Muenster

The UCLA Prosthetics-Orthotics Program conducted a case study project on the Muenster type prosthesis from 1968 to 1969. Results of the two-year proj ect generally concur with the results of a study by New York University on the Muenster.* This study states:

1. Amputees reacted positively to the comfort and security of the socket.

2. The decrease in flexion range had no appreciable effect on the prosthetic functions of unilateral amputees. However, for bilateral subjects, modification of the anterior trim line and the provision of a wrist flexion device were necessary for performance of tasks close to the body.

3. Lifting and holding forces available to the amputee were generally superior.

A prescription for a Muenster prosthesis is determined by the patient? stump length.

MinimumLength

Stumps that are categorized as very short, from 1-1/2- 3 inches long, disappear into the cubital fold during elbow flexion at angles exceeding 90°. On the Muenster prosthesis, the maximum elbow flexion angle is limited accordingly, usually less than 90°. Thus, a limited amount of elbow flexion is needed for the Muenster prosthesis.

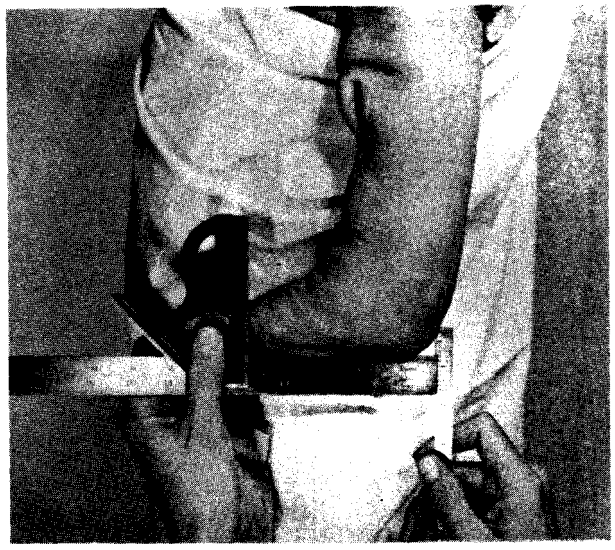
Maximum Length

Below elbow stumps which retain forearm rotation (pronation-supination) to a substantial degree can benefit most from the below elbow flexible hinge prosthesis. Active pronation-supination of the terminal device is eliminated on the Muenster.

Bilateral Amputees

The fitting of a bilateral amputee is complicated by the difficulty he has donning two closely fitted prostheses without assistance and the limitation imposed by restricted elbow flexion, particularly on the dominant side. These problems can be resolved by fitting the sockets less snugly to facilitate donning and lowering the anterior trim line to provide additional elbow flexion. A wrist flexion unit on the dominant side for activities close to the body. Some juvenile bilateral amputees could be successfully fitted with similar modifications.

* The "Muenster-Type" Fabrication Technique for Below-Elbow Prostheses, Adult Prosthetic Studies, Research Division, College of Engineering, New York Univeristy, New York, New York, June 1964.



Measurements

The stump length measurement from the olecranon, as illustrated, and the olecranon to thumb tip measurement on the sound arm are for reference during fabrication of the prosthesis.

Wrap Cast

The wrap cast serves as the check or trial fitting socket. The procedure must be followed exactly for the desired results. Proper application of the molding process is also essential for the success of the &rap.

Materials:

cotton stockinette or casting sock

scissors

elastic webbing

Yates clamp

bucket of water

sheet (to drape patient)

skin marking pencil

elastic plaster bandage

towel

straight edge ruler

Show the patient how the molding process will be done after the wrap cast is applied. Practice the molding grip on the patient so that the characteristics of his stump are familiar.

Place the index and long fingers into the proximal cubital fold and locate the biceps tendon. (Have the patient contract his biceps muscle if the tendon is difficult to locate.)

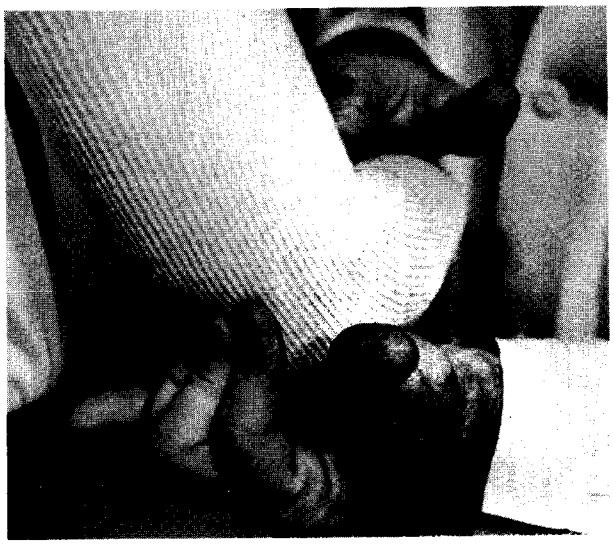
With the fingers extended, one on either side of the tendon, gently force them towards the humerus and then downward onto the cubital fold and the anterior surface of the stump. Avoid any contact by the fingers on the distal stump.

The above procedure is more difficult on a very short stump. If the prosthetist's and amputee's arms are on the same level, the molding can be applied more conveniently. Children should therefore sit on a table or stand on a raised platform.

The dorsal aspect of the elbow is wedge shaped. Shape the left hand for right amputations. Shape the right hand for left amputations. The thenar and hypothenar eminences should form a channel into which the elbow will fit.

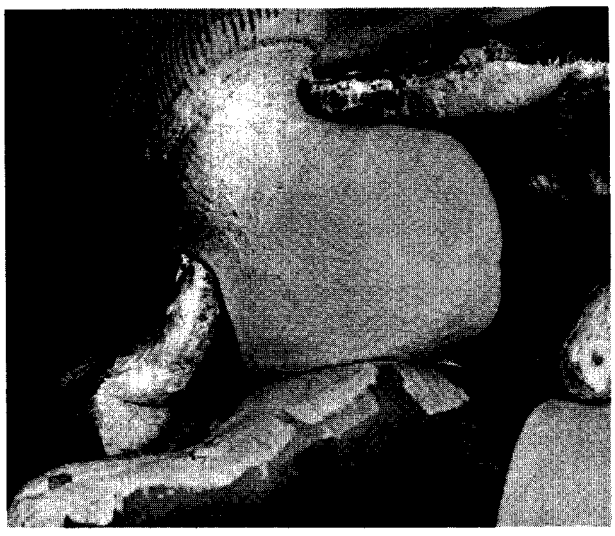
Position the hand as described above to the proximal ulna with as little contact on the olecranon as possible. This part of the hand application is only for support without distortion of the tissues.

