal notch anteriorly, continuing over the shoulder to just above the scapulae. These two components are stabilized by a fixed length anterior post and two fixed length posts which go from the center shoulder line to the mandibular area. A leather strap holds the metal mandibular plates in position posteriorly.

5. & 6. Similar to Illustration I, N but only one post is used dorsally.

b) Two Jury Mast variations were reported by four facilities.

1.-3. A cupped chin piece is hinged to the Occipital plate. This structure is cantilevered from a single posterior post which arises from the cross-piece of a Taylor brace. The attachment at the level of the occiput does not permit horizontal rotation in these applications.

4. The posterior post is attached to the body with a thoracic band and to the head with metal extensions continuing to the temple which are anchored anteriorly with a forehead strap. A second strap supports the head from the temples by passing from temple under the chin, with a chin cup, and up to the other temple.

c) One facility reported fitting a "Boldray Brace" for these conditions. This brace stabilizes the head with zygoma bars and a forehead strap attached to a large occipital pad. This structure is supported by a single posterior post arising from the dorsal cross-piece of a Taylor brace.

d) One other facility reported that they participated in fitting skeletal fixation halos for these conditions.

Five of the 34 facilities providing cervical devices to patients with torticollis fitted only "other" types of braces.

1) Starting with a four-poster brace, as Illustrated in Plate 1, N, a fifth post is added which applies lateral pressure against the mandible. at the edge of the chin piece.

2) A single posterior post, arising from the crosspiece of a Taylor brace, is riveted to an occipital plate. The position of the head is maintained by leather straps passing from the occipital piece to a cupped chin piece.

3) A single posterior bar, arising from two crosspieces of a Taylor type brace, has an adjustment for angulation from the vertical at about C7. A leather covered metal collar which is open in front is attached. This collar exerts pressure low under the mandible on the concave side and high on the head on the convex side.

4) A single posterior bar, arises from a dorsal band of a spinal brace. Angulation from the verticle is achieved by adjustment of a wing-nut and over a slotted band which is located at about mid-scapular level. The posterior post cantilevers the head with a hinged chin and occipital ring.

5) A cloth chest corset with built-in side bars that extend to the head, applies pressure laterally to a chin piece on the concave side and against the side of the head on the convex side.

D. Trunk and Spinal Orthotics

Although orthotic appliances are applied to the trunk for a large variety of medical reasons, the essential purpose of applying an exoskeletal device can only be to position and/or maintain trunk alignment. Malalignment may be due to disease, congenital defect or trauma. In any event, the problems may be reduced to: correction of exaggerated curves in the sagittal plane (scoliosis) or in the frontal plane (thoracic kyphosis or lumbar lordosis); fixation of fractures and post-operative conditions; or alleviation of discomfort of the lumbrosacral spine.

Following the procedure described above (pages 60-63) seven bracing problems were defined for this portion of the survey:

1. Curvature:
   a) Kyphosis Dorsal Spine
   b) Lordosis Lumbar Spine
   c) Scoliotic Curvature (regardless of etiology)
2. Low Back Pain, with or without Disc Complications
3. Fracture or Post-operative Condition:
   a) Low Cervical and High Dorsal Spine
   b) Mid-low Dorsal and Upper Lumbar Spine
   c) Lower Lumbar or Sacral Region

Having established that this survey would limit its inquiry to exoskeletal braces and corsets, these two device classes were then defined as:

A) BRACES. All devices which contain a rigid frame of support including both vertical and horizontal metal bars.

B) CORSETS. All devices which may or may not contain rigid vertical or horizontal metal bars or supports, but *not* both.

Seven designs were selected as basic examples of the spinal braces now in general use. Illustrations of these patterns were synthesized from drawings submitted by orthotists throughout the country and by previously published illustrations. These basic brace types may be defined as:

Q) A lumbar and lower thoracic brace composed of a metal frame encircling the dorsal half of the body, held in position by a corset or strapped to an apron or abdominal pad. The metal frame includes (flat, canted or curved) paravertebral and lateral vertical bars attached to (straight, angular or butterfly shaped) pelvic and thoracic bands (Plate II, page 83).

R) A lumbar and sacral brace composed of a rectangular frame strapped to an apron or abdominal pad. The frame consists of essentially vertical, but diverging bars and two parallel horizontal bands which form a solid frame with or without projecting members (Plate III, page 83).

S) A hollow-back extension type brace which applies pressure to the lumbro-sacral area by lever action adjusted by straps which pass between the two lever arms on either side of the body (Plate IV, page 84). The brace is stabilized on the body by a corset, pad or apron.

T) A full back brace with a pair of paravertebral bars extending from a (straight, angular or butterfly shaped) pelvic band, at the level of the coccyx or lower sacrum, to the upper third of the scapula or higher. In many variations the upper portion of the vertical bars turn laterally along the superior border of the scapulae. This brace also has a dorsal crosspiece which joins the two uprights at a position between T-10 and the lower third of the scapulae. The brace is attached by a corset, pad or apron and by two shoulder straps which are attached to the superior terminus of the uprights and the dorsal crosspiece (Plate V, page 84).

U) A spinal hyperextension brace consisting of a metal frame which rests against the anterior half of the body; a back pad which holds the brace against the body with varying degrees of pressure; a sternal and a pubic pad which transmit counter pressure anteriorly (Plate VI, page 85).

W) A Milwaukee type scoliosis brace (Plate VII, page 85).

Z) A molded body corset (Plate VIII, page 86), this may be made of a variety of materials such as plastic laminate, Celastic or glass cloth and resin.

The full array of corsets are lumped under the "Other" category.

