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A PROSTHETIC AND ORTHOTIC MEASURING TABLE

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In recent years a number of devices and procedures have been introduced which facilitate the taking of measurements or plaster moulds of various types of deformity. Indeed it is seen that several differing types of apparatus have been developed to take an impression of only one type of deformity.

The fact that many of these designs or procedures leave something to be desired in terms of accuracy or application is perhaps a reflection of an inadequate appreciation of the ergonomics involved, and a seeming preoccupation with the deformity presented, rather than the patient as an entity.

No criticism is implied, but while it is agreed that measuring equipment currently available can produce reasonably accurate dimensions, the end product often falls short of an ideal; and it is suggested that the basic problem which arises is not so much the nature of the design or procedure being used, but to three interrelated factors.

1. The alignment of the body at the time the procedure is being carried out.
2. The relationship of the body to the device being used.
3. The contractile state of the musculature of the body part during the given procedure.

The provision of an appliance is an aspect of treatment, the objective of which is maximum restoration of function, and this is, in part, relative to the alignment of the human and mechanical components. At present this is achieved by the rather uneconomical procedures of static and dynamic alignment. It is suggested that these could be simplified greatly if it were possible to determine relative body alignment at the outset. Equally the relationship of the measuring device to the body is significant in that unless the alignment of the two coincides any measurement or plaster mould being taken will not be accurate.

The part of the appliance in contact with the body must be shaped so as to withstand the forces which will be exerted at the interface without causing discomfort or impeding circulation; thus the disposition of soft tissure at the time of measurement or plaster mould is also significant, since it must affect the amount of modifications to be done to the plaster cast.

Muscle activity will be discussed in a later work. Suffice it to say here that any change in cross-sectional area can be used to exert force, but, if this potential force is to be controlled it is essential that the muscle groups be relaxed at the time the plaster mould or measurement is being taken.

It will be apparent that unless the patient is comfortable and secure, it will be impossible to achieve relaxation and thereby disposition of soft tissue. Under these circumstances it may be proposed that there are given criteria which must be met in order to achieve an accurate representation of the part:

a) There is control over the position of the body and its relationship to the device being used to take the measurement.
b) It should be possible to determine the static alignment of the appliance during the procedure.
c) That any active musculature should be relaxed while the procedure is being undertaken.
d) There is control over the disposition of soft tissue.
e) The procedure for measuring any deformity should not be fatiguing for either the patient or the person taking the cast.

The immediate implication in meeting any of these criteria is stability, and in this state it should be possible to control the position of the body in its relationship to the device being used and that of the person taking the cast. Since these problems are present with all levels of deformity it seemed appropriate to design a basic device which would meet the criteria mentioned, with the possibility of attaching either newly designed measuring or moulding equipment, or modifications of existing ones.

The main problem is one of control of body position and its center of gravity; it is apparent that with the disabled person this cannot be achieved with the patient sitting or standing unsupported, and obviously the position of greatest stability and relaxation of muscle is with the patient lying horizontal on a bench or table.

However, if it is necessary to cater to a variety of deformities and determine static alignment, a horizontal position provided by a table, although meeting some of the criteria, does not meet all; unless it were possible to control the angle of the table top.

It is this concept which led to the development of the equipment described here, which is based upon the assumption that with ade-