Place the index, middle, and ring fingers on the posterior aspect of the humerus proximal to the olecranon. With the finger pads, as illustrated, gently apply pressure against the humerus down toward the olecranon.

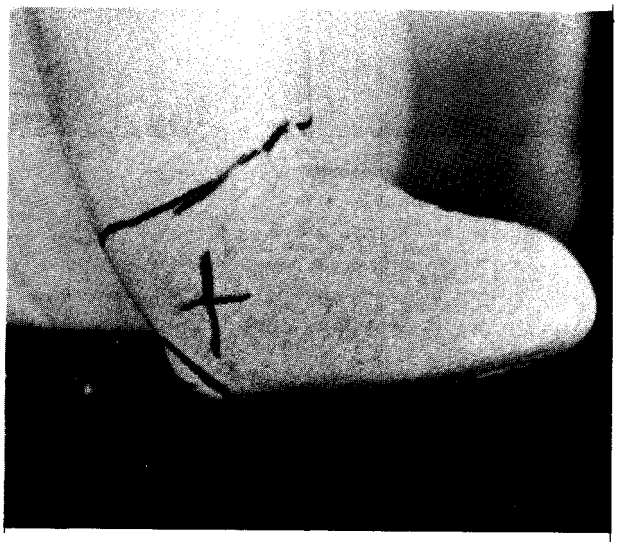


The proper application during the molding process is illustrated. There is no pressure between the palm of the hand and the olecranon.

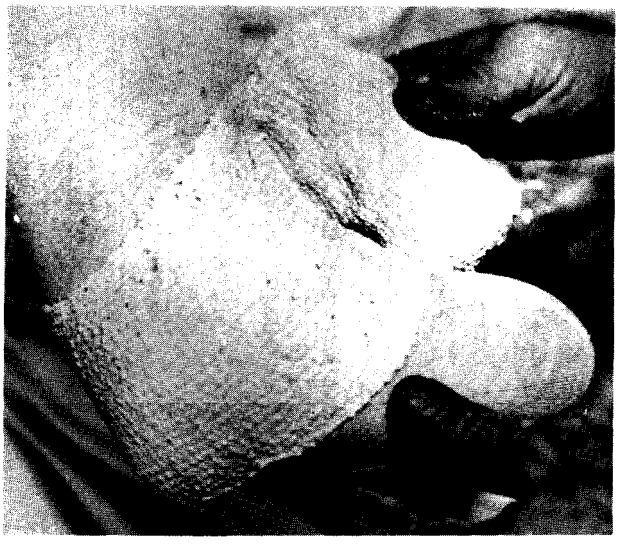
In this manner a relief is automatically provided for the olecranon. The directional forces of the molding grip or the fingers against the posterior humerus are balanced by the pressure of the fingers on the cubital fold.



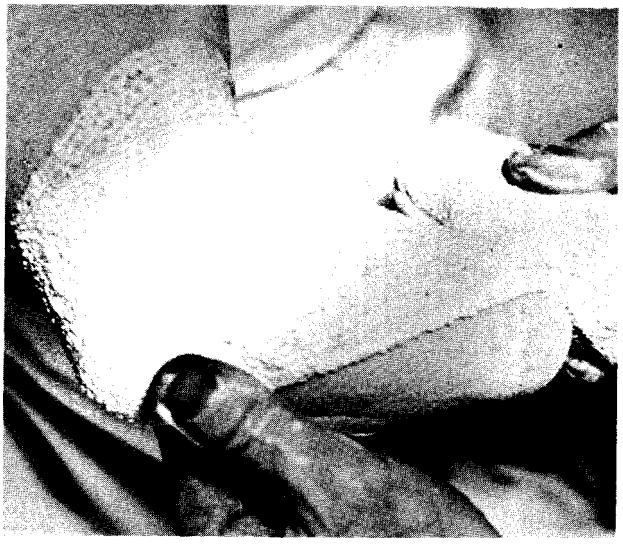
Mark the proximal line of the wrap. Draw a line beginning at the posterior, connecting two points, l-inch above the condyles of the humerus to the anterior. Include all of the cubital tissues. Outline the olecranon and the epicondyles.



Begin the wrap by placing a layer of plaster across the anterior elbow spanning the cubital fold. Use 6 or 8 CM elastic plaster bandage. Continue the wrap with figure of eight patterns to cover the elbow and stump.

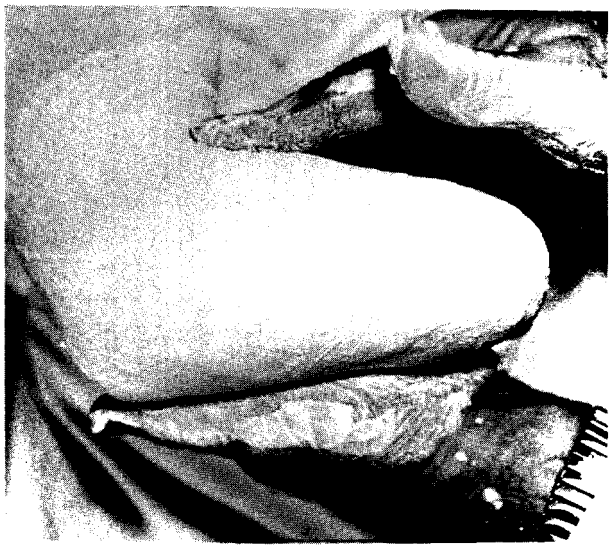


Spiral the wraps to cover the distal end.



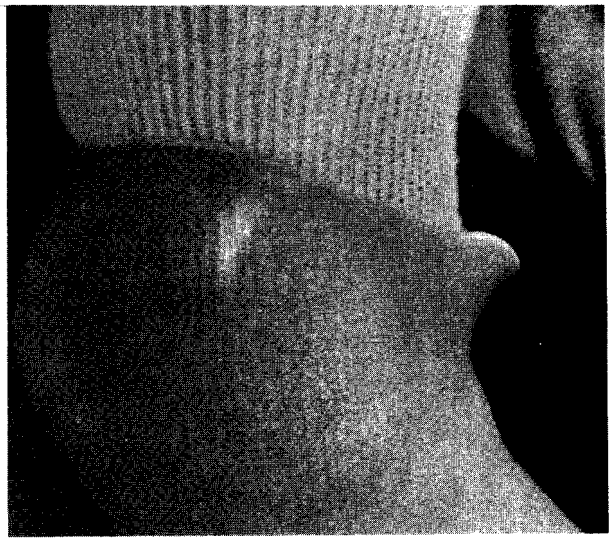
Continue the wrap at least 1/4 inch above the reference marks. Add at least four layers of plaster, strong enough to be used as the check socket.

Locate the biceps tendon and smooth the wrap. Mold over the distal end and along the shaft of the ulna. Do not mold over the condyles or flares of the humerus, or over the proximal edge of the wrap on the medial or lateral aspect of the arm.