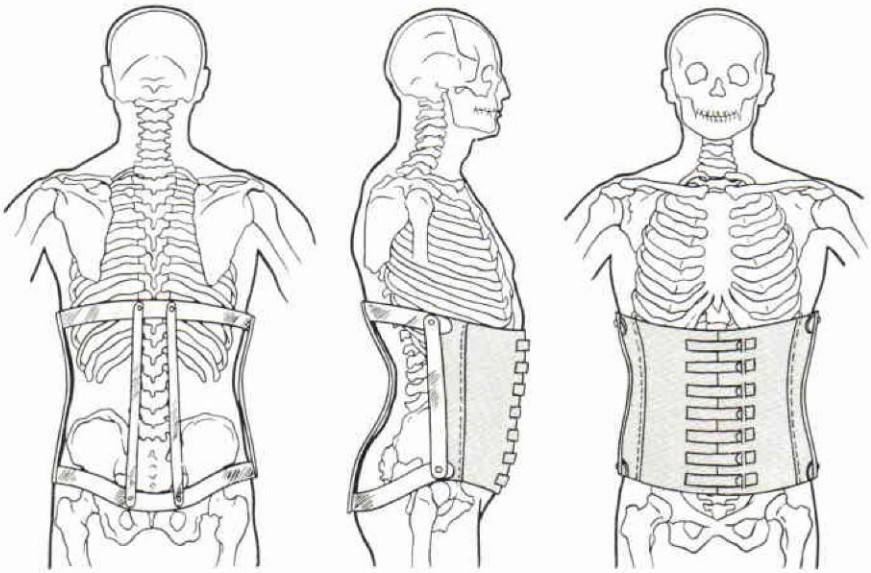


PLATE II SPINAL BRACE Q

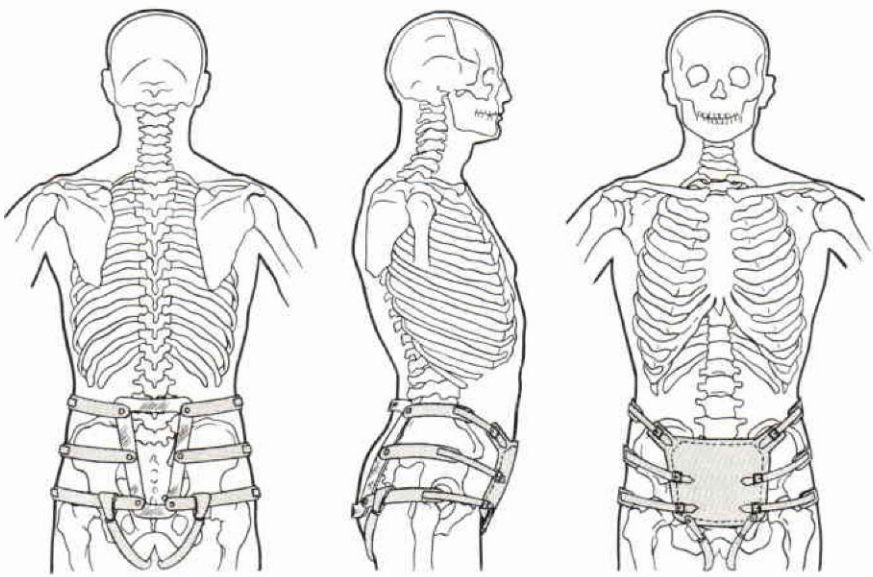


PLATE III SPINAL BRACE R

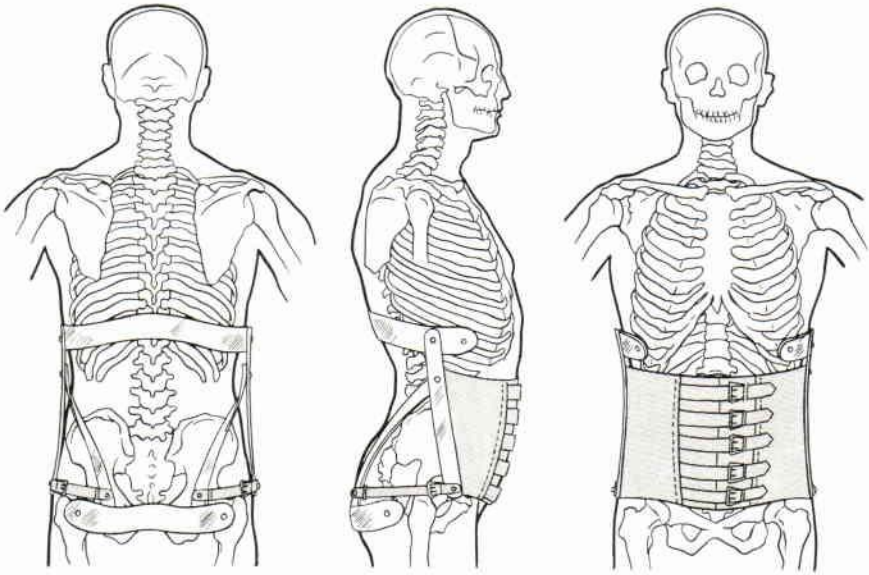


PLATE IV SPINAL BRACE S

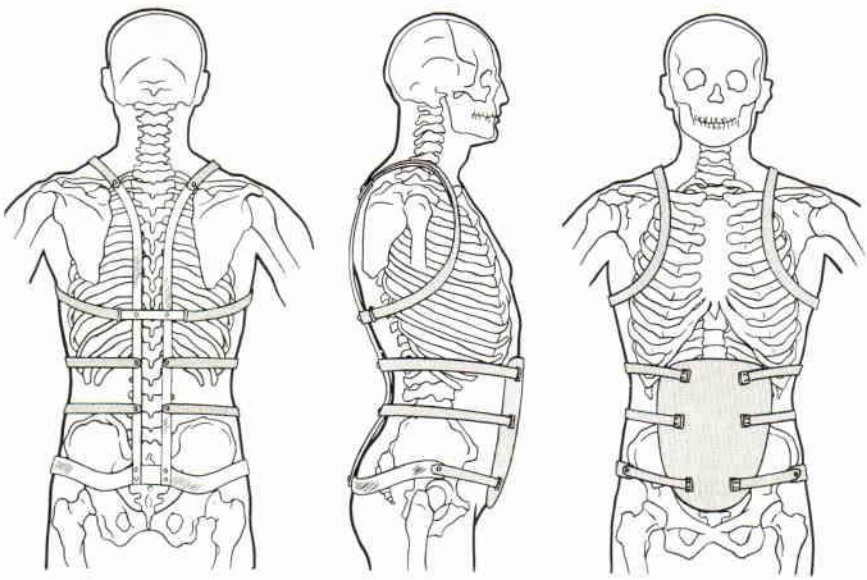


PLATE V SPINAL BRACE T

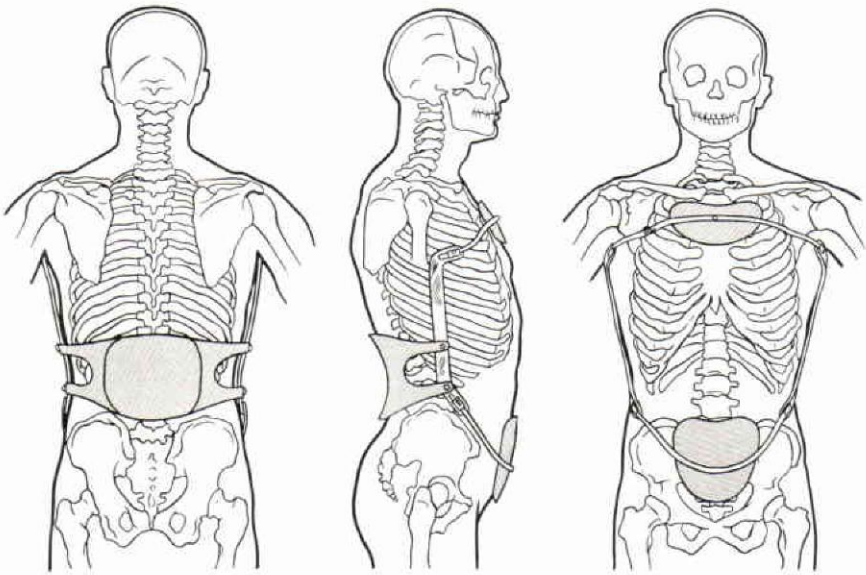


PLATE VI SPINAL BRACE U

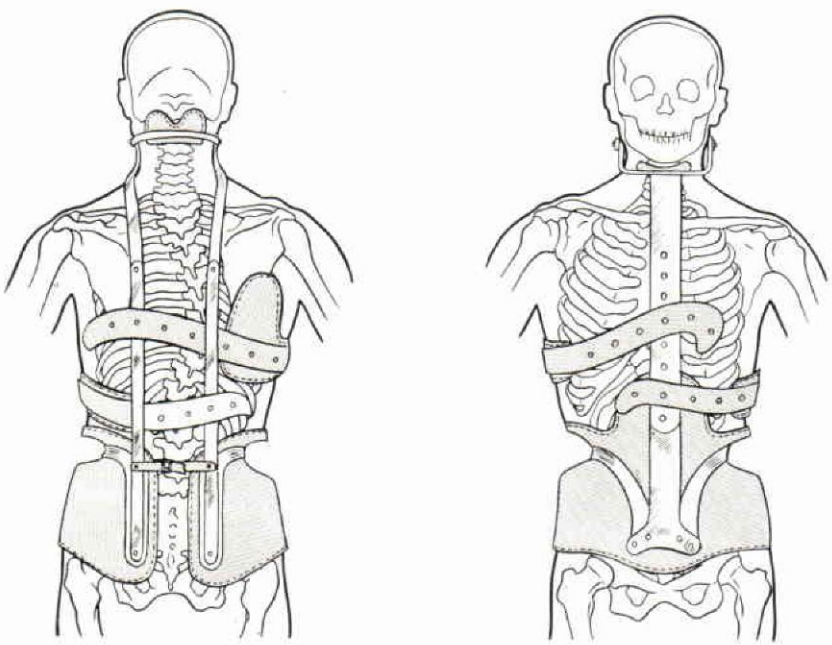


PLATE VII SPINAL BRACE W

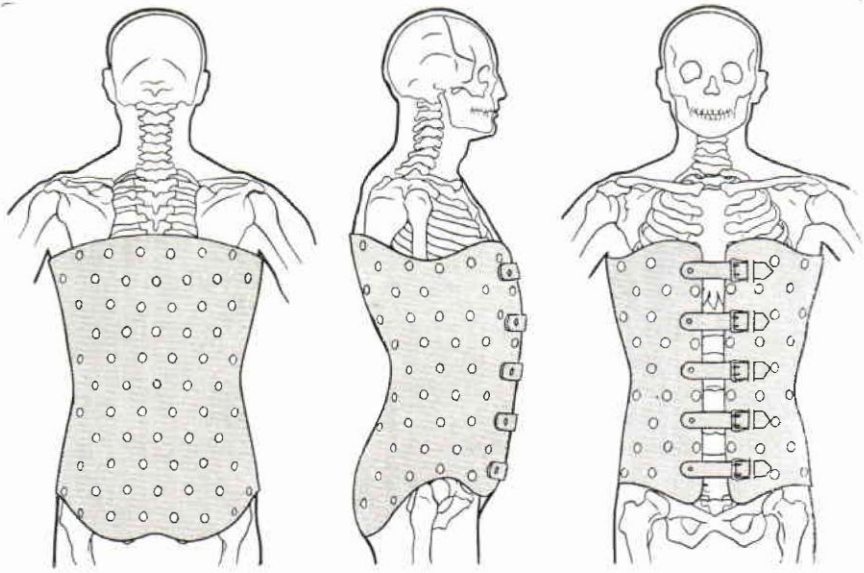


PLATE VIII SPINAL BRACE Z

An attempt to analyze the frequency with which a spinal appliance was used for a given condition presented a complex problem. Most of the facilities reported one or another of the seven appliance illustrations as being similar to the appliance they fitted, but described their brace as being a variation of the illustration. Some of these variations appear to be very real, while others fall in the realm of semantic differences.

All of these factors have, and continue today, to cloud the picture of spinal and trunk orthotics. To clarify this matter, the data has been analyzed within two parameters: 1) The brace illustration selected by the respondent for a given condition; and 2) The brace type fitted by each facility to 50% or more of its patients with a given condition. To be included in the analysis, a facility must have fitted ten or more patients for the condition being studied. (The exception to this was Condition D, scoliosis.)

The tables, therefore, may be interpreted as indicating the basic "appliance of choice" for each condition.

Condition A: Kyphosis or Anterior Curvature of the Dorsal Spine (Table 8).

Of 141 facilities reporting that they fitted the same appliance to 50% or more of their patients with this condition, ninety-one (65%) selected illustration T, (Plate V), as resembling the appliance fitted; thirteen (9%) selected illustration Q, (Plate II); seventeen (12%) selected illustration U (Plate VI); while fifteen (11%) reported that they fitted corsets for this condition.

Further analysis of these data by city size does not show significant variation in the figures reported for the total sample. Variations by area of the country, however, do appear. These variations are in the reported application of devices Q, U and corsets. There are not the variations for appliance T, for in each area 50% to 86% of the facilities reporting, selected it as the appliance of choice.

In the New England area and the Rocky Mountain states, appliance U is seldom fitted for Condition A, while in the South it may be expected to be fitted more often than appliance Q or corsets for Condition A.

In the Midwest, the North Central, the Rocky Mountains and the Pacific Northwest, appliance Q is seldom fitted for Condition A. In those areas in which it is fitted for Condition A, it is routinely modified.

Table 8.—Appliance Fitted to 50% or More of Patients with Kyphosis

(141 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type T (Plate V)	U (Plate VI)	Q (Plate II)	Corsets	Other
Large	35	6	7	7	3
Middle	34	3	3	4	2
Small	22	8	3	4	0
Total	91	17	13	15	5

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Appliance Type T (Plate V)	U (Plate VI)	Q (Plate II)	Corsets	Other
New England	9	0	2	2	0
Mid-Atlantic	12	4	3	3	2
South	16	5	3	1	1
Midwest	18	4	1	1	0
North Central	7	1	0	2	1
Rocky Mountain	4	0	0	2	1
Texas-Oklahoma	12	1	3	4	0
California	7	1	1	0	0
Pacific Northwest	6	1	0	0	0
Total	91	17	13	15	5

Corsets are seldom used in the South, Midwest, California or the Pacific Northwest, while in Texas and Oklahoma and the Rocky Mountain areas they may be expected to be fitted more often than either appliance Q or U for Kyphotic curvature.

Condition B: Lordosis or Anterior Curvature of the Lumbar Spine (Table 9).

Of 137 facilities reporting that they fitted the same appliance to 50% or more of their patients with lordosis, forty-nine (36%) selected illustration S (Plate IV) as resembling the appliance fitted; forty-one (30%) selected illustration Q (Plate II); nineteen (14%) selected illustration T (Plate V); while twenty-eight (20%) reported that they fitted corsets or other appliances for this condition.

Analysis by city size indicates that corsets are used more routinely for this condition in small cities than in large or middle size cities. In the small cities they are about as equally used as are appliances resembling illustrations S and Q. In middle size cities there seems to be a decided preference for the use of appliances resembling illustration S and less use of corsets and other appliances. In large cities the overall usage of the appliances mentioned is quite similar, in proportion, to the total observed with the exception of the "Other" category. On the whole the responses indicated that

an equal frequency of appliances resembling illustrations S and Q should be anticipated regardless of city size.

Analysis by geographic area shows a decided preference for appliances resembling illustration S in the South and in Texas-Oklahoma while some preference in that direction appears in the Midwest and North Central areas. The reverse is true in the Rocky Mountain area where the preference is for appliances resembling illustration Q. This same preference, to a lesser degree, appears in the New England, Mid-Atlantic and Pacific Northwest areas.

The Mid-Atlantic area seems to show the most diverse practice in dealing with patients of this type. A seeming preference for corsets as an alternative to appliances resembling illustration Q is seen in the Texas-Oklahoma area, but the the opposite trend is seen in California.

Table 9.—Appliances Fitted to 50% or More of Patients with Lordosis

(137 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type S (Plate IV)	Q (Plate II)	T (Plate V)	Corsets	Other
Large	19	19	8	7	6
Middle	20	14	7	3	1
Small	10	8	4	8	3
Total	49	41	19	18	10

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Appliance Type S (Plate IV)	Q (Plate II)	T (Plate V)	Corsets	Other
New England	3	5	3	2	1
Mid-Atlantic	5	7	4	2	3
South	13	4	2	4	2
Midwest	12	9	3	2	2
North Central	2	1	2	1	0
Rocky Mountains	0	4	1	2	0
Texas-Oklahoma	7	2	1	4	0
California	5	5	2	0	2
Pacific Northwest	2	4	1	1	0
Total	49	41	19	18	10

Condition C: Low Back Pain or Strain, with or without Disc Complications and Exclusive of Fractures (Table 10).

Of 142 facilities reporting that they fitted the same appliance to 50% or more of their patients with this condition, one hundred and one (71%) stated that they were called upon to fit corsets, while thirty-six (25%) fitted appliances similar to illustration Q and five (5%) fitted other appliances.

Analysis by city size indicates a slight preference for appliances resembling illustration Q in small cities while a slight preference for corsets is evident in the large cities.

Geographic differences are also slight though a preference for using corsets in treating this condition is seen in the South, the North Central area and the Pacific Northwest, while a preference for using appliances similar to that in illustration Q appears in the Mid-Atlantic area, the Midwest and Texas-Oklahoma, where the most diverse practice appears.

Table 10.—Appliances Fitted to 50% or More of Patients with Low Back Pain or Strain

(142 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Corsets	Appliance Type Q (Plate II)	Others
Large	47	13	2
Middle	34	12	0
Small	20	11	3
Total	101	36	5

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Corsets	Appliance Type Q Plate II)	Others
New England	13	4	0
Mid-Atlantic	13	9	0
South	19	4	0
Midwest	16	9	0
North Central	9	0	0
Rocky Mountains	5	2	0
Texas-Oklahoma	8	4	3
California	11	3	2
Pacific Northwest	7	1	0
Total	101	36	5

Condition D: Scoliotic Spinal Curves (Regardless of Etiology) (Table 11).

Of 125 facilities reporting that they fitted the same appliance to 50% or more of their patients with Scoliotic Spinal Curves (with no minimum number of fittings during the last twelve months); thirty-nine (31%) selected illustration W (Plate VII) as resembling the appliance fitted; thirty-two (26%) selected illustration Q (Plate II); twenty-one (17%) selected illustration Z (Plate VIII; thirteen (10%) selected illustration T (Plate V); while eleven (9%) indicated that they used corsets and nine (7%) selected other illustrations or described appliances that were not illustrated.

Further analysis by City Size and Geographic Area indicates that there is no simple approach to the treatment of scoliotic spinal curves with bracing that is generally accepted.

Of the seven conditions studied in this survey, appliances similar to illustration W were reported only for scoliosis, with the single exception of one facility in the North Central area which fits a similar appliance to patients with Kyphotic curvature.

Devices similar to illustration Q were described as generally higher than illustrated with added 'slings', corsets and/or unilateral crutch extensions. All of the facilities reporting the fitting of devices similar to illustrations Q and T for scoliotic spinal curves mentioned some or all of the above modification.

Facilities reporting the application of devices similar to illustration Z utilized numerous materials in fabrication ranging from polyester, resins, to plaster, leather, Celastic and celluloid.

Table 11.—Appliances Fitted to 50% or More of Patients with Scoliosis

(125 Facilities by City Size)
a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type W (Plate VII)	Q (Plate II)	Z (Plate VIII)	T (Plate V)	Corsets	Other
Large	14	17	11	3	9	2
Middle	18	8	6	3	2	4
Small	7	7	4	7	0	3
Total	39	32	21	13	11	9

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Appliance Type W (Plate VII)	Q (Plate II)	Z (Plate VIII)	T (Plate V)	Corsets	Other
New England	1	3	1	1	3	1
Mid-Atlantic	6	9	2	1	2	1
South	8	2	4	3	1	4
Midwest	8	7	1	3	4	2
North Central	4	2	2	0	1	0
Rocky Mountains	2	1	2	1	0	0
Texas-Oklahoma	9	1	0	1	0	0
California	1	4	6	0	0	1
Pacific Northwest	0	3	3	3	0	0
Total	39	32	21	13	11	9

Condition E: Fractures of the Low Cervical and High Dorsal Spine. (Table 12).

Of 108 facilities reporting that they fitted the same appliance to 50% or more of their patients with Fractures of the Low Cervical and High Dorsal Spine or patients who had undergone surgery in these areas, forty-seven (53%) selected illustration T (Plate V) as resembling the appliance fitted; sixteen (15%) selected illustration N (Plate I), while thirty-five (32%) indicated that other types of appliances were prescribed for this condition.

The smaller number of facilities reporting and the relatively high number which reported appliances that were not illustrated seems to indicate that the treatment of this condition through bracing is not well defined. It is evident, however, that the majority of patients with this condition are fitted with modifications of the appliance illustrated in Plate V. There is further evidence that the modifications made must usually result in an appliance which is a combination of illustrations T and M or N. This appliance is used a great deal in the South.

Patients fitted with appliances similar to illustration N most usually receive a device which varies little from the one shown in Plate I. This appliance seems to be most frequently fitted in the Midwest and North Central areas.

The "Other" category is made up of a relatively equal frequency of corsets with cervical extensions, and appliances similar to illustrations Q, U, M, P and Z. The highest relative frequency of "Other" appliances is reported in the Mid-Atlantic area. Here appliances similar to illustration Q were reported by four facilities. There was no pattern to the remaining reports from that area. In the Midwest four facilities reported fitting devices similar to illustration U. Reports from the remaining areas indicate varying local practice.

Table 12.—Appliances Fitted to 50% or More of Patients with Fractures of the Low Cervical and High Dorsal Spine

(108 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type T (Plate V)	N (Plate I)	Other
Large	21	4	16
Middle	18	7	11
Small	18	5	8
Total	57	16	35

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Appliance Type T (Plate V)	N (Plate I)	Other
New England	6	0	2
Mid-Atlantic	7	0	10
South	13	3	6
Midwest	7	6	8
North Central	3	3	1
Rocky Mountains	5	1	1
Texas-Oklahoma	5	2	2
California	7	0	5
Pacific Northwest	4	1	0
Total	57	16	35

Condition F: Fractures of the Mid-, Low Dorsal or Lumbar Spine (Table 13).