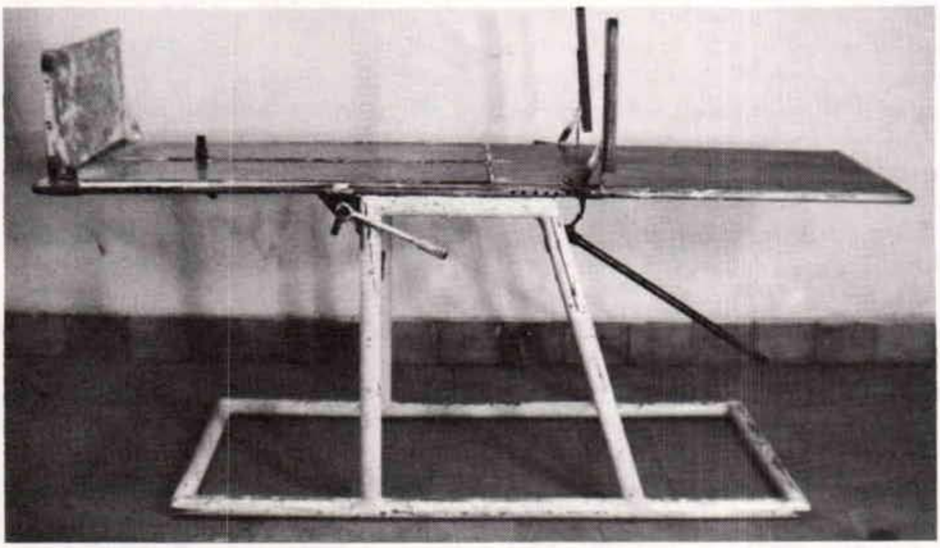

Fig. 1. The basic table shown in the horizontal position.

quate stabilization of the body on the surface of the table, it should be possible to tilt it and the patient through a range of 90 deg., thus meeting the criteria for a variety of deformities.

The Basic Table

The design (Figs. 1 & 2) is similar to that of a tilting table used for treatment in physiotherapy departments; indeed, some of the existing models could be altered for use in the present context except that in order to achieve sufficient rigidity it is necessary to fit locking levers to the table hinges and to redesign the table top.

The design consists of two frames. The lower, or base, frame is designed so that the table will not overturn when the upper frame is brought from one position to another. The uprights have a cross-bar that contributes to the rigidity and provides a support for an additional locking mechanism. A geared mechanism for raising and lowering the table top was considered, but not included in the present design for reasons of economy. Moreover, the lever arm formed by the length of the table from its head to the hinges is long enough to enable the upper frame to be raised or lowered with comparative ease.

The upper frame has a cross-bar to which is fitted a round longitudinal slide that receives the lower-limb adaptor (Fig. 3).

Fitted to the frame are two arm rests, on which the patient may support himself, and a footrest. The table top consists of four boards any of which may be removed for convenient working during a given procedure.

The design of the table lends itself to a variety of attachments which are described here briefly, although it will be seen that there is scope for further design activity and that with minor modification some existing equipment could be used.

The Symes/knee-disarticulation attachment (Figs. 4, 5, and 6) consists of a board 18cm x 16cm the upper surface of which is padded with microcellular rubber and cov-

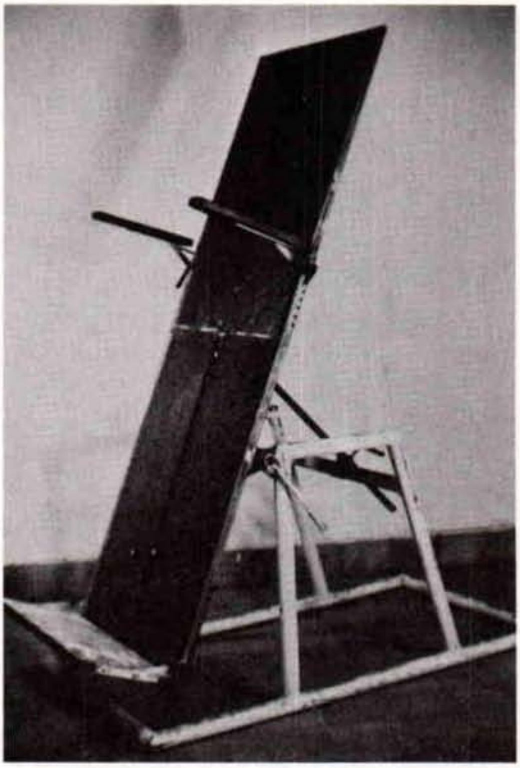

Fig. 2. The basic table shown in the vertical position.