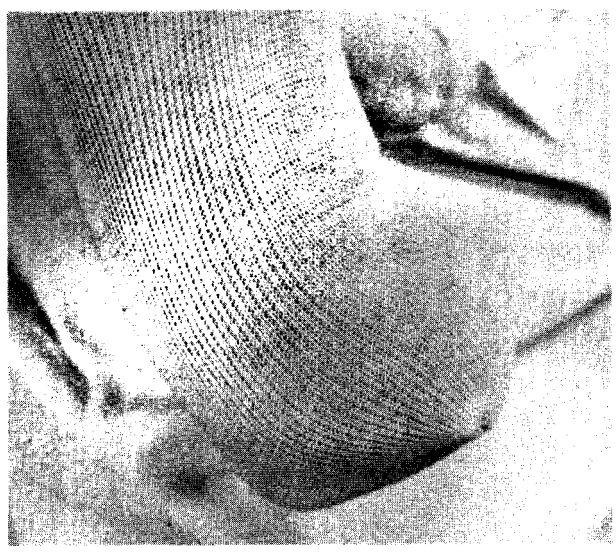


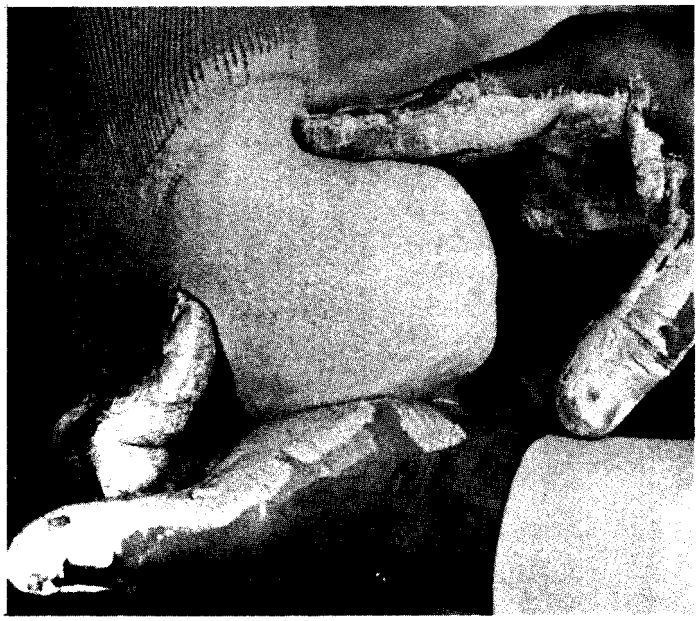
Apply the molding grip. Press the fingers until all loose tissues are displaced and firm resistance is attained.

The Muenster type socket encapsulates the elbow. It cups up over the olecranon, fits snugly over the cubital fold and contains a channel for the biceps tendon.



To take the cast apply a casting sock or stockinette sewn across the end on the stump.

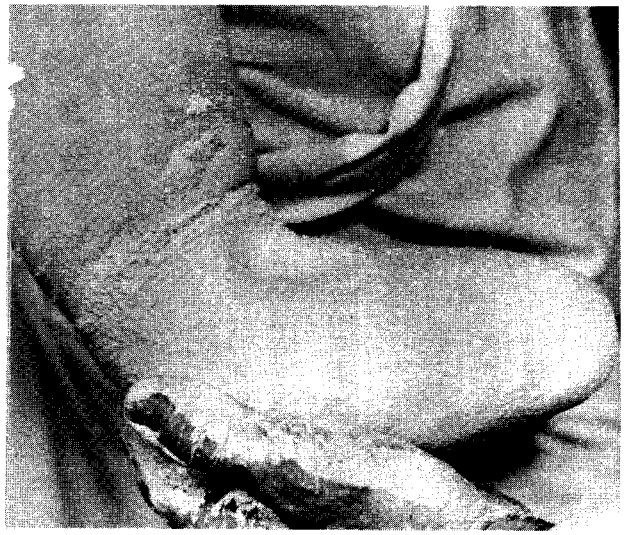




Maintain the molding grip until the plaster sets. Now support the cast and ask the amputee to push slightly against resistance to elbow flexion, extension and rotation. (Although the stump cannot rotate the cast, unfortunately it may rotate within the cast.) If gross movements of the stump occur within the wrap, it should be rejected.

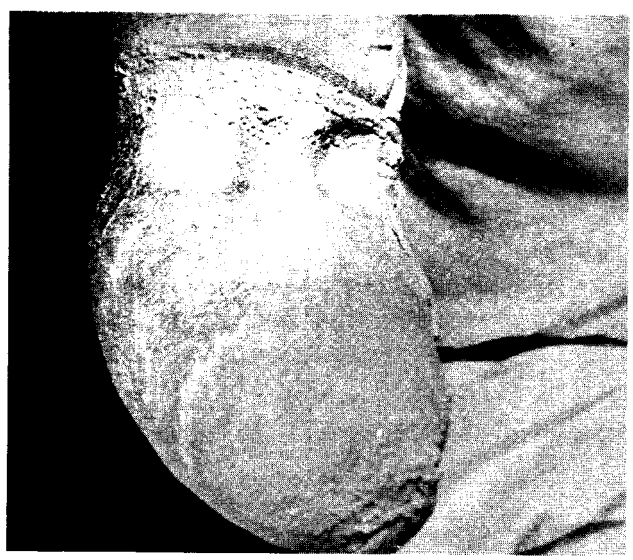
When the cast is applied to longer stumps, the patient should extend his elbow approximately 10° below that of the 90° position.

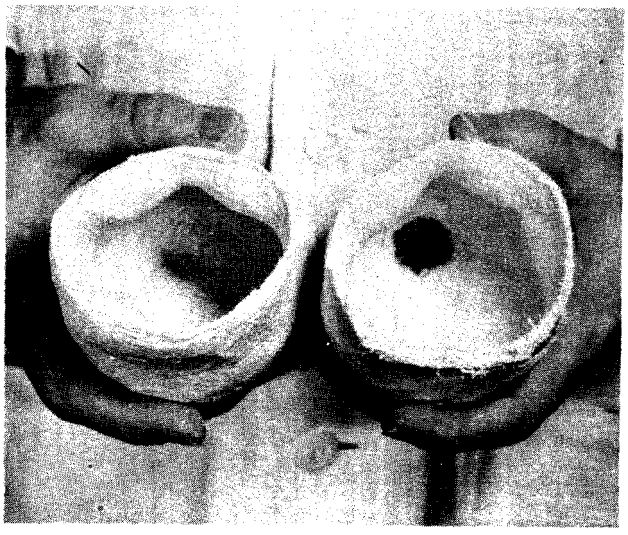
Do this when the plaster begins to get firm but has not set. Remove the fingers from the cubital fold and support the cast until the plaster thoroughly sets.