Of the 134 facilities reporting that they fitted the same appliance to 50% or more of their patients with fractures of the mid-dorsal, low dorsal or lumbar spine or patients who had undergone surgery in these areas, fifty-five (41%) selected illustration T (Plate V) as resembling the appliance fitted; forty-two (31%) selected illustration Q (Plate II); twenty-two (17%) selected illustration U (Plate VI) while twelve (9%) indicated that they were called upon to fit corsets and three (2%) indicated that some other appliance was used in the treatment of this condition.

Analysis by city size indicates no preference between appliances similar to illustration T or Q in large cities and a relatively lesser application of braces of the type depicted in illustration U. In middle size cities some preference for appliances of the illustration T type was shown, but preference for illustration U and Q type appliances was almost equal. The pattern for preference in small cities was close to that of the total.

Analysis by geographic area shows that for the treatment of this condition appliances of the type shown in illustration Q are most frequently prescribed in the Mid-Atlantic area and the South. Appliances of the type shown in illustration T are most frequently prescribed in the Midwest and Pacific Northwest. This latter design is an important part of the armamentarium for treatment of this condition in other parts of the country. California and New England demonstrated equal preferences for appliances

of the type illustrated in Q and T. Braces similar to illustration U are most frequently used in the South and Midwest. Although U type appliances are used in the Western two-thirds of the country, no indication was found that this design is used in New England or the Mid-Atlantic areas.

No distinction was made in the questionnaire between compression type fracture and other fractures of the dorsal and lumbar spine. If such a distinction had been made it is possible that a more definite pattern of bracing might have attained.

Table 13.—Appliances Fitted to 50% or More of Patients with Fractures of the Mid Dorsal, Low Dorsal or Lumbar Spine
(134 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type T (Plate V)	Q (Plate II)	U (Plate VI)	Corsets	Other
Large	21	21	3	5	2
Middle	17	12	13	5	1
Small	17	9	6	2	0
Total	55	42	22	12	3

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographical Area	Appliance Type T (Plate V)	Q (Plate II)	U (Plate VI)	Corsets	Other
New England	5	5	0	2	2
Mid-Atlantic	7	11	0	3	0
South	6	10	6	1	0
Midwest	13	5	5	2	0
North Central	4	1	3	0	0
Rocky Mountains	4	0	2	2	1
Texas-Oklahoma	4	3	2	2	0
California	5	5	3	0	0
Pacific Northwest	7	2	1	0	0
Total	55	42	22	12	3

Condition G: Fractures of the Lower Lumbar or Sacral Region (Table 14).

Of the 146 facilities reporting that they fitted the same appliance to 50% or more of their patients with fractures of the lower lumbar or sacral region or patients who had undergone surgery in these areas, seventy-nine (54%) selected illustration Q (Plate II) as resembling the appliance fitted; thirty-eight (26%) indicated that they were called upon to fit corsets; while seventeen (12%) selected illustration T (Plate V) and twelve (8%) described some other appliance.

In the large cities the practice seems to be to use corsets more than appliances similar to that illustrated in Plate II. Also, relatively more appliances other than those indicated are used in treating this condition. In middle size cities a higher number of the appliances similar to that shown in illustration Q are used and a lesser number of corsets. The pattern for preference in small cities was close to that of the total.

A pronounced preference for appliances similar to that shown in illustration Q is seen in every geographic area except the Rocky Mountains. In that area corsets seem to be the preferred type of treatment.

Table 14.—Appliances Fitted to 50% or More of Patients with Fractures of the Lower Lumbar or Sacral Region
(146 Facilities Reporting)

a) DISTRIBUTION BY CITY SIZE

City Size	Appliance Type Q (Plate II)	Corsets	T (Plate V)	Other
Large	26	16	6	6
Middle	32	10	6	4
Small	21	12	5	2
Total	79	38	17	12

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Appliance Type Q (Plate II)	Corsets	T (Plate V)	Other
New England	6	3	3	1
Mid-Atlantic	11	4	1	1
South	16	7	4	3
Midwest	16	6	3	2
North Central	5	3	2	1
Rocky Mountains	3	4	2	1
Texas-Oklahoma	6	5	1	0
California	10	5	0	3
Pacific Northwest	6	1	1	0
Total	79	38	17	12

The procedures followed in fabricating and fitting spinal and trunk appliances fell into three distinct categories:

(1) Facilities which make all of the parts from which devices are fabricated.

(2) Facilities which use prefabricated parts in the making of devices.

(3) Facilities which fit prefabricated devices.

These categories must be further qualified. Facilities which state that they make all of the parts from which devices are fabricated mean one of two things: they fabricate each appliance for a patient from raw materials or they fabricate each appliance for a patient from stock parts which they have designed and keep available in stock. This latter form of "making all of the parts" overlaps category (2) where the facility may use its stock parts or purchase prefabricated parts from a source of central supply.

Table 15.—Procedures Followed in Fabricating and Fitting Spinal and Trunk Appliances

Percent of Facilities Reporting which:	Appliances Q	R	S	T	U	W	Z
(1) Make All Parts	84.5	85.7	87.7	82.2	50.5	52.6	98.1
(2) Use Prefabricated Parts	12.4	14.3	5.6	14.0	9.9	42.1	0.0
(3) Fit Prefabricated Braces	3.1	0.0	6.7	3.8	39.6	5.3	1.9

As can be seen in Table 15, the majority of all spinal and trunk appliances are fabricated from parts made in the facilities reporting. The use of prefabricated braces is limited except in the fitting of appliances similar to that shown in illustration U (Plate VI).

Analysis by city size does not show a pattern significantly different from the national total. Analysis by geographic area indicates that in the South and Midwest there seems to be diversity in fabricating procedures which is not seen in the other geographic areas. This diversity is not seen in all appliances and did not prove to be significant.

Of great concern to the Orthotists of this country is the terminology used in referring to the appliances which they are called upon to fit. In order to find out the names applied to a number of spinal appliances, Spinal Orthotics Questionnaire A was circulated in November, 1961. The responses to this questionnaire are summarized in Tables 16 and 17.

The number of names applied to the braces shown in Questionnaire A may be unrealistically high due to the fact that only one view of each brace was shown; moreover, the illustrations are schematic representation of metal structures rather than complete or finished appliances. Many of the respondents pointed out that their answers were based on what they felt was being represented in this questionnaire rather than on the similar devices that are actually fitted in their facilities.

Table 16 illustrates the number of different names given to each of the eighteen appliances listed in the questionnaire. The range of names given, varies from eight for illustration R to forty-one for illustration O. The confusion in terminology, however, is more apparent from Table 17 where thirty names of spinal appliances are listed and their use with each of the eighteen illustrations is noted. Of the thirty names half were used in identifying five or more illustrations.

Four of the eighteen illustrations are related to illustrations used in the Interview Questionnaire. These are: Brace Q, (Plate II) which is essentially the same as illustration A, (Plate IX); Brace S, (Plate IV) which is essentially the same as illustration K (Plate IX); Brace T, (Plate V) which is essentially the same as illustration R (Plate IX); and Brace U (Plate VI) which is essentially the same as illustration E (Plate IX).

Of the eighteen illustrations in Questionnaire A, (Plate IX), six may be identified by name on the basis of majority identification by the respondents. These are:

1) Illustration R—*Taylor Spinal Brace.* Eight different names were given to this illustration. 98.5% of those responding referred to it as a Taylor Spinal Brace of some variant thereof.

2) Illustration B—*Taylor Crutch Spinal Brace.* Twenty-one different names were given to this illustration. 70.5% of the respondents gave a variety of the name Crutch to this appliance while 88.6% termed it a variety of the Taylor Spinal Brace.

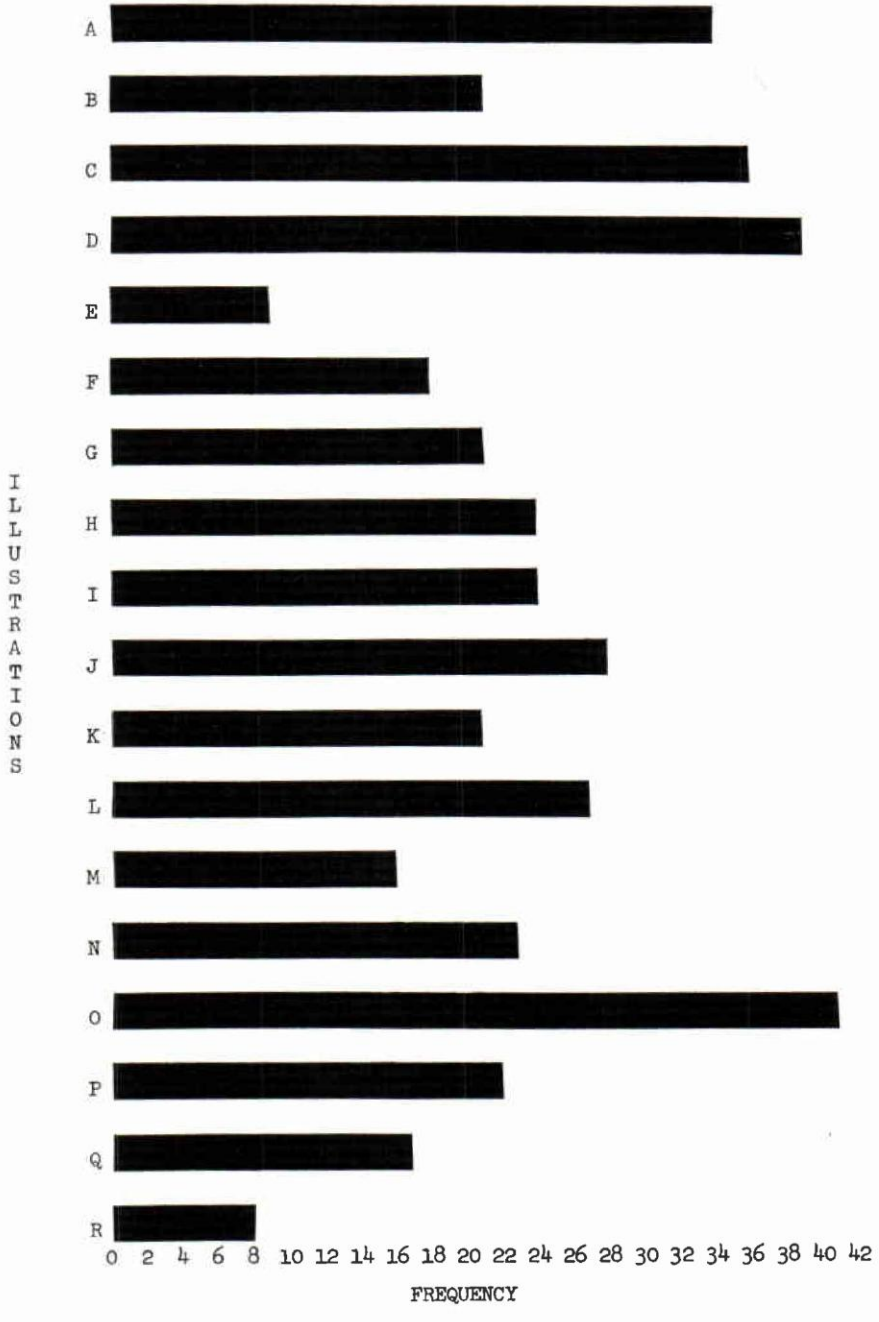
3) Illustration J—*Taylor Knight Spinal Brace.* Twenty-eight different names were given to the illustration of this appliance. 82.9% of those responding indicated that it was a variety of Taylor Spinal Brace while 55.3% indicated that it was a variety of Knight Spinal Brace.

4) Illustration A—*Knight Chairback Spinal Brace.* Though thirty-four different names were applied to this illustration, 45.8% of the respondents gave the name Chairback or some variant thereof and 34.6% gave the name Knight or some variant thereof.

5) Illustration K—*Williams Flexion Spinal Brace.* Twenty-one different names were applied to this illustration. 97.2% referred to it as a Williams Brace or some variant thereof, while 22.5% included the term Flexion in their name of this appliance.

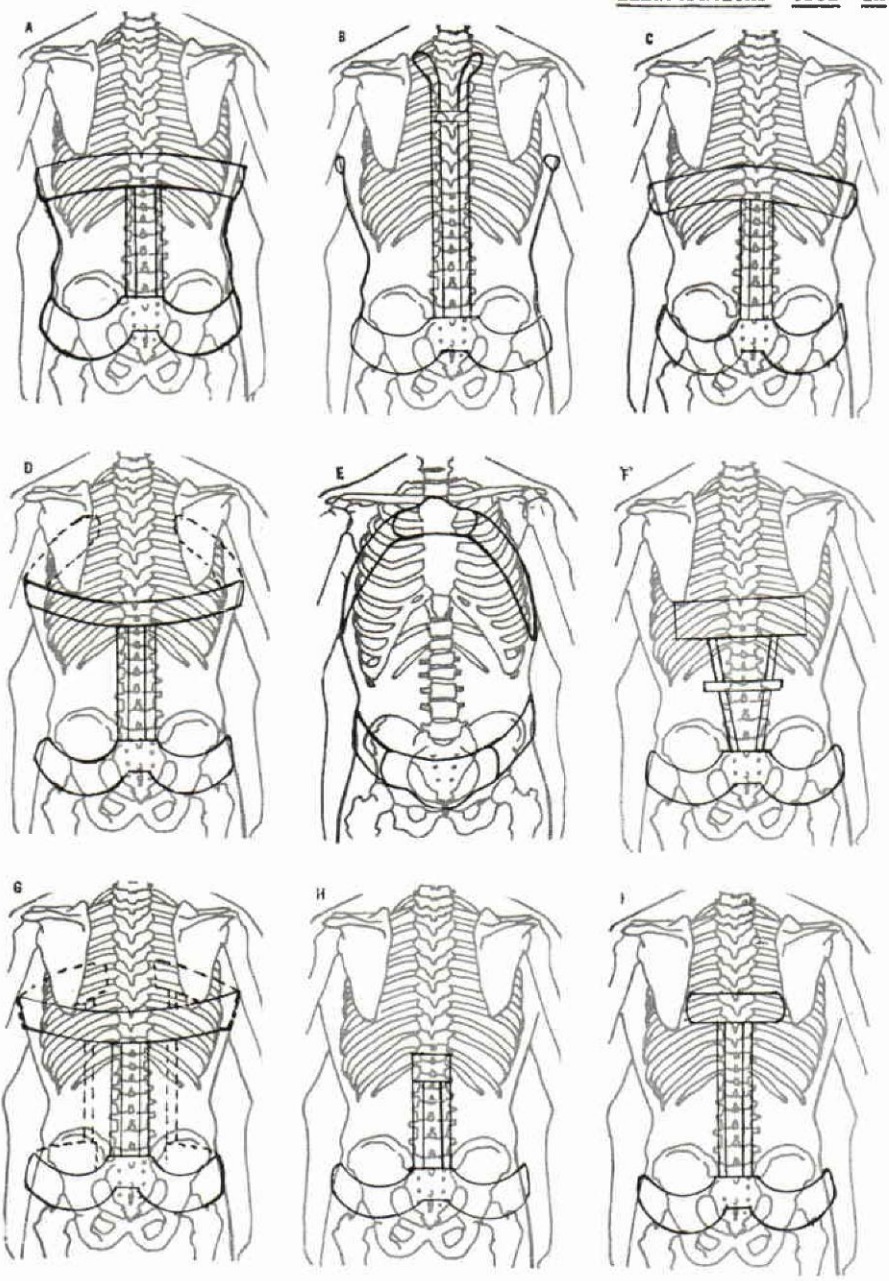
6) Illustration P—*Steindler Spinal Brace.* Twenty-two different names were given to the illustration of this appliance, however, 59.7% of those responding named it a Steindler Spinal Brace.