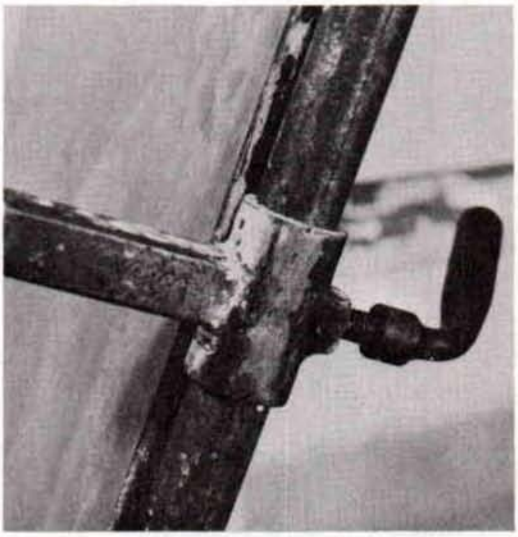

Fig. 3. The lower extremity adaptor, a piece of square bar welded to a slide which allows movement up or down the frame as well as rotating left or right.

Fig. 4. The Symes/knee disarticulation board clamped to the adaptor and set for a right Symes amputation.

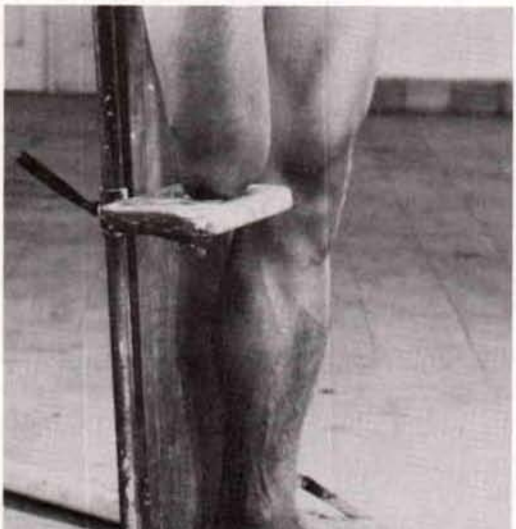

Fig. 6. Knee disarticulation patient positioned ready for the moulding procedure.

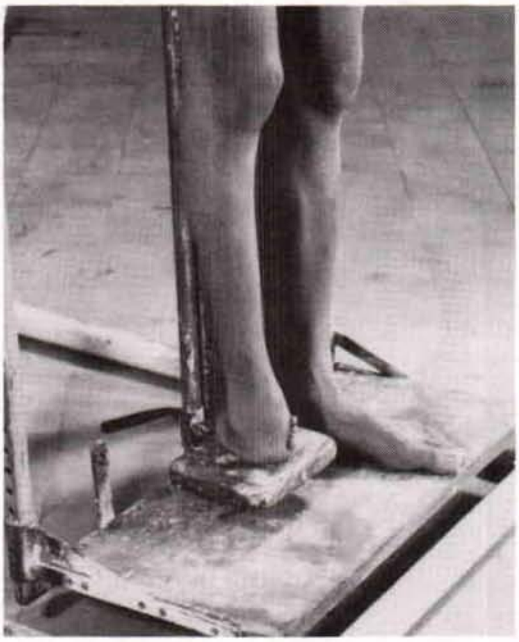

Fig. 5. Patient in position ready for the application of plaster: note the right board has been removed to facilitate working.

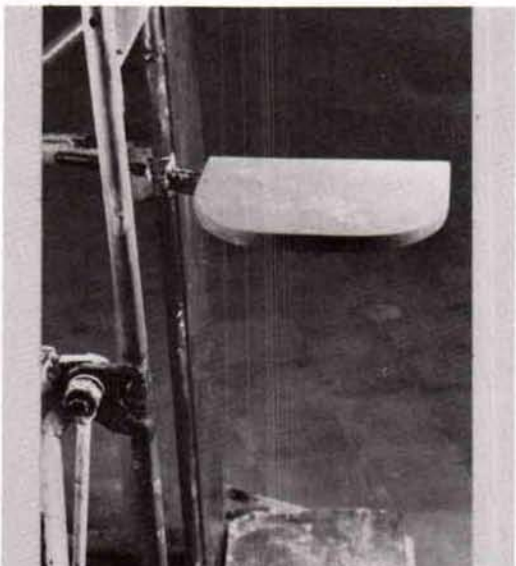

Fig. 7. Hip disarticulation board in position. This is attached to the frame with the same extension arm as that used for the Symes/knee disarticulation board.