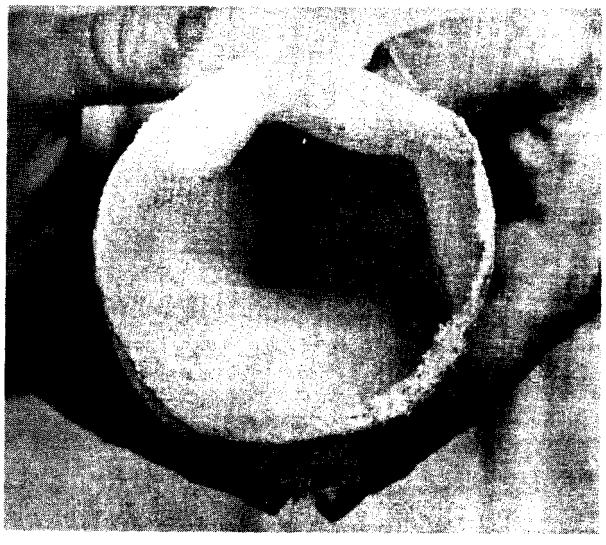


The procedure outlined in the previous step will give the amputee with a longer stump a greaterrange of elbow motion. If this procedure is used on a prosthesis for a short stump, some stability will be sacrificed.

Remove the cast by pulling the stockinette down over the cast. Thread the tissues away from the proximal brim to break suction and work the cast off the stump.







When this technique is used, the casts are remarkably similar, as shown. Casts from three amputees were used in this section.

Preparation of the Check Socket Using the Wrap Cast

Materials:

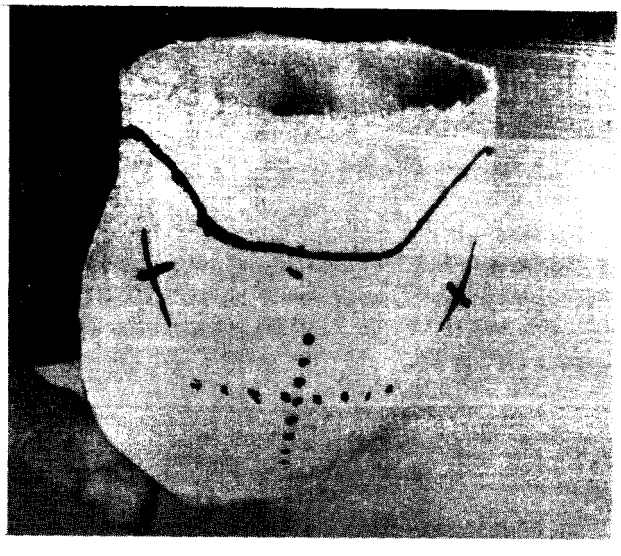
knife

scissors

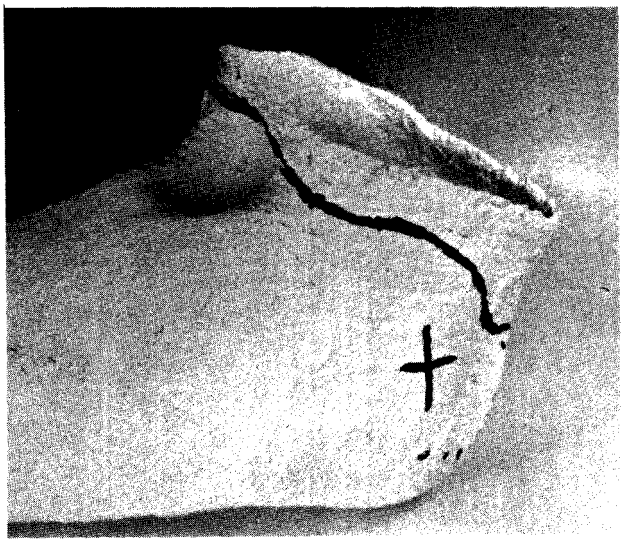
fresh plaster

water

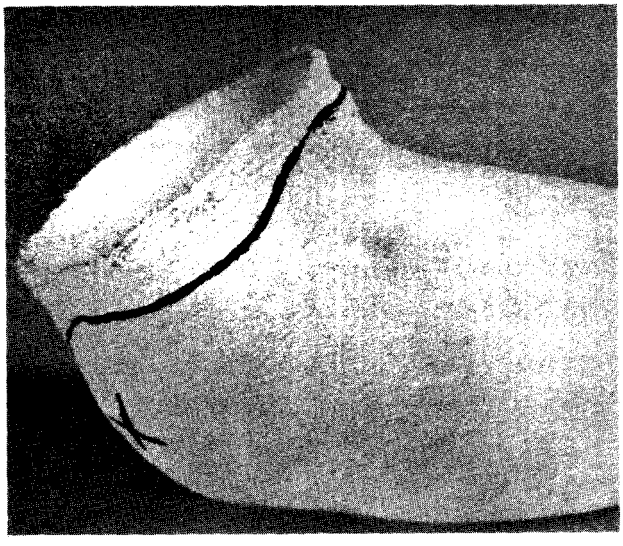
Mark the trim lines. The posterior trim line is at the upper margin of the indents, made from the three fingers proximal to the olecranon. Continue the line up, proximal to the humeral condyles at least 1 inch. Mark a cross at the apex of the olecranon bulge as shown. Transfer the marks for epicondyles from the inside of the cast.



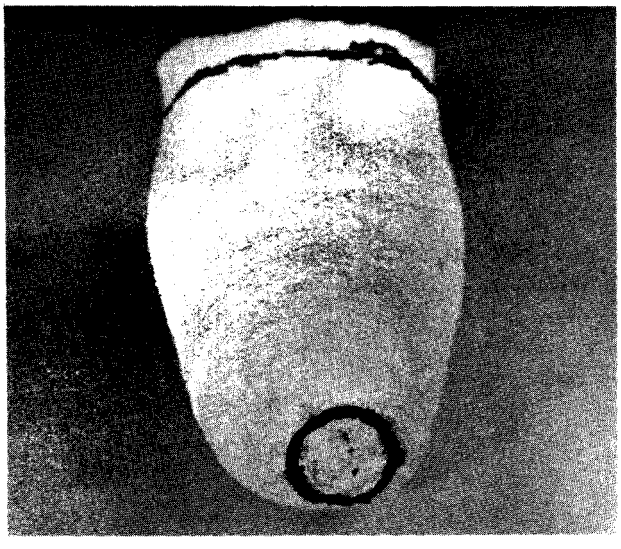
Continue the line on the medial side including all of the indent. It will form a flare and permit greater flexion of the elbow without pinching.