Table 16.—Summary of Responses to Spinal Orthotics Questionnaire A
Frequency of Spinal Brace Names Applied to Each Illustration



P L A T E

Illustrations Used in



I X

Questionnaire A: Spinal Orthotics

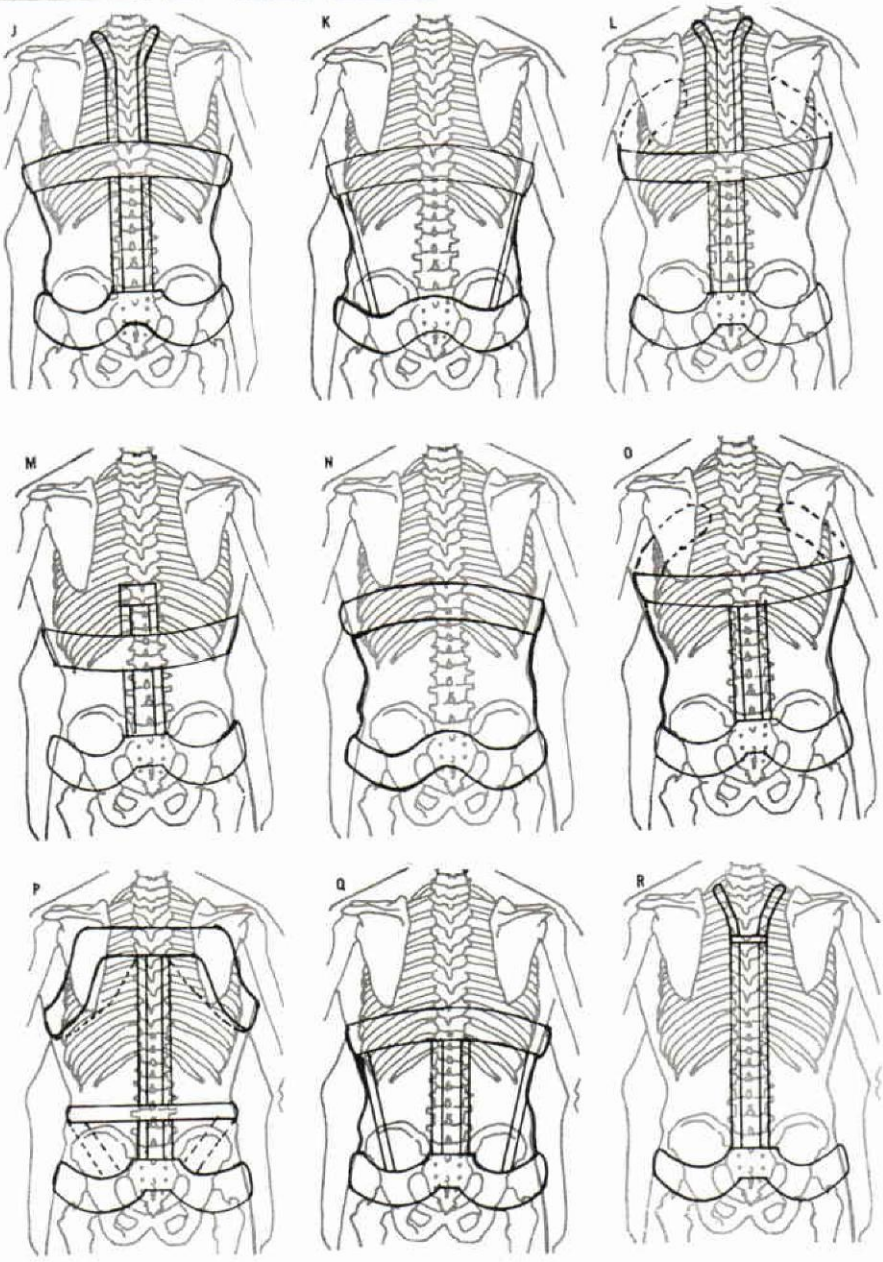


Table 17.—Summary of Responses to Spinal Orthotics Questionnaire A
Frequency of Different Illustrations being Identified with the Same Spinal Brace Name

Name of Spinal Brace	Illustrations A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	TOTAL 18
1. Knight	X	X	X	X		X	X			X	X		X	X	X		X	X	13
2. Chairback	X		X			X	X	X	X	X	X		X	X			X		11
3. Lumbosacral or Sacrolumbar	X		X	X		X		X		X	X			X	X		X		10
4. Modified Taylor	X	X	X			X			X	X	X	X						X	9
5. Modified Chairback	X		X	X		X							X	X	X	X	X		9
6. Low	X		X			X		X				X	X	X	X				8
7. Goldthwait	X		X			X	X	X	X		X								7
8. McCausland			X			X	X	X	X		X					X			7
9. Modified Knight			X				X							X	X	X	X		6
10. Hyperextension		X			X					X				X	X	X			6
11. Arnold				X	X		X					X			X	X			6
12. Taylor-Knight		X								X		X				X	X		5
13. Bennett	X		X				X					X				X			5
14. Magnussen	X			X			X								X	X			5
15. Steindler				X			X								X	X	X		5
16. Taylor		X							X			X						X	4
17. High Low or Hi Lo	X							X	X				X						4
18. Sacro-iliac	X		X					X			X								4
19. Crutch		X		X											X	X			4
20. Cowhorn				X								X	X		X				4
21. Dorsolumbar		X														X	X		3
22. Posture			X					X	X										3
23. Williams											X			X			X		3
24. Jewett					X	X													2
25. Baker or Lennox Baker			X						X										2
26. Flexion			X										X						2
27. 4-bar	X		X																2
28. 2-bar	X		X																2
29. High		X							X										2
30. Osgood						X		X											2

E. Lower Extremity Orthotics

Orthoses are now used in the treatment of lower extremity dysfunctions of four types and/or etiologies.

1) Neuro-muscular dysfunctions such as spasticity, flaccidity and athetosis
2) Congenital or acquired joint dysfunction, deformation or malformation
3) Fracture
4) Congenital fore-shortened and/or malformed limb segments

The armamentarium of components available for bracing these conditions consist of stylized structural supports and joints which are usually identified as:

Shoe Modifications
Foot Plates and/or Shoe Attachments
Ankle Joints and/or Locks
Knee Joints and/or Locks
Hip Joints and/or Locks
Pelvic Bands and Belts
Cuffs, Straps and Bands
Uprights and Twisters

Present practice is to fit these components to the contours of the individual patient utilizing stops, locks and controls as prescribed, (Plate X, Page 100. Each brace component is designed and prescribed to provide the support, control and/or freedom of movement necessary to the functional or dysfunctional requirements of the corresponding limb segment or joint. Using this premise as a point of departure it was agreed that major limb deficiencies of congenital etiology required fitting of a prosthetic nature and did not fall within the scope of the orthotics survey. Investigation of orthotic applications to lower extremity fractures was similarly omitted from this survey as stubborn non-union cases constitute the only group of leg fractures where bracing is used as standard treatment.

Thus, this portion of the orthotics survey was reduced to three general areas of inquiry.

1) The extent to which each facility is providing orthotic equipment (i.e., the number of initial and replacement units) for four major debilitating neuro-muscular syndromes: Paraplegia, Hemiplegia, Poliomyelitis and Cerebral Palsy
2) The extent to which each facility employs facility fabricated and prefabricated components and brace units
3) The components used for six key joint dysfunctions:
   Pes Varum
   Tibial Torsion
   Genu Valgum
   Genu Recurvatum
   Knee Flexion Contracture
   Legg-Perthes

Formal training courses in lower extremity orthotics became available to orthotists about six months prior to the field work for this report. It is felt that this report represents the state of lower extremity orthotic service prior to the availability of formal training and that a marked change in the practice of lower extremity orthotics may be expected within the next five years.

A total of 152 facilities provided data on lower extremity devices. An additional three reported that they do not fit patients with lower extremity problems.

Each of these 152 facilities reported fitting lower extremity orthoses to patients with *Paraplegia* during the preceeding twelve month period.

Patients with *Hemiplegia* were fitted with orthoses by 132 facilities, as shown in Table 18. This condition is being treated by the application of

COMPLETE FRAME

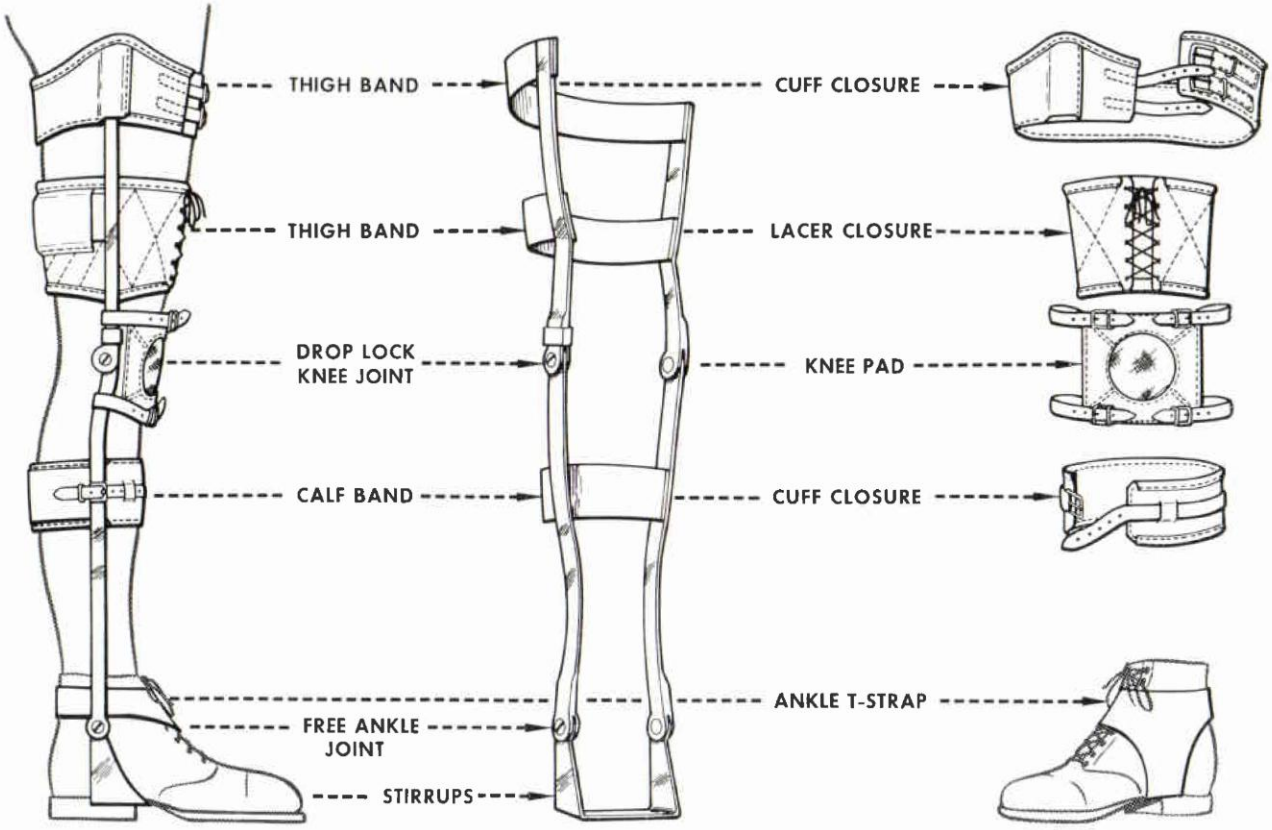


PLATE X

DIAGRAMATIC LONG LEG DOUBLE BAR BRACE WITH FREE ANKLE AND DROP LOCK KNEE JOINTS

lower extremity devices throughout the country. Application of upper extremity devices is more limited and is used with markedly lower frequency in the Mid-Atlantic states.