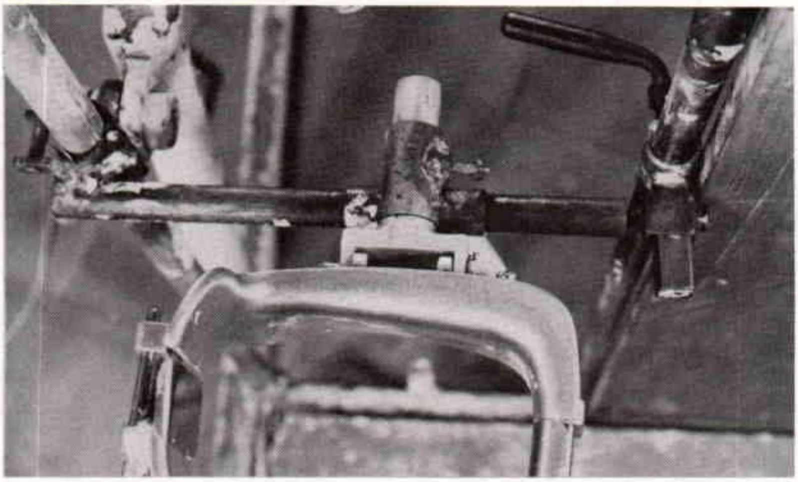

Fig. 8. The above knee attachment with the combination or horizontal vertical and A.P. slides it is possible to adjust the position of the socket-brim as well as control flexion extension.

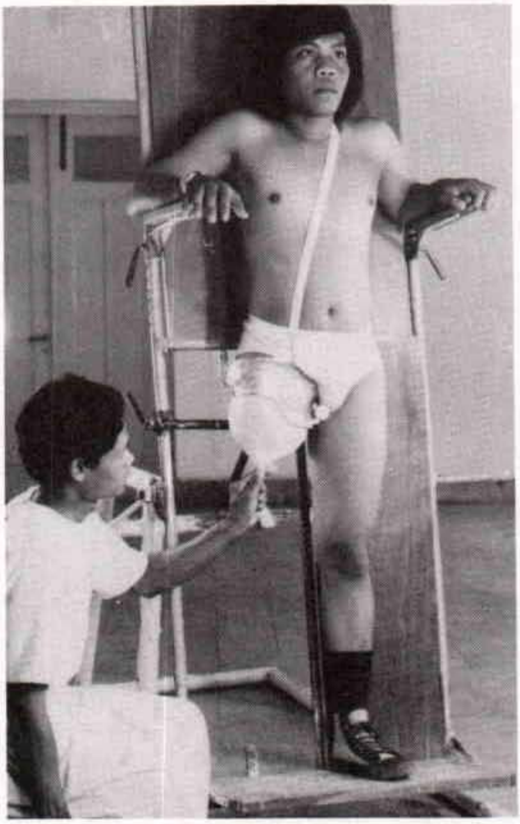

Fig. 9. Patient in position, plaster mould being taken.

ered with vinyl sheet. It is fixed to an extension arm 16cm long which in turn clamps on to the lower-limb adaptor. The point of fixation of the board to the arm is by a pivot and may be locked by a wing nut. The reason for this is that since the lower-limb adaptor rotates about the longitudinal slide the board may be used for either left or right amputations.

The hip-disarticulation attachment (Fig. 7), is also a board with similar padding but different shape. By removing the Symes/knee-disarticulation board from the extension arm it is possible to use this to support the hip disarticulation board. However, because of the shape and positioning of the board for either left or right it is not possible to have one central pivot, and two are used, one for left, one for right amputations.