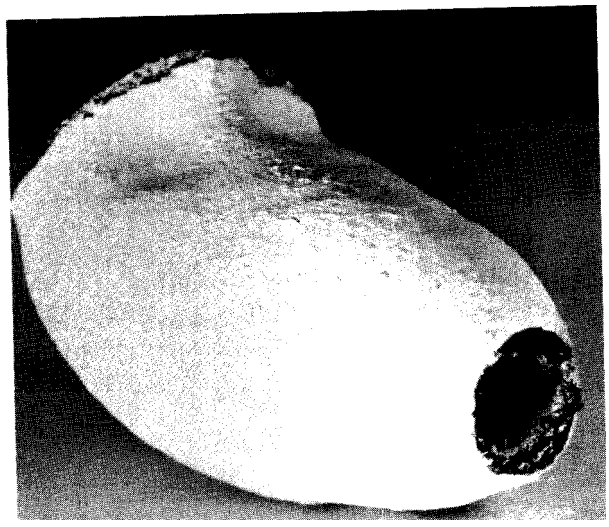
Repeat the process on the lateral-anterior side of the cast.



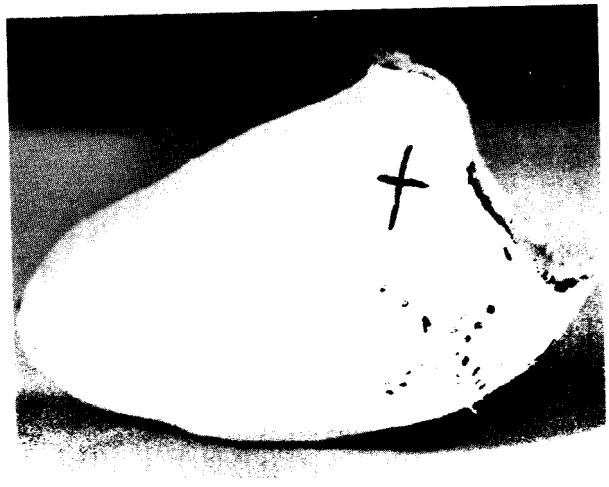
At the distal end mark an outline only large enough to allow for the passage of a pulling sock. Do not shorten the cast.



Cut the hole on the end.



Cut the cross marked over the olecranon.



Smooth the inside of the cast with plaster slurry.

Muenster Check Socket Fit

Materials:

sharp knife

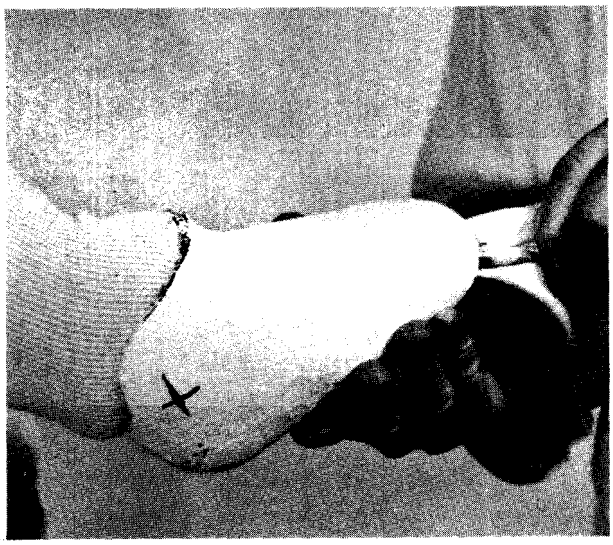
plaster cutting shears

marking pencil

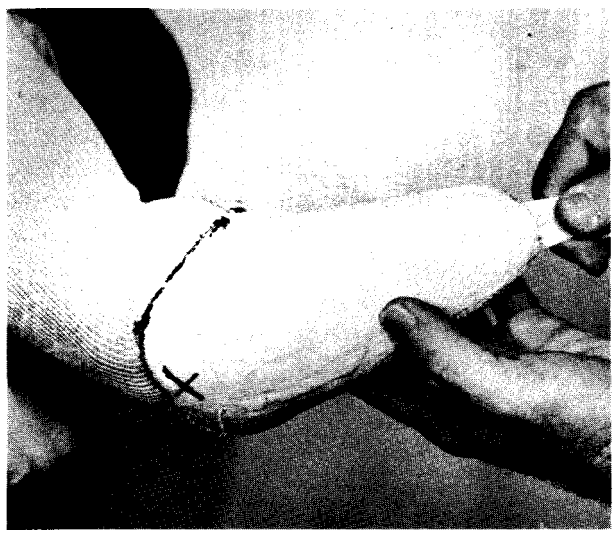
cotton stockinette (stump pulling sock)

powder

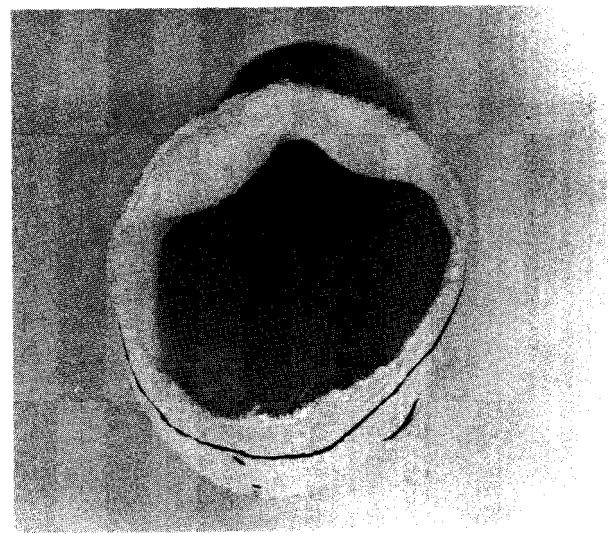
Powder the stump and socket. Apply the pulling sock. Insert the end of the pulling sock through the distal opening of the socket.



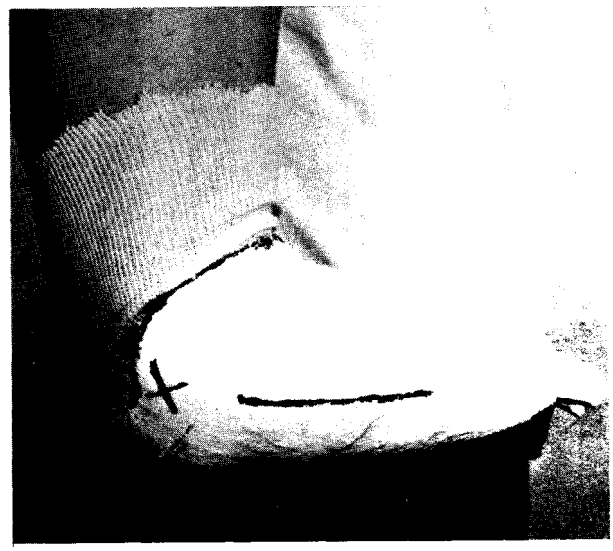
Thread the sock through the distal opening by pulling it gently on one side and then the other. Note the amount of tissues at the anterior brim. A typical illustration is shown.