Table 18.—Facilities Reporting Types of Orthoses Prescribed and Fitted to Patients with Hemiplegia

Geographic Area	Upper Extremity Only	Short Leg Only	Long Leg Only	Upper Extremity & Lower Extremity
New England (17 Facilities)	7	15	14	13
Mid-Atlantic (15 Facilities)	6	13	14	2
South (23 Facilities)	16	23	23	18
Midwest (24 Facilities)	12	23	21	12
North Central (9 Facilities)	7	9	9	7
Rocky Mountain (7 Facilities)	7	7	7	5
Texas-Oklahoma (16 Facilities)	9	15	16	12
California (14 Facilities)	7	14	12	9
Pacific Northwest (7 Facilities)	6	7	7	6

One hundred forty-seven facilities estimated that they had fitted 8,265 polio or post-polio patients with lower extremity devices during the preceding twelve month period. This number represents approximately 1,090 patients receiving their first brace and 7,175 patients who were provided with replacement braces. One facility fitted as few as two patients during the year whereas another reported fitting 506. The frequency distribution of the number of lower extremity orthoses provided to patients with motor disabilities resulting from poliomyelitis revealed that approximately half of the facilities produced orthoses for less than 50 patients during the preceding year and that there was a progressive drop in the number of facilities serving larger numbers of patients.

The findings for private and institutional facilities are compared in Table 19. From this table it can be seen that the majority of lower extremity polio braces are fabricated by 11% of the facilities in this sample.

Table 19.—Estimated Number of Lower Extremity Orthoses Furnished for Polio and Post-Polio Patients

Number of of Units	Private Facilities	Institutional Facilities
0	5	0
1-24	43	5
25-49	25	5
50-74	17	3
75-99	8	1
100-124	14	2
125-149	3	1
150-174	3	—
175-199	—	—
200-249	7	1
250-299	1	—
300-349	1	—
350-399	4	2
400-449	—	—
450-499	—	—
500-549	1	—

Further analysis of these data by city size or geographic area revealed that the patterns for these subsamples were identical with the patterns for the entire sample.

One hundred and twenty-three of the 152 facilities that provide lower extremity orthoses reported cerebral palsy braces during the preceding 12 month period. One hundred and nineteen of them estimate that they had fitted 7,623 cerebral palsy patients. Two thousand, three hundred and ninety-seven of these were first fittings and 4,695 were replacements of old braces. Table 20 indicates the number of cerebral palsy braces fitted by each facility and clearly demonstrates that the majority of these orthoses are produced by comparatively few facilities. Many of the facilities reported that most of the cerebral palsy bracing in their city or state was done by one particular facility. Although most facilities do provide cerebral palsy braces on request, this is, to a large extent, considered as a specialized orthotic application.

Table 20.—Estimated Number of Lower Extremity Orthoses Furnished for Cerebral Palsy Patients

Number of Units	Private Facilities	Institutional Facilities
0	27	2
1-24	49	8
25-49	17	1
50-74	15	2
75-99	1	3
100-124	3	1
125-149	1	—
150-174	2	—
175-199	4	—
200-249	2	—
250-299	3	—
300-349	4	2
350-399	—	—
400-449	2	1
450-499	—	—
500-549	1	—
Over 1000	1	—

Eight types of orthoses were reported as being prescribed and fitted for cerebral palsy:

1) Phelps type braces: double long leg, semi-flexible supports which are designed to give during muscular spasm were reported in all areas. They are used most frequently in Mid-Atlantic, Mid-western, Rocky Mountain, Texas-Oklahoma and California areas (see Table 21). When considered in terms of geographic areas, these devices are the most frequent types reported for this application.
2) Newington braces: heavy rigid double long leg braces with pelvic band and spinal extensions (including scissoring attachments). They are designed to position and stabilize the limbs. Although this type of brace is reported in all areas they are seldom furnished in small cities. Moreover, in only four areas (the Midwest, North Central, Texas-Oklahoma and Pacific Northwest) do 25% or more of the facilities report using them.
3) Double long leg braces with drop or pin locks. The data provided by facilities described them as regular weight, conventional long leg braces with special knee locks. These braces are intermediate to the two preceding types. They were reported in all areas except Texas-

Table 21.—Lower Extremity Orthoses Reported for Cerebral Palsy: Percent of Facilities Reporting by Area and City Size

City Size	Phelps	Newington	Double Long Leg Drop Locks	Double Long Leg Pelvic Band	Single Long Leg	Double Long Leg	Short Leg	Torsion Bar or Twister
Large (49 Facilities)	32%	24%	26%	14%	—%	2%	6%	—%
Middle (42 Facilities)	33	22	24	13	4	2	6	—
Small (30 Facilities)	36	47	30	30	3	3	18	—

Geographic Area	Phelps	Newington	Double Long Leg Drop Locks	Double Long Leg Pelvic Band	Single Long Leg	Double Long Leg	Short Leg	Torsion Bar or Twister
New England (15 Facilities)	13%	7%	27%	7%	—%	7%	60%	—%
Mid-Atlantic (8 Facilities)	55	11	28	28	—	—	—	—
South (20 Facilities)	25	5	35	40	5	5	5	5
Midwest (23 Facilities)	31	26	26	18	4	4	9	—
North Central (9 Facilities)	22	44	67	—	—	—	11	—
Rocky Mountain (5 Facilities)	40	20	20	20	—	—	—	—
Texas-Oklahoma (15 Facilities)	54	33	—	20	—	7	7	—
California (10 Facilities)	50	10	40	—	—	—	10	—
Pacific Northwest (7 Facilities)	29	29	29	—	14	—	—	—

Oklahoma. From the nationwide point of view they are the second most frequently reported cerebral palsy brace type. In New England and the North Central areas they are the most frequent type.

4) Double long leg braces with pelvic bands and joints. Facilities also referred to these braces as complete control, conventional heavy duty, rigid full control, aluminum control, complete body control and heavy duty polio type braces. The intent of these braces is essentially similar to that of the Newington Braces. These braces are reported in six areas. They are most frequently used in the Mid-Atlantic and Southern states (28 and 40% respectively) and occasionally in the Midwest and Texas-Oklahoma region. They are seldom used in the New England and Rocky Mountain areas where this type of brace is usually prescribed as a Newington Brace.
5) Single long leg braces were reported by one facility in each of three areas (the South, Midwest and the Pacific Northwest). These are usually double upright braces with knee locks and spring type ankle locks.
6) Double bar braces were reported by one facility in each of four areas. This is actually a miscellaneous category as the braces were not described in detail.
7) Single and double bar short leg braces are the most frequently used type of device for cerebral palsy patients in New England. These braces are also reported by two Midwestern facilities and four facilities in four other areas. These types of devices are usually reported in small and middle sized cities.
8) One Southern facility reported fitting twisters to cerebral palsy patients.

One hundred of these facilities reported that they are providing night splints to cerebral palsy patients while twenty specifically stated that they do not, (Table 22). These devices include foot spreader bars of the Dennis

Table 22.—Percent of Facilities in Each Area Fitting Night Splints to Cerebral Palsy Patients

Geographic Area	No Patients were fitted	Some Patients were fitted	Patients were usually fitted
New England (15 Facilities)	47	40	13
Mid-Atlantic (18 Facilities)	—	56	44
South (19 Facilities)	10	68	21
Midwest (27 Facilities)	19	66	16
North Central (9 Facilities)	11	66	22
Rocky Mountain (5 Facilities)	20	60	20
Texas-Oklahoma (13 Facilities)	15	77	8
California (10 Facilities)	10	70	20
Pacific Northwest (4 Facilities)	25	75	—

Browne and 'A' frame types and short leg single upright braces with calf bands and ankle joints which are locked in the desired position.

One hundred-twenty of the 121 facilities that reported providing cerebral palsy braces supplied information describing their method of fabrication. Twenty-three stated that they make all their own parts, 77 use prefabricated parts and kits, while ten others follow both procedures. The data is broken down according to city size and geographic areas in Table 23. The typical procedure is to utilize prefabricated kits which means assembling stock

parts, bending the uprights and positioning the joints to fit the contours of the individual patient.

At least one facility in each area makes a complete custom brace; use of prefabricated parts was more frequently reported by the facilities that produced more than 100 units. The major exceptions to these generalizations are the Mid-Atlantic and Rocky Mountain areas where an equal or larger number of facilities make all or most of their own parts.

Table 23.—Fabrication Method for Cerebral Palsy Braces

a) DISTRIBUTION BY CITY SIZE

City Size	Fabricates All Components	Utilize Prefabricated Components	Utilize Both Components
Large (49 Facilities)	18	27	4
Middle (41 Facilities)	6	32	3
Small (30 Facilities)	9	9	3

b) DISTRIBUTION BY GEOGRAPHIC AREA

Geographic Area	Fabricates All Components	Utilize Prefabricated Components	Utilize Both Components
New England (15 Facilities)	4	9	2
Mid-Atlantic (18 Facilities)	8	8	2
South (20 Facilities)	5	14	1
Midwest (22 Facilities)	5	16	1
North Central (9 Facilities)	—	8	1
Rocky Mountain (5 Facilities)	3	2	—
Texas-Oklahoma (14 Facilities)	5	8	1
California (10 Facilities)	1	8	1
Pacific Northwest (7 Facilities)	2	4	1

Facilities were asked to name and/or describe the components which were used for fitting a prescription for each of the following six joint dysfunctions: Pes Varum, Genu Valgum, Genu Recurvatum, Tibal Torsion, Knee Contrature and Legg-Perthes.

One hundred and thirty-six facilities reported fitting ten or more patients with orthotic devices for *Pes Varum* during the preceding twelve month period.

A. *Night Splints* were reported by thirty facilities.

B. *Shoe Modifications* were reported by eighty-four facilities throughout most of the country. The exceptions occur in New England and the North Central states where only three of the twenty-two facilities reported using shoe modifications for Pes Varum. Four of the California firms reported the use of shoe modifications without additional supports. Two other facilities, one in the South and one in Texas, reported using night splints and shoe modifications as the orthotic treatment procedure being followed.

Eighty reported using heel wedges. Seventy-one of them also reported using sole wedges. Sixteen of this same group (of 71) also used Thomas heels. Nine reported using arch supports and seven reported using shoe reinforcing plates.

C. *Braces.*

1. Shoe attachments were described by ninety-four facilities. Twenty-four facilities reported using two types of shoe attachments and four others reported using three types. Stirrups were reported by more facilities in each area than any other type of attachment. (Stirrups, 60; Flat Caliper, 27; Caliper Points, 32.) Seven

facilities located in New England, Mid-Atlantic, Midwestern and California areas reported using Foot Plates with stirrups.

2. One hundred and one of the facilities described the types of ankle joints which they used. Sixty-nine reported using free ankle joints while twenty-six reported using spring loaded Klenzack joints.
3. 'V' or 'T' straps were reported by one hundred and fifteen facilities.
4. Upright components were described by one hundred and twenty-two facilities. Eighty-nine reported using double bar short leg braces while seventy reported using single bar short leg braces.
5. Of the four facilities reporting long leg braces, two use knee joints with drop locks, one uses Klenzack joints and one reports using a bale lock.

One hundred and thirty-seven facilities reported that they had fitted ten or more patients with orthotic devices for *Tibial Torsion* during the preceding year.

A. *Night Splints* were the only devices provided for Tibial Torsion by eight of the facilities. An additional three utilized heel and sole wedges in addition to the night splints. Seventy-five facilities reported that they were requested to furnish both diurnal and nocturnal devices. The fifty-one other facilities had not been requested to furnish night splints for Tibial Torsion patients during the preceding year.

B. Prescriptions calling for *Shoe Modifications* were carried out at fifty of the facilities. Forty-eight reported using sole wedges, forty-one of these forty-eight and the two remaining ones use heel wedges. Eight also used Thomas heels, two in combination with heel wedges, one with a sole wedge and five with both.

C. *Braces.*

1. Upright components were reported by 126 facilities which used them for tibial torsion. Cable twisters and/or elastic strap twisters were reported by one hundred and three facilities. Short leg or below the knee units were reported by six facilities. Long leg or single and double vertical supports from the ankle to the knee and from the knee to the hip joints were reported by twenty-seven facilities.
2. Information describing other components of these devices was not routinely recorded.

One hundred and thirty-seven facilities reported that they had fitted ten or more lower extremity devices to patients with *Genu Valgum*, the preceding year.

A. *Night Splints* are regularly provided by only fifteen facilities inincluding: four in California and four in the Midwest, two in the South, Rocky Mountain area and Texas-Oklahoma, and one in New England. In all cases night splints are reported as being used in connection with braces.

B. *Shoe Modifications* were reported by twenty-three facilities located in the following regions of the country: New England, the South, the Midwest, Texas-Oklahoma and California.

C. *Braces.*

1. Shoe attachments were described by ninety-seven facilities. Stirrups were reported by sixty-six facilities in all areas of the country, caliper points by twenty-four in all areas except the

Rocky Mountain states, and split stirrups were reported by eleven (three each in New England and the South, two in the Midwest and one each in the Mid-Atlantic, California and Pacific Northwest areas). Foot plates with stirrups were reported by eight facilities, five in New England and one each in the Mid-Atlantic, South and Midwest areas.

2. Upright components were described by one hundred and thirty-six facilities. Double bar long leg braces were reported by seventy-three facilities in all areas except the Rocky Mountain states. Single bar long leg braces were reported by fifty-five facilities located in all areas. Long leg braces with a single lateral A/K bar and double B/K bars were reported by twenty-two facilities located in all areas except the North Central states.
3. Ankle joint data was furnished by one hundred and one facilities. Free joints were reported by eighty-two facilities, caliper points by twenty-four. Klenzack and gastroc or pretibial assists were each reported by one facility and eight facilities reported using no ankle joints.
4. Knee joint data was furnished by one hundred and sixteen facilities. Seventy-six facilities reported that some or all of their braces for genu valgum do not have knee joints. Thirty-seven facilities located in all areas of the country use drop locks and eighteen others use spring drop locks. Eighteen facilities located in areas other than New England and the Mid-Atlantic states reported using free joints.

One hundred and twenty-six facilities reported fitting at least ten lower extremity orthoses to patients with *Genu Recurvatum*. Braces were described by one hundred and twenty-four facilities and one other stated that his facility was directed to provide elastic knee caps with lateral uprights to patients with this condition.

A. *Night Splints* were reported by only four, widely dispersed facilities (one in the Mid-Atlantic, South, Midwest and North Central states).