The above-knee amputation attachment consists of a horizontal slide which clamps to the lower-limb adaptor and the side of the frame (Figs. 8 and 9). The moulding device, in this instance a Berkeley Brim, is fitted to a locking slide and may be moved medially or laterally; the height may be adjusted by moving the assembly up or down the frame. The horizontal slide may be used for left or

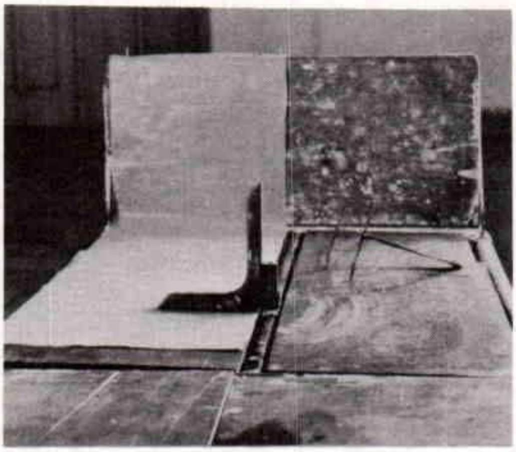

Fig. 10. The right angled pointer used to locate the perineum. Note that the tracing paper extends to the foot board making it possible to determine limb profile tibial torsion, ankle position, and angle of the foot at the one time.

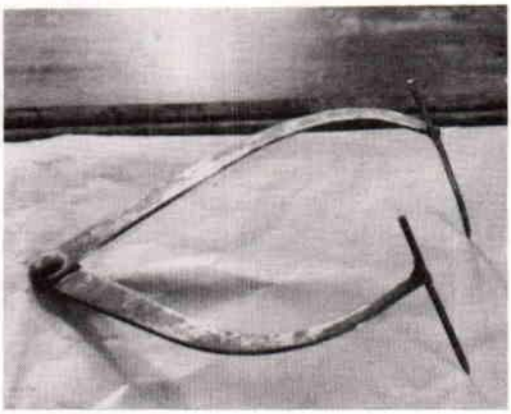

Fig. 11. The dividers used to obtain M.L. dimensions, tibial torsion, and ankle joint position.

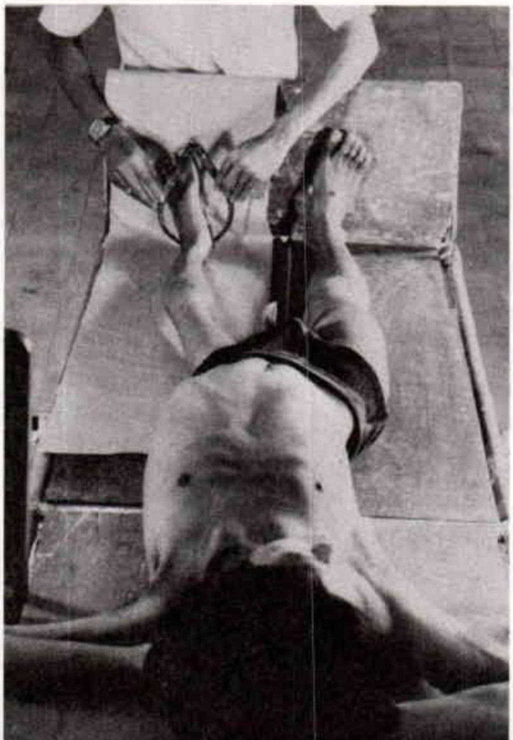

Fig. 12. Patient in position on the table, note the centre line of the table establishing a point of reference for the future alignment of the brace.

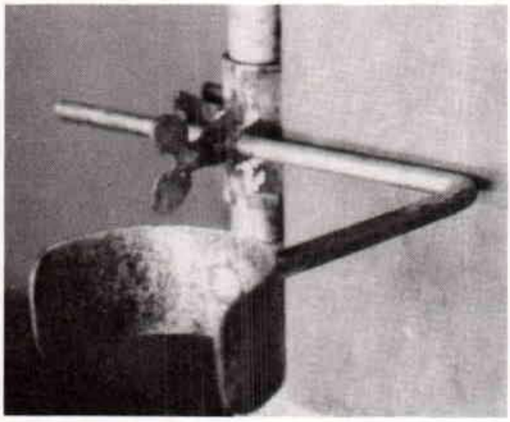

Fig. 13. The below elbow stabilizer to hold the arm in the correct position while moulding.

right amputations by simply removing the central support and reversing the slide.