If excessive tissues gather and the stump does not enter the socket even with much effort, trim small amounts of plaster from the area above the olecranon at the posterior area of the cast.



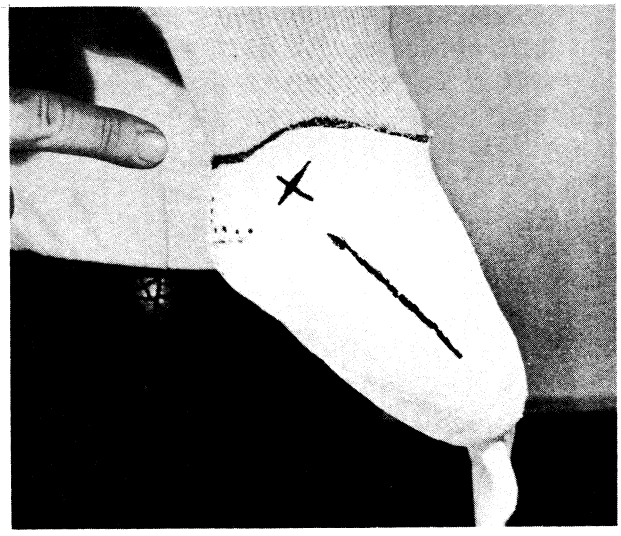
Draw a reference line on the cast parallel to the shaft of the ulna for the range of motion tests.

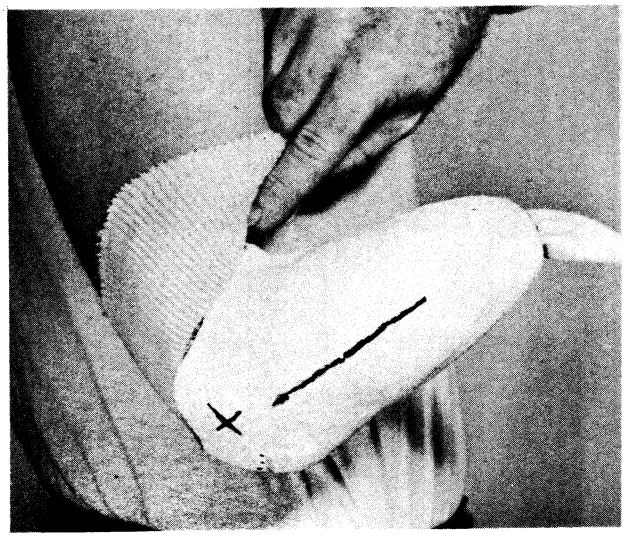


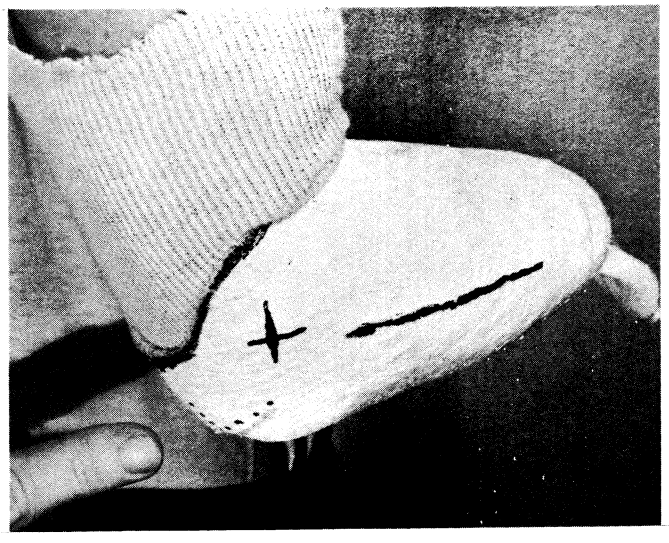
If the cubital tissues pass freely through the proximal opening of the socket without assistance from the pulling sock, the wrap is too loose. The molding grip did not have enough pressure. A new wrap should be made. For all Muenster fittings, the cubital tissues should be threaded into the socket with a stump pulling sock. This forms a seal at the proximal brim,

Proximal Trim For Elbow Flexion and Extension

The posterior trim proximal to the olecranon and flares of the humeral condyles determines the extended position of the stump. The goal is 35° of initial flexion.

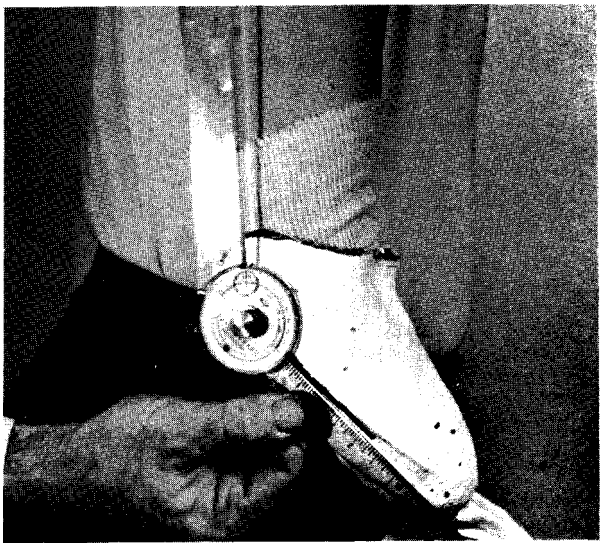




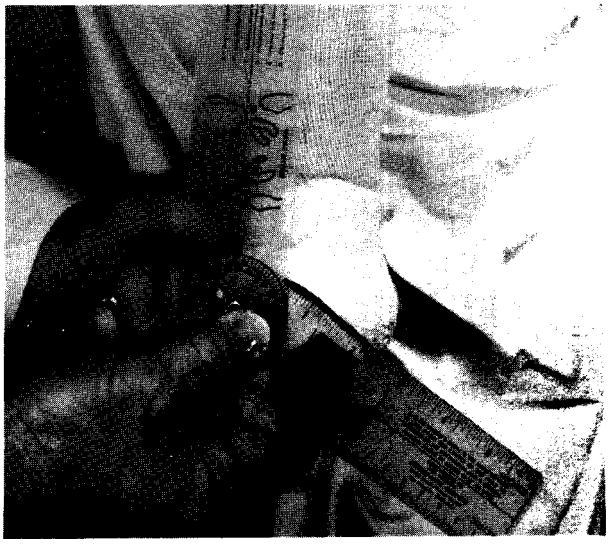


The anterior trim at the cubital fold, the biceps tendon channel, and the opening over the olecranon in the form of a cross determine the flexed position of the elbow. The goal is 105° elbow flexion, more if possible. Lowered trim lines or loose fit, however, will affect retention of the socket on the stump. The initial trim lines therefore need to be closely maintained in order to provide maximum socket retention. The lines should be reduced only to provide greater comfort or increased range of motion.