B. *Shoe Modifications* were reported by only two facilities.

C. *Braces.*

1. Shoe attachment data is available from eighty-four facilities, but little of this information was recorded for the four Westernmost areas. Stirrups were reported by sixty-two facilities. Split stirrups were reported by eighteen facilities, caliper points by sixteen facilities and foot plate with stirrups by five facilities.
2. Upright components were described by one hundred and sixteen facilities of which one hundred and thirteen reported long leg bar braces.
3. Ankle joints were described by ninety-two facilities. Their distribution does not permit geographic analysis. Free ankle joints were reported by seventy-four, caliper points by sixteen, spring loaded joints by nine and no ankle joints were utilized by three.
4. Knee joints were described by one hundred facilities. Free knee joints were reported by sixty-two facilities in all parts of the country. However, only twenty-two of the facilities in both the North Central and Rocky Mountain areas reported using this type of device. Whereas, forty-six to one hundred percent of the facilities in the other seven areas use them. Knee joints with drop locks were reported by forty-eight facilities located in all parts of the country. More facilities in New England, Mid-

Atlantic, North Central and Rocky Mountain states reported using drop locks than any other type of knee lock for this brace type. Knee joints with spring drop locks were reported by two of the above fifty facilities and three others. Other knee units reported include:

Bale locks, variable position locks, knee corsets, plunger locks and Klenzack locks.

5. Hyperextension blocks were reported as being used in genu recurvatum braces by twenty-seven facilities. Approximately fifty percent or more of the Texas-Oklahoma, Rocky Mountain, Pacific Northwest and North Central facilities use them.
6. Bands and straps were reported by eighty-seven facilities. Thorough information describing all of the band and strap components was reported by less than half of the facilities, back knee straps were reported by sixty-one facilities representing all parts of the country. Calf bands were reported by fifty-eight, eight using two bands and fifty using one. Thigh bands were reported by fifty-five, thirty-six using two and nineteen using one thigh band; twelve others also reported using thigh lacer and three thigh sling straps.

One hundred and twenty facilities reported they had fitted patients with *Knee Flexion Contracture* in excess of fifteen degrees during the preceding year. One hundred and eight provided some descriptive data for these orthoses.

A. No *Night Splints* were reported though it was understood that some of the other devices described were to be fitted and worn in a recumbent position.
B. *Shoe Modifications.* Shoe build-ups were reported by ten firms in the Eastern portion of the country.
C. *Braces.*
   1. Shoe attachments were reported by sixty-four facilities, primarily located in the Eastern two-thirds of the country.
   2. Upright components were described by one hundred and three facilities. Long leg double bar braces were reported by ninety-eight. Long leg single A/K bar and double B/K bar braces were reported by two others. A long leg single bar brace was reported by one and short leg double bar braces by two.
   3. Knee joint data was reported by ninety-five facilities, three of which do not use knee joints and seven which employ free knee joints. Seventy facilities reported using variable position lock while the drop lock was reported by thirty-one facilities. Turnbuckles were reported by twenty-four and serrated disc by one facility.
   4. Ankle joints reported include seventy using free joints, eleven using caliper points, seven using spring loaded Klenzack, two using serrated disc and two reported using gastrocnemius or pretibial assist. Three did not use ankle joints.
   5. Bands and straps were not reported in a uniform fashion. The indications are that a typical knee flexion contractural brace includes: one calf band and two thigh bands (or a thigh lacer) and a knee cap pad.

One hundred and fifty-three facilities reported they had fitted *Legg-Perthes.*

Eighteen facilities reported they had been called upon to furnish patients with a Perthes sling and crutch only.

Sixty-two others reported that some of their patients had been furnished a Perthes sling.

One hundred and nine facilities fitted orthotic devices which were non-weight bearing braces without ankle joints including either a lock knee or no knee joint and with an elevation added to the opposite shoe. Twenty-five of these facilities applied traction to the shoe; eight of these facilities also used caliper points in some of their Legg-Perthes braces.

Ninety-two reported using long leg double bar braces with metal ischial ring. Twelve reported using long leg double bar braces with ischial band. Four reported using long leg double bar braces with ischial cuff. Five reported using long leg double bar braces with quadrilateral socket for ischial weight bearing. Five others stated they used long leg double bar braces without any ischial weight bearing.

In regard to knee joints fifty-two reported using no knee joint while fifty-four reported using a knee joint with a drop lock.

One hundred and forty-nine facilities provided information describing their methods of fabricating lower extremity orthoses for Pes Varum, Genu Valgum, Genu Recurvatum, Tibal Torsion, Knee Contracture and Legg-Perthes.

Only eight facilities reported fitting prefabricated braces. Two of these eight use prefabricated braces one to five percent of the time; one about fifteen percent; three about fifty percent and two always use prefabricated units. Four facilities that reported using prefabricated braces fifty percent or more of the time are located in New England. The remaining four are dispersed throughout the country.

Uprights are usually prefabricated. Eighty-seven facilities reported using only prefabricated uprights; ten used them from seventy-five to ninety-six percent of the time: thirteen used them fifty to seventy percent of the time and seven others used them from five to twenty-five percent of the time. The remaining thirty-one facilities reported that they make all of their own uprights. The pattern of these practices are generally identical throughout the country. The Southern states contain the highest percent of facilities that make all their own components; approximately half of the New England facilities make fifty percent or more of their own components and generally speaking most facilities in the North Central states use prefabricated parts some of the time, but two of the eight reporting make their own components for some cases.

Locking knee joints are fabricated by fifty-five of the facilities. Six of them use prefabricated parts from five to ninety-five percent and an additional ninety-three facilities always use prefabricated locking knee components.

Locking ankle joints are made by only fourteen facilities. This refers to five facilities which make all their own; seven which fabricate fifty percent of their locking ankle joints and two which make eighty and ninety percent respectively. One hundred and thirty facilities use only prefabricated locking ankle joints.

Free ankle joints are made by sixty-six facilities, forty-one of which make all their free ankle joints at the facility. In addition to the eighty-three facilities who use only prefabricated free ankle joints; seven use from eighty to ninety-five percent prefabricated joints; fifteen utilize them fifty to seventy percent of the time and three others use them ten to twenty percent of the time.

Caliper points are always made by fifty-four of the facilities while eighty-six reported that they always use prefabricated ones. Of the remaining

eight, five made their own fifty percent of the time and three made them from seventy-five to ninety percent of the time.

F. Upper Extremity Orthotics

In the planning stage, it was decided that the complexity of upper extremity orthotics meant that the survey would have to limit its scope in this category. Since the type of training with each orthotist received determined his later practice this was selected as the area to be studied.

At the time the field work for this survey was undertaken (May, 1962) upper extremity orthotics was the only orthotic subject matter area which had been presented (for a reasonable period of time) through one of the OVR sponsored educational programs.

The course, "Functional Bracing of the Upper Extremities," was first offered in 1958 by the University of California, Los Angeles. According to a recent tabulation (July 1, 1962) ninety-one orthotists who have completed the program are practicing at the present time. Their distribution throughout the United States, as shown in Table 24, indicates that this type of service is available in every geographic area.

Table 24.—Georgraphic Distribution of Orthotists Completing UCLA Course in Upper Extremity Orthotics

Geographic Area	Orthotists
New England	4
Mid-Atlantic	12
South	15
Midwest	14
North Central	9
Rocky Mountain	10
Texas-Oklahoma	7
California	14
Pacific Northwest	6
Total	91

Training in upper extremity orthotics has also been made available through the Georgia Warm Springs Foundation and Rancho Los Amigos Hospital as well as through American and European apprenticeship programs. Recently developed procedures such as those of Baylor University, the University of Michigan, etc., have not yet reached the general public.

One hundred and fifty facilities have information regarding the fitting of upper extremity orthotic appliances. This group estimated that they had fitted 8,160 appliances for upper extremity disabilities during the past twelve months. The distribution of this production in relation to training is shown in Table 25.

Table 25.—Relation of Training in Upper Extremity Orthotics to Number of Units Provided

(Number of Facilities Reported)

Training	0	1-24	25-49	50-99	100-199	200+	Total
UCLA Course	—	7	7	6	9	1	30
Georgia Warm Springs	—	1	2	1	—	1	5
Rancho Los Amigos	—	4	1	—	—	—	5
American or European Apprenticeship	9	37	29	20	8	7	110
Total	9	49	39	27	17	9	150

Over a third of the reporting facilities indicated that they fitted less than twenty-five units in the past twelve months. Further analysis was made of those facilities reporting that they fitted less than fifteen units (Table 26). Fifteen facilities did not give useable information; eleven indicated that another local facility was providing this service while twelve stated that the physicians in their area were not prescribing appliances for upper extremity disabilities. Of this latter group three facilities were located in the New England area; two in the Mid-Atlantic area; four in the South; two in the Midwest; and one in the Rocky Mountain area.

With formal training available in upper extremity orthotics, the one hundred and ten facilities which had not availed themselves of this opportunity were asked to give their reasons for not attending these courses. The majority indicated that the training programs were too costly both in terms of expense and time lost from the facility or that their facility was not large enough to consider providing upper extremity appliances. A third of the

Table 26.—How Upper Extremity Appliances are Provided in Areas where where Facilities Reported Fitting Fifteen or Less Units

Training	Provided by Another Facility Locally	Provided in a Local Institution	Not Prescribed	No Answer	Total
UCLA Course	—	—	1	2	3
Georgia Warm Springs	—	—	1	—	1
Rancho Los Amigos	—	—	1	1	2
American or European Apprenticeship	7	4*	9	12	32
Total	7	4	12	15	38

* Two facilities reported that an Occupational Therapist was fitting these appliances.

answers indicated that fabricating and fitting of upper extremity appliances was not economically worth-while. The remaining group gave a variety of non-responsive answers which could not be tabulated.

Conclusions

1) Orthotic services are readily available throughout the United States. There is no need for a patient to be denied the benefits of an orthopedic appliance due to the lack of adequate service for the fabricating or fitting of appliances. However, there is a growing need for trained personnel in the field of orthotics at both the fitter and shop worker level. In the past two to three years, the persons entering the field of orthotics are just replacing those leaving the field through death, retirement or other reasons. The result is that less well trained individuals are being called upon to accept more responsibility than is warranted for sound patient care. With the population increase, this situation is serious today and could become critical within the next decade. In addition, though there has been a drop in the incidence of paralytic poliomyelitis, other conditions requiring bracing are on the increase. These seem to be of a more serious nature, relatively, as they are often complicated by age, mental damage, and impairment of systems other than the musculo-skeletal.

2) Orthotic services available throughout the United States varies greatly. This does not mean that the quality of service is less in one geo-

graphic area than in another. This survey had no yardstick to measure quality; in fact, no known yardstick of orthotic quality exists. The reason for this variety of service seems to be the result of the physician-orthotist relationship in which the physician is his own authority for the appliances fitted to his patients during their treatment process. Thus, even within the same locale, patients with the same disability are fitted with markedly different appliances.

3) Physicians of many specialties seem to take more interest in the prescription of orthotic devices than they do of prosthetic appliances. The reason for this is that the patient requiring an orthotic device is generally involved in a continuing treatment program while the amputee is not. In addition, the care of the amputee seems to have gravitated to a few medical specialities. This does not mean that the quality of orthotic prescription is better than that of the prosthetic prescription. In fact, the very opposite seems to be the case. Numerous orthotists reported that not only must a brace name be given in an appliance prescription, but also the prescribing physician's name, so that the anticipated appliance will be fitted. The consequences of such practice are most apparent in today's world with the mobility of patients, physicians and orthotists.

4) The initial prescription for orthotic appliances generally comes from a physician who may consult with representatives of other disciplines prior to writing the prescription. This does not imply that orthoses are prescribed by clinic teams, in the formal sense. The orthotist may be consulted prior to issuing a prescription depending on the physician, the condition being treated, and the reputation of the orthotist.

5) Prescriptions for replacement appliances are routinely required for patients whose conditions are not static, such as, children, geriatric patients, and patients with progressive disabling conditions. Appliances for patients with stabilized conditions may be provided without prescription, though there is a strong feeling among orthotists that prescriptions are desirable in all cases.

6) For the four cervical conditions studied during the survey, all six of the devices illustrated in Plate I were reported as being fitted for each condition.

7) For the seven spinal and trunk conditions investigated, appliances resembling illustrations Q and T (Plate II and V) were mentioned with sufficient frequency that they appeared in tabulations for six of the seven conditions, and that for five of the seven conditions both appliances were listed.

8) From a study of reply data it is obvious that the names of spinal and trunk appliances are most usually based on the name of the person associated with the development of the appliance. In few instances is the name of the appliance based on the anatomical structure with which it is associated or the function it is supposed to perform.

9) Corsets, as a class of appliance, were reported for six of the seven spinal and trunk conditions. This finding indicates that they are an important segment of the practice of orthotics. Shoes, also, seem to be an increasingly important segment of the practice of orthotics.

10) There is a definite trend toward the use of prefabricated parts in the fabrication of orthotic devices, however, many parts are still made by hand. There is a less definite trend toward the fitting of prefabricated appliances. The majority of facilities which participated in this survey fabricate or are capable of fabricating all of the necessary components for the appliances they fit.

Recommendations

1) Definite steps must be taken to offer training for all levels of personnel within the orthotic facility. This training should begin with the basic facts now known regarding anatomy, physiology and kinesiology; mechanics; materials; etc. The beginnings of such courses in orthotics are already available in the existing prosthetic courses. Courses should begin on a vocational, practical level and progress, in time, to the pre-vocational and post-graduate levels.

2) The physician must be included with the orthotist in any educational programs because the training the orthotist receives is for naught unless the physicians with whom he works avail themselves of his knowledge and ability. With this, it should be recognized that the relationship between physicians and orthotists must be brought to a higher, more professional level, so that the patient may receive the best service possible in both the medical and mechanical senses.

3) Projects should be undertaken that would resolve the differences within the field of orthotics. Immediate attention must be given to the terminology used to refer to appliances so that a system of communication can be developed throughout the United States. In this, the cooperation of both physicians and orthotists is extremely necessary.

4) The diversity of approach in the fitting of spinal and trunk disabilities, plus the numerous modifications in existing appliances reported, indicates that detailed research in the areas of bio-mechanics and patho-mechanics of the spine and trunk is necessary so that devices may be prescribed and designed to provide the desired function for the individual patient.