The lower-limb orthotics measuring device (Figs. 10, 11, and 12), permits measure to be taken either in the horizontal position or at an angle of 45 deg., the foot board and center of the table being the basic reference points.

A right-angle pointer is fitted to the lower-limb adaptor and is used to locate the height of the perineum; and a pair of calipers or dividers are used to measure the medio-lateral dimensions of the knee and ankle. It

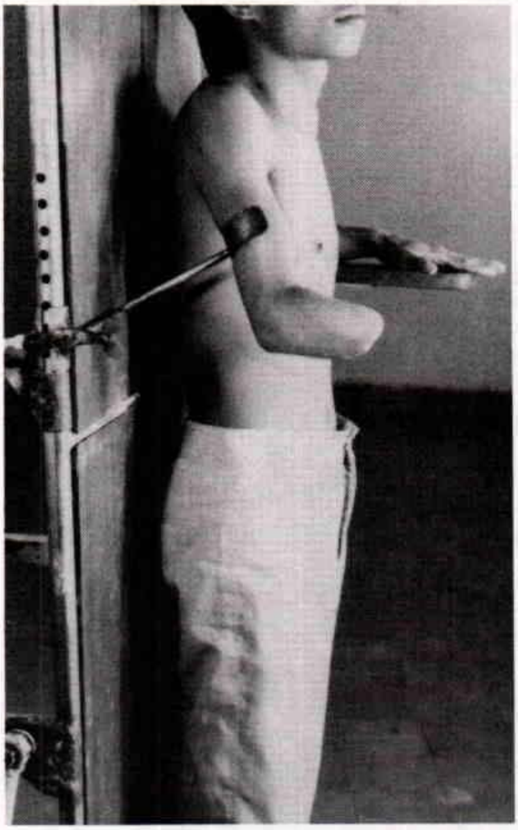

Fig. 14. Patient in position ready for moulding procedure to begin.

should be noted that the measuring paper in this procedure extends under the foot, thus giving the possibility of limb profile, tibial torsion, when present, and the foot angle and position of the malleoli.

The below-elbow arm stabilizer (Figs. 13 and 14) is simply a padded cuff fixed to an adjustable support and is used to steady the upper arm during the application of plaster. Its particular advantage is not so much in the molding procedure but rather in the fact that since the table gives the frame of reference it is easy to ensure that the forearm is held in the correct position while the mould is being taken.

The above-elbow device (Figs. 15 and 16) uses the same clamp as is used in the below-elbow case, but has a former which fits into the axilla allowing the orthotist/prosthetist to use both hands to control the shape of the plaster and the position of the stump.

The spine and trunk unit (Fig. 17) is a suspension apparatus that is clamped to the hood of the frame for use when measuring under traction. It will be apparent, however, that by removing and repositioning some of the boards, moulds and measurements may

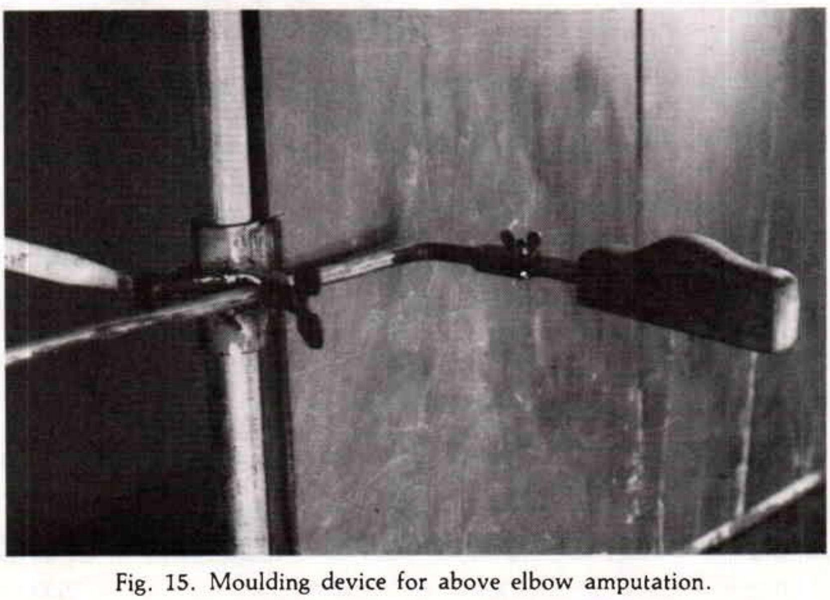

Fig. 15. Moulding device for above elbow amputation.