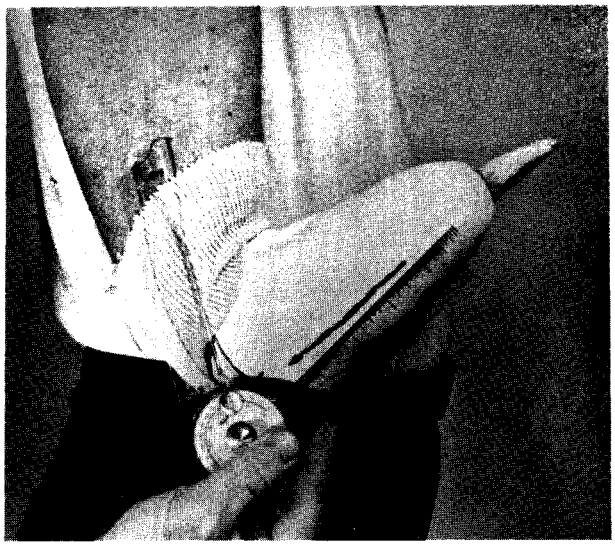
For longer stumps, careful trimming of the check socket as outlined in the two previous steps will surpass the goals. In the illustration the initial flexion angle is 30°.



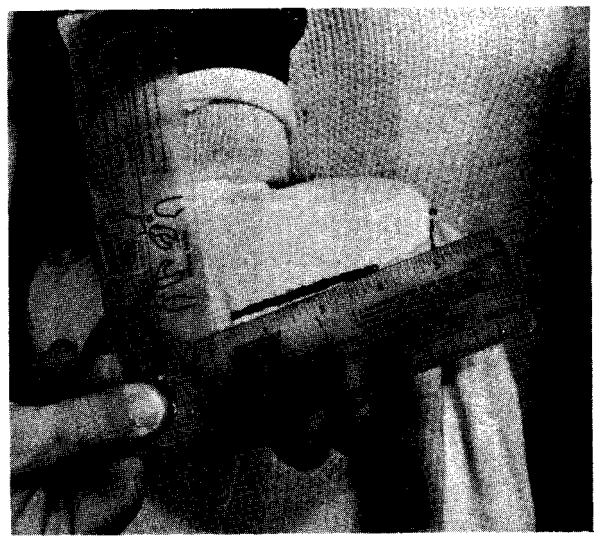
On this very short stump, 36° of initial flexion began to adversely affect socket retention on the stump.



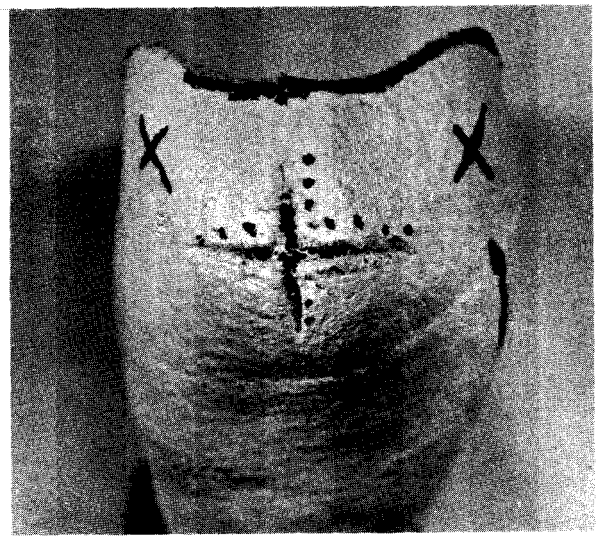
If the anterior brim is the correct height and is properly flared with a groove or channel for the biceps tendon, the flexion angle can be increased by relief over the olecranon. If the anterior brim is too high, the upper arm will be impinged. In the illustration almost 120° of elbow flexion was obtained.



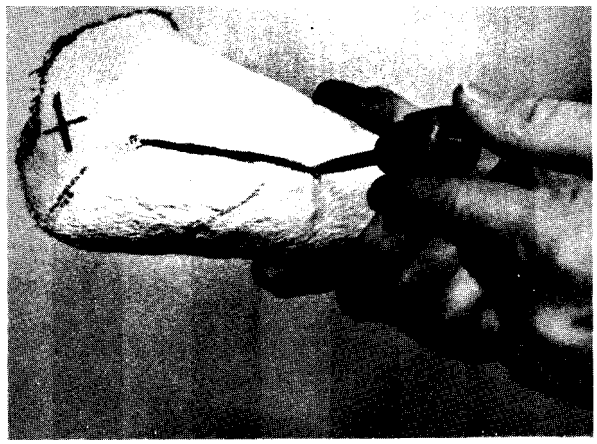
On this short stump only 103° elbow flexion could be obtained without sacrifice of socket retention.



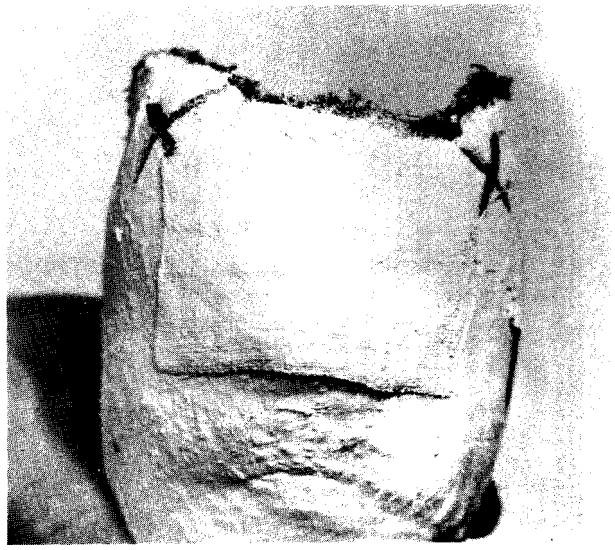
To create enough clearance for the olecranon, expand the cuts by forcing them from the inside of the socket. This will also help increase the flexion angle. If excessive pressure exists, repeat this over the epicondyles.