5) The diversity of approach to the treatment, i.e. bracing, of lower extremity conditions indicates a need for broad studies of specific problems in relation to bracing rather than further study of lower extremity bracing per se.

6) New techniques and methods are being developed by individuals in the field which need to be identified and evaluated. During the survey many devices or methods were found which have been developed, are being prescribed by physicians and used locally with success. Through lack of adequate communication these are not being placed in their proper perspective and evaluated. Means should be made available to utilize this resource to its fullest.

7) The diversity of fabrication practice, from the custom-made device, to the fitting of prefabricated devices, must be studied to determine the best method for serving patients. This study should include not only methods of fabrication, but also materials and their application in reducing costs and, at the same time, increasing the service of appliances.

8) Further study of methods for increasing production in the event of a national emergency is indicated since more than half of the reporting facilities are located in prime target areas and would be rendered useless in any large scale emergency.

References

1. Nattress, L. W., Lecture notes for course in *History of Prosthetics and Orthotics*. University of California at Los Angeles, 1958.
2. Litt, B. D. and Nattress, L. W., *Prosthetic Services U.S.A.*, American Orthotics and Prosthetics Association, Washington, D. C., October, 1961.
3. Storrs, R. A., Private communication, 1962.

4. GLUSHIEN, A. S., ET AL., *Proceedings of the First Annual Symposium on Orthopedic Appliances*, Orthopedic Appliance and Limb Manufacturers Association, Washington, D. C., 1948.
5. *Impairments by Etiology and Activity Limitation*, Health Statistics, Series B-35, U. S. Department of Health, Education, and Welfare, Washington, D. C., July, 1962.
6. WILSON, A. B., and NATTRESS, L. W., *Report of the Pilot Study, "Survey to Determine the State of Services Available to Amputees and Orthopedically Disabled Persons,"* The Committee on Advances in Prosthetics, American Orthotics and Prosthetics Association, May, 1960.
7. *Orthopaedic Appliance Atlas*. Vol. I, "Braces, Splints, Shoe Alterations", The American Academy of Orthopaedic Surgeons, J. W. Edwards, 1952.
8. VON WERSOWETTZ, O., "Basic Principles of Lower Extremity Bracing," *American Journal of Physical Medicine*, 41-4:156, 1962.
9. BOLDRAY, E., "Immobilization of the Cervical Spine," *Surg. Gyn and Obstetrics*, 80-1:106, 1945.
10. PERRY, J. and NICKEL, V., "Total Cervical Spine Fusion for Neck Paralysis," *J. of Bone and Joint Surgery*, 41:37, 1959.
11. GOLDTHWAIT, J. E., ET AL., *Body Mechanics*, J. B. Lippincott & Co., 1937.
12. WILLIAMS, P. C., "Lesions of the Lumbosacral Spine—Lordosis Brace," *J. of Bone and Joint Surgery*, 19:702, 1937.
13. BAKER, L. D., "Rhizomelic Spondylosis," *J. of Bone and Joint Surgery*. 24:829, 1942.
14. JEWETT, E. L., "A Light Hyperextension Back Brace," *J. of Bone and Joint Surgery*, 19:1128, 1937.
15. BLOUNT, W. P., SCHMIDT, A. C., ET AL., "The Milwaukee Brace in the Operative Treatment of Scoliosis" and "Making the Milwaukee Brace," *J. of Bone and Joint Surgery*, 4:511 & 526, 1958.
16. *Geographic Divisions and Large Metropolitan Areas*, Health Statistics, Series C-6, U. S. Department of Health, Education and Welfare, Washington D. C., March, 1961.
17. *United States Census of Population*: 1960. *United States Summary*, Final Report PC (1)—1A, U. S. Government Printing Office, Washington, D. C., 1961.
18. Guilford J. P., *Fundamental Statistics in Psychology and Education*. McGraw-Hill, 1950.

Study of Rehabilitation of Chronically Ill Planned

The Department of Physical Medicine and Rehabilitation of the New York Medical College has announced a two-week course on "Rehabilitation of the Chronically Ill Patient," which is scheduled for April 22 through May 3, 1963, at the Bird S. Coler Hospital, New York City.

This course is planned to provide a broad review of the principles, techniques and problems involved in the rehabilitation care of the chronically ill patient. It will consist of lectures, seminars, clinical demonstrations and practice workshops, and will include the contributions of the various disciplines to the rehabilitation process. The teaching staff includes members of New York Medical College, professional staff of the Medical Center and noted guest lecturers. A tuition fee of $150 will be charged for the course.

For further information, write to:

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PRESIDENT FILLAUR REPORTS ON AOPA's REGIONAL MEETINGS

The American Orthotics and Prosthetics Association each spring presents a series of Regional Meetings devoted to new developments in orthotics and prosthetics. These meetings are the responsibility of the eleven National Directors of the Association, whose photographs appear on the cover of this issue of our *Journal*.

In recent years these meetings have won recognition as outstanding educational activities of the Association—of benefit not merely to members, but to all who are concerned with the orthopedically handicapped.

The meetings are open to physicians, therapists, rehabilitation workers generally. Members of the Association under the leadership of their eleven Directors put in many hours of preparation on the programs. The speakers are drawn from the medical profession and from the research and educational activities at the Northwestern University, New York University, and the University of California at Los Angeles.

Since many readers of the *Journal* will want to include one or more of these meetings in their schedule for travel, I am listing them here in chronological order, including (for the record) those meetings already held.

March 22-23—Region IX program at the Cockatoo Inn, Hawthorne, California (a suburb of Los Angeles). Mr. Charles D. Neal of Los Angeles, is Regional Director, Mr. Kenneth Dodd of Santa Monica is Vice-President, and Mr. L. Benson Marsh of Sierra Madre is Secretary-Treasurer.

The program included a demonstration of casting techniques by personnel of the University of California at Los Angeles, Prosthetics Education Program. Dr. Jack Armold, Director of Prosthetic Education of Northwestern University discussed ethical considerations of our profession. The National AOPA was represented by Executive Director Lester A. Smith. Mr. Drury Davis, Insurance Advisor to the Association, attended, as did leading orthopedic and prosthetic suppliers throughout the United States.

Business procedure in the management of the orthotic and prosthetic facility was discussed by Dr. Kenneth Johnston, Assistant Professor of Accounting, Graduate School of Business of Northwestern University.

March 31—Region X presented a technical session at the Cabana Motor Hotel in Palo Alto, California. Dr. J. M. Morris of the Biomechanics Laboratory, University of California Medical School, discussed the Role of the Trunk in Stability of the Spine. A report on AOPA's Technical Mission to Europe was given by Executive Director, Lester A. Smith.

The officers of the Region include Mr. Herbert Hart, who is also our National Vice-President, Mr. Arthur Craig of Modesto, and Mr. Walter Koniuk of San Francisco.

April 5-7—Region VIII has scheduled a program in the Baker Hotel in Dallas, Texas. Speakers include: Mr. John Bray, Prosthetist, on the staff of the University of California at Los Angeles, demonstrating the Total Contact Socket Techniques and presenting a program on Long Leg Bracing; Mr. Ambrose Reiter of Northwestern University School of Business on the interpretation of Financial Statements; and Dr. Jack Armold of Northwestern University on Ethical Consideration in Orthotics and Prosthetics Practice.

The officers of this region include President David C. McGraw of Shreveport, Louisiana, Vice-President Charles Kymes of San Antonio, and Secretary-Treasurer Walter T. Benedict of Corpus Christi, Texas.

April 18-21—Region V will meet at the Pantland Hotel in Grand Rapids, Michigan. This Region covers the states of Michigan, Ohio, and West Virginia.

The tentative program includes Management of the Juvenile Amputee, Friday, April 19; Prosthetics, Dr. George T. Aitken and Dr. Charles D. Frantz; Orthotics, Dr. James A. MacDoonell and Dr. Alfred B. Swanson; Ethical Considerations in Business Aspects of Prosthetics-Orthotics, Saturday, April 20, Dr. Jack Armold; and Business and Administrative Procedures in Prosthetics-Orthotics, Saturday, April 20, Dr. Kenneth Johnston. Other programs are being arranged.

The officers of the Region are D. R. Coon of Detroit, President; Bart Crowley of Akron, Ohio, Vice-President, and Secretary-Treasurer Cletus Iler of Saginaw, Michigan.

April 26-28—Region III will meet at the Roosevelt Hotel in Pittsburgh, Pennsylvania. This Region includes the states of Pennsylvania, Maryland, Virginia, and the District of Columbia. Alfonse Glaubitz, Head of the State Hospital for Crippled Children, of Elizabethtown, Pennsylvania is Program Chairman. The program includes: New Developments in Lower and Upper Extremities presented by the Prosthetic Staff from New York University; The Dynamics of the Chest, Spine, and Abdomen as related to Orthotics—Dr. Robert D. Keagy, of Northwestern University; The Total Contact Knee Socket—by the Prosthetic Staff of New York University; and Professional Ethics by Dr. Jack Armold of Northwestern University.

The Pennsylvania Orthopedic and Prosthetic Society will meet jointly with AOPA Region III for this session.

Officers of the Pennsylvania Society are President Alfonse R. Glaubitz, Vice-President Gene E. Watters, and Secretary-Treasurer Joel Kalas.

The officers of Region III are: Louis Pulizzi, President, Charles Dankmeyer of Baltimore, Vice-President, and Gene Watters, Secretary-Treasurer.

May 3-4—Region I meets at the New Charterhouse Motel in Cambridge, Massachusetts. This Region covers all six New England states.

Mr. John Buckley of Providence is Program Chairman and Mr. Herman Kraus of Boston is in charge of arrangements.

The program will feature a number of comprehensive seminars comparable in format to the instructional lectures at the meeting of the American Academy of Orthopaedic Surgeons. Program features planned include a panel on the Future of Orthotics and Prosthetics as a profession, the Norton-

Brown Spinal Bracing Research Program, Prosthetics Program from the staff of New York University.

May 10-12—Region IV meets at the Kentucky Hotel at Louisville, Kentucky. Region IV is roughly comparable in extent to the states of the old Confederacy excluding Virginia and ending at the Mississippi River.

Mr. Ralph Snell of Nashville, Tennessee and Mr. Herbert Luckett of Louisville are joint Program Chairmen.

The Program includes: A presentation of Congenital Cases fitted with appliances of the Shrine Hospital of Lexington, Kentucky, and Professional Ethics, a presentation by Dr. Jack Armold of Northwestern University.

The officers of the Region are: President Louise Gillespie of Pensacola, Florida. Vice-President W. A. McElduff, Asheville, North Carolina, and Secretary-Treasurer Moody Smitherman, Birmingham, Alabama.

May 18-19—Region VII the Mid-Western States, will meet at Omaha, Nebraska, at the Town House. Donald Bohnenkamp is Program Chairman.

The officers of the Region are: Erich Hanicke, Regional Director; Donald Bohnenkamp of Omaha, Vice-President; and Mrs. Betty Hanicke, Secretary-Treasurer.

The Program for this Regional Meeting includes the following: Diseases of the Bone as related to Orthotics and Prosthetics by William Kernahan, M.D. of Chicago; Shoes and their Modifications by Mr. Charles Fryer of Northwestern University and Erich Hanicke of Kansas City; and Business and Administrative Procedures in Prosthetics and Orthotics—Dr. Kenneth Johnston of Northwestern University.

May 24—Region II will meet at the Waldorf-Astoria Hotel in New York City. This is a joint meeting of Region II covering the states of New York and New Jersey, and the Metropolitan Orthopedic Appliance and Limb Manufacturers Association.

Mrs. Mary Dorsch, the Regional Director, reports that Mr. Jack Gold of Newark is Program Chairman.

This meeting will feature a series of panels made up of the experienced members of the Association in the metropolitan area. Mr. William Spiro will be moderator for the first panel, devoted to Orthotics. Mr. Fred Eschen of New York City is to be moderator for the Prosthetic panels series. The annual Banquet and Dinner Dance of MOALMA will be the final event of the one day session.

June 7-9—Region XI will meet at the Ridpath Hotel in Spokane, Washington.

The officers of this Region are: William Bartels, of Portland, Oregon, Regional Director; Jack B. Meredith of Spokane, Vice-President; and Robert E. Lebold, of Salem, Oregon, Secretary-Treasurer.

Roy Snelson, of Rancho Los Amigos and the University of California at Los Angeles staff will present a Technical Session. Other details will be announced in the AOPA *Almanac* for May.

June 14-16—Region VI Meeting, covering the states of Illinois, Indiana, Wisconsin, and Eastern Missouri, will be held at the Wagon Wheel Lodge, in Rockton, Illinois.

The officers of the Region are: William Scheck, Regional Director; John DeBender, Vice-President; and Alfred Dennison, Secretary-Treasurer.

The Program includes: Medical Law in the Field of Orthotics and Prosthetics, presented by Frank Karaba, Attorney at Law, Chicago, Illinois; Congenital Classifications by Dr. Claude Lambert of Chicago; Medical Aspects of Scoliosis by Dr. Raymond Pellicore; Functional Long Leg Brace by Mr. John Bray; and Business and Administrative Procedures by Messrs. Frank Karaba and Ambrose Reiter.

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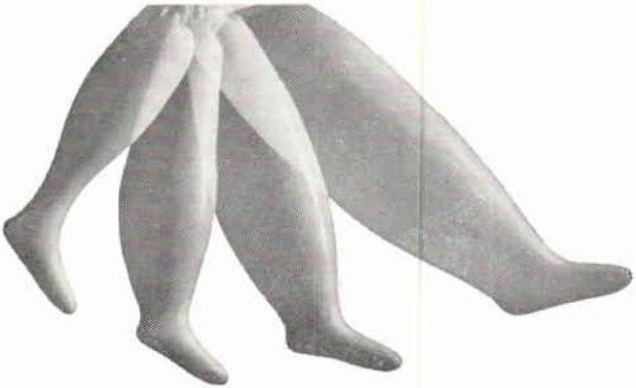

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Mrs. Esther Pava
Vice President

Mrs. Ted W. Smith
Secretary-Treasurer

Mrs. Lorraine Scheck
Past President

DEAR AUXILIARY MEMBERS:

With the Phoenix meeting in the past and now just pleasant memories, we turn to the business of our organization.