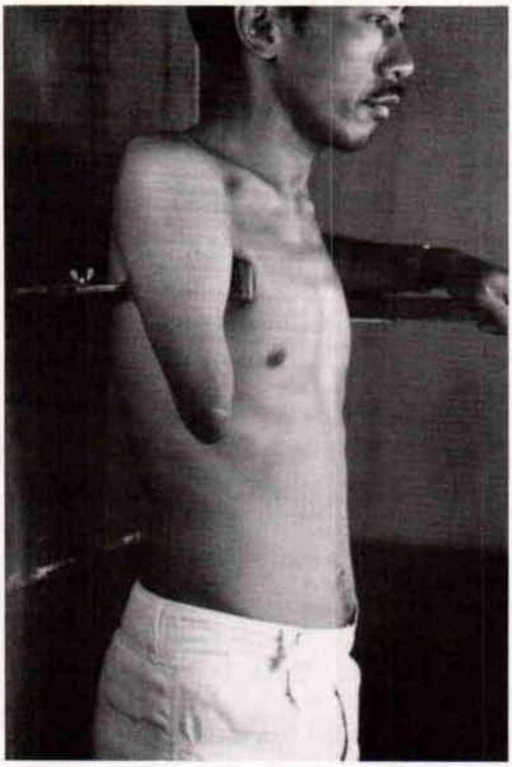

Fig. 16. Patient in position ready for the application of stockinet and plaster.

Fig. 17. Patient in suspension ready for the application of plaster bandages. With the use of supports it is possible to have part or all of the procedure in the horizontal position.

be taken with the table in a horizontal position.

Of the devices discussed above the reader will have noted there is none described for that perennial subject, the below-knee amputee. Efforts have been made to devise a stabilizing bar to hold the stump in the correct position while taking the plaster mould, but this has so far not proven to be more efficient than procedures already available.

Discussion

At first sight the concept of a basic device upon which a range of fitments may be used may seem complex and perhaps costly, and it is as well to examine briefly these factors rather than leave the subject as an apparent technical tour de force.

At the time of writing, three tables as described have been in use for periods of 2-3 years with only minor changes in the original design. The concept of using one basic device to cater for a variety of deformities has been readily accepted and it seems appropriate to make a preliminary assessment of the design.

Patient Acceptance: A series of questions and observations were made of both new and experienced patients; the consensus was that they all felt secure, were able to relax and cooperate fully during the procedure irrespective of the deformity being catered for.

Professional Staff: The immediate feature which became apparent was that after instruction in the various procedures, professional staff became more aware of the relationship of the deformity to the patient. Since there is a frame of reference, body alignment can be readily observed, corrected, or taken into account, for subsequent static alignment.

Of particular interest was the fact that, with new students it was possible to demonstrate spatial relationships which are otherwise abstract until the often fatiguing process of dynamic alignment begins. Finally the design appears as such that all procedures can be carried out with a minimum of fatigue of the clinician.

Technical and Production: Comparisons were made between conventional procedures and those using the table. The space required is less than usually acceptable since the table can double for an examination couch. In most plaster rooms a couch is necessary. Preparation and cleaning times are the same or slightly less since all components are located in one place. Time required per procedure is approximately the same or slightly less; however the rejection rate for given moulds was markedly less, and cast modifications required much less time. Measurements could be taken at given angles, as the table provided reference, and were therefore more accurate. This also applied to static and dynamic alignment.

These factors taken into account indicate that the initial cost of producing the table is soon offset by increased efficiency in the department.

As presented here the table has been deliberately designed to be as simple as possible commensurate with efficiency and it will be apparent that further improvement can be made. This is an aspect of progress.

Footnotes

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