Our first business meeting was held on October 14, in the Ramada's Arcade Room. Discussion was held on acquiring a definite goal for our group and each member was asked to give consideration before our second business meeting, held October 17. The setting for this meeting was so perfect—the Camellia Room, furnished in white wrought iron with deep red velvet cushions and carpet, with the west glass wall overlooking the pool bathed in sunshine.

The discussion of a worthy project occupied the greater share of our time and thoughts. Several suggestions of various charities were made, including a scholarship fund for a young person studying to enter our field of endeavor. Beverly Gruman was appointed Chairman of a committee to give further study to this matter. She and her committee, consisting of Dorothy Smith, Fran Lambert and Carole Karg, are working on this and will report their findings to us at the '63 Assembly in New Orleans.

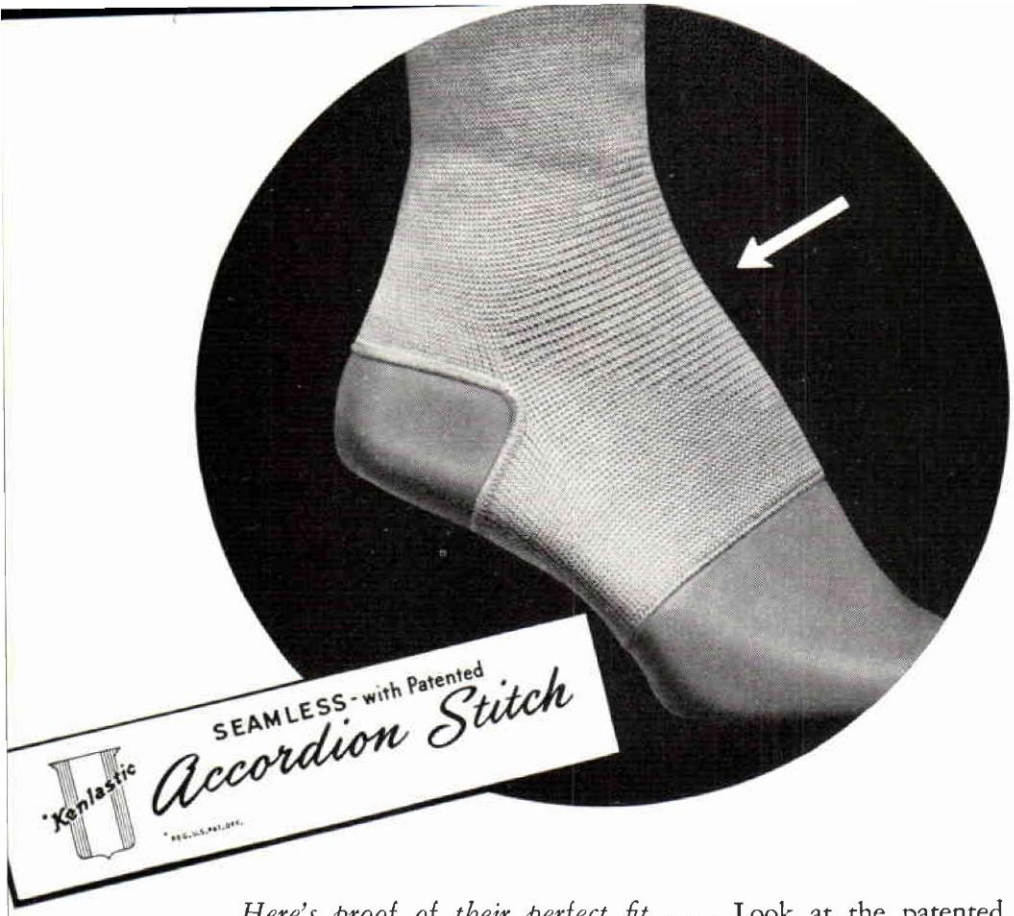
Annual dues were raised to $2.00, the extra dollar to be used for the project.

Agnes Brown and Pauline Tyo are our wonderful birthday card committee this year. Thank you, Agnes and Pauline.

You know, of course, that Regional Meetings in each of your respective areas are coming soon. I would like to suggest that you plan to attend with your husband—line up a baby-sitter now or whatever you must do. You'll enjoy it, your husband will appreciate having you along and you do meet such nice people and see different places. At your Regional Meetings you see old friends and make new ones, then when you attend the National at New Orleans you will see those familiar faces again. See President Fillauer's column in this issue of the *Journal* for the details of the Regional Meetings—places, hotels, programs, etc. Each meeting will have something planned for the wives of members.

Sincerely,

ELINOR BOHNENKAMP



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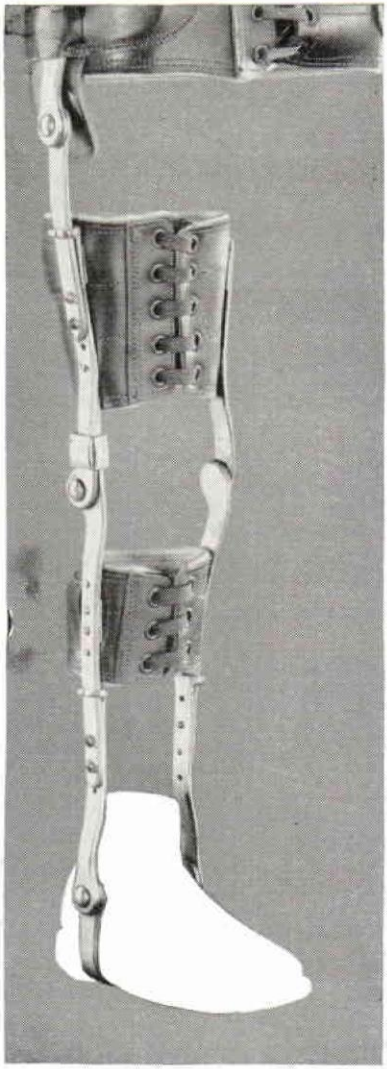

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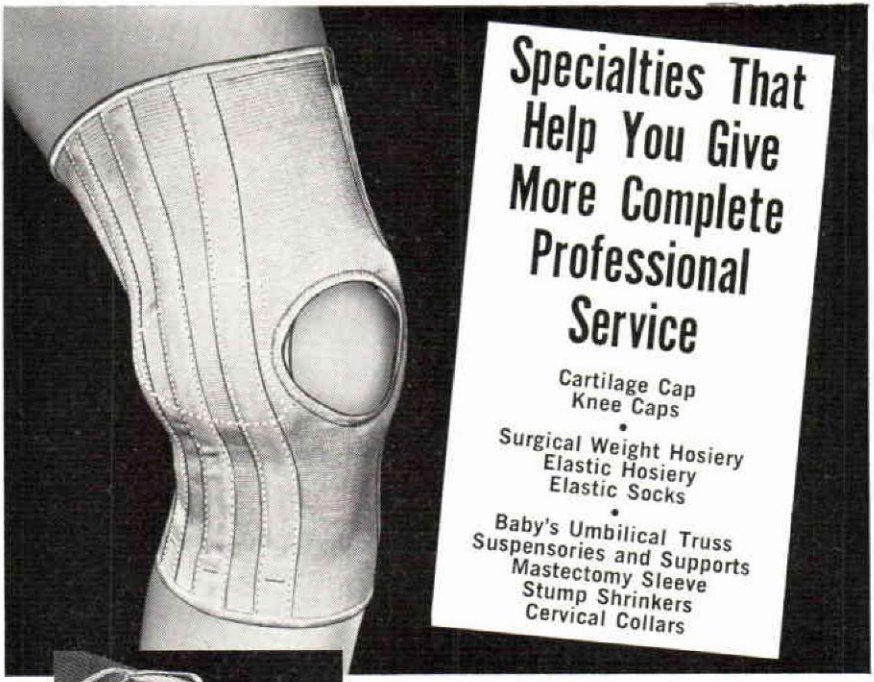

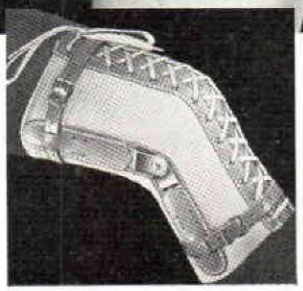

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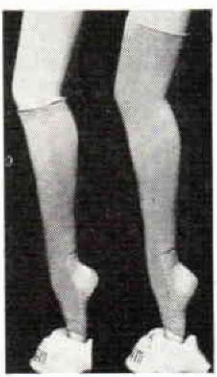

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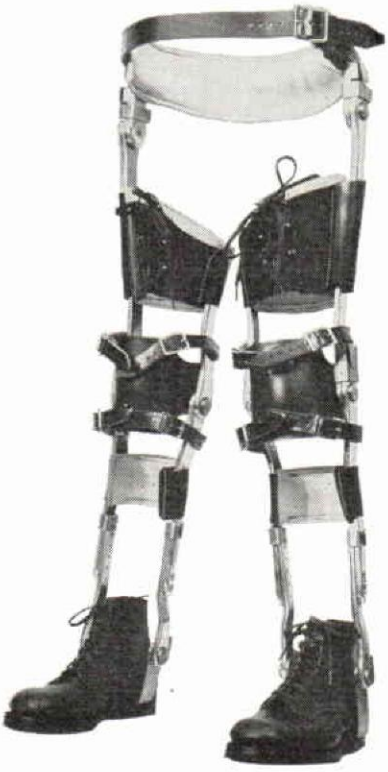

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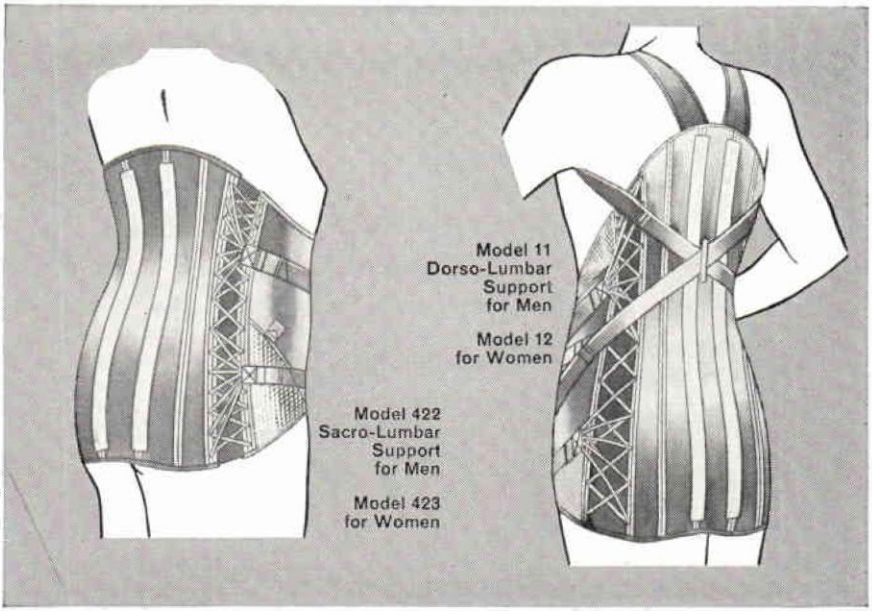

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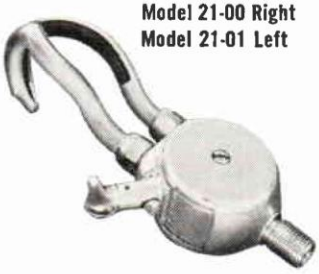

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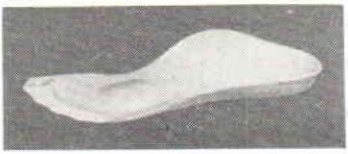

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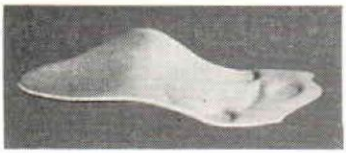

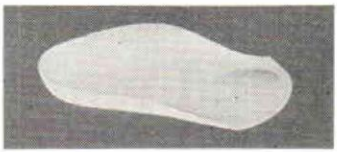

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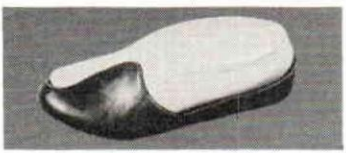

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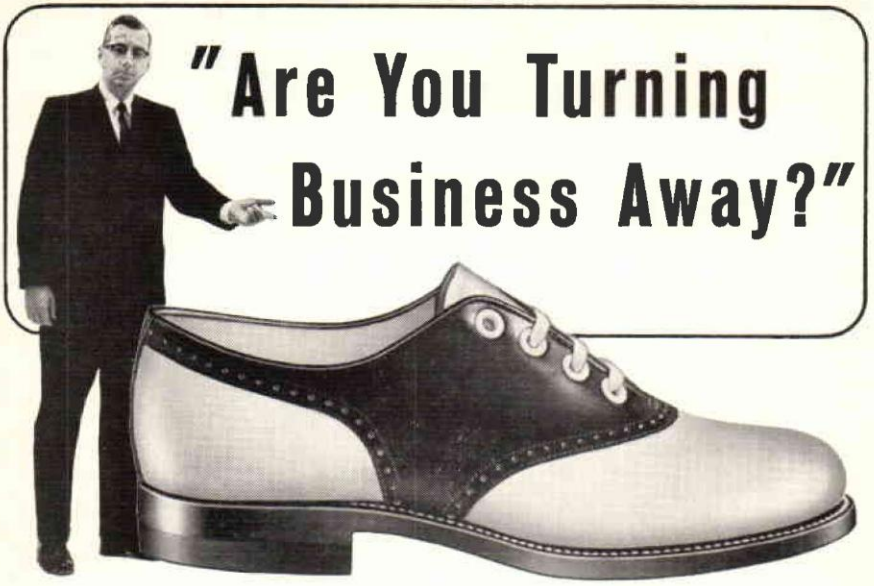

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