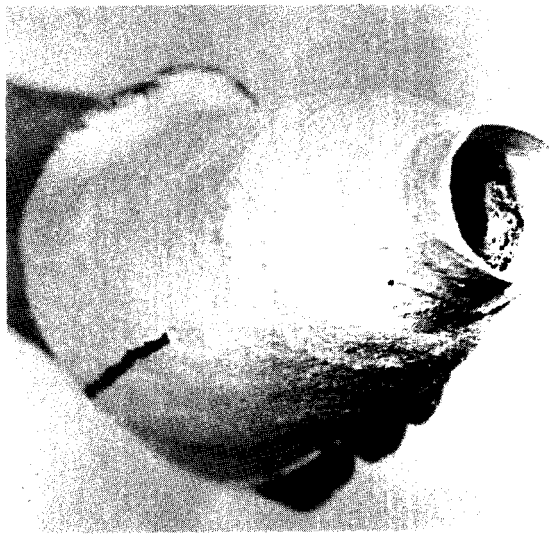
Identify the reference line by making a hole at either end.



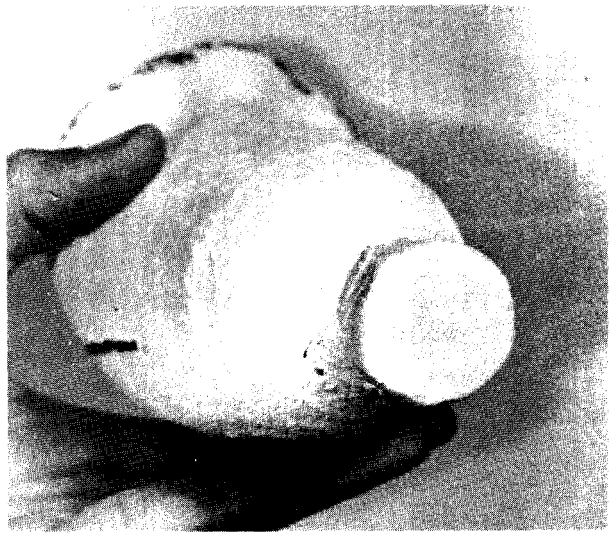
Seal the opening over the olecranon area with plaster bandage. Carefully maintain the enlargement made previously .



Form a cone extension over the distal end for the stump sock channel.

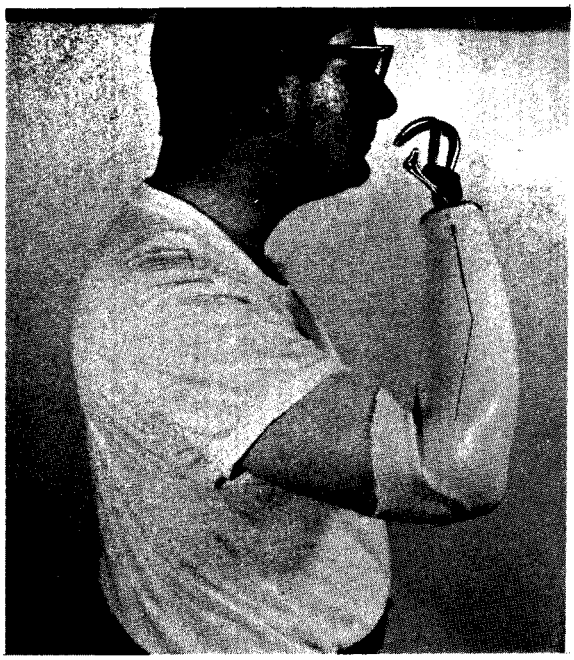


Seal over the cone. The lamination model is now ready to be made.

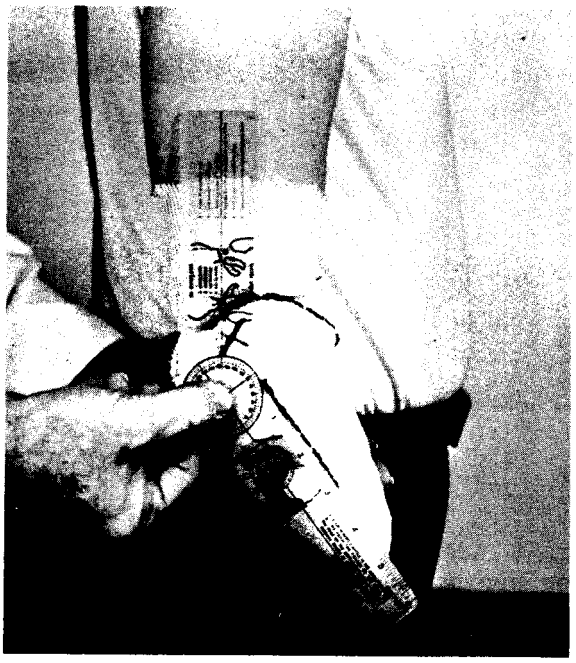


Forearm Extension Preflexion Angle

In the illustration below, the term preflexion or prepositioning is demonstrated. Prepositioning is the medical term used when the hand is positioned in relation to the upper extremity. In the illustration, the stump to the upper arm approximates the 105° angle which is the goal for the check socket. The forearm extension is positioned an additional amount of flexion which prepositions the terminal device to a range of motion most frequently used by below elbow amputees.

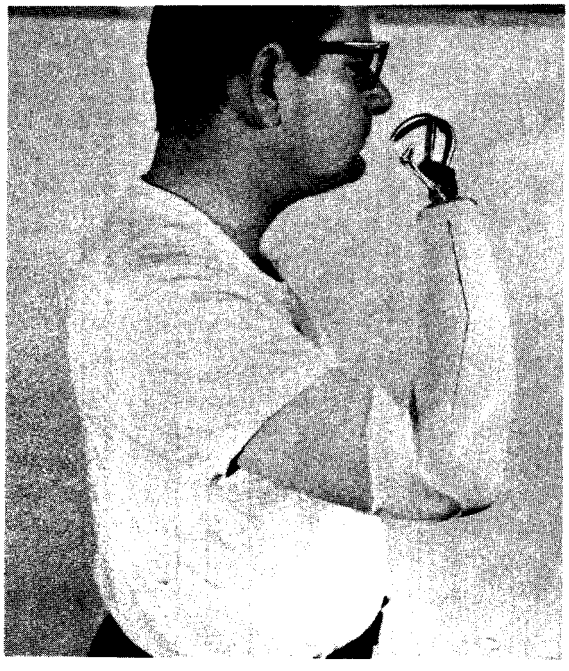


For the Muenster technique the stump motion is limited and the extended position of the stump (elbow extension) is also limited. The normal angle of the humerus to the ulna approximates 170°, in some cases 180° or more (hyperextension) may be reached. The attitude of the stump in the Muenster socket will approximate only a 145° angle without sacrifice of the retension characteristics of thesocket (illustrated below). The reduced amount of extension from the normal position required by the Muenster socket is termed initial flexion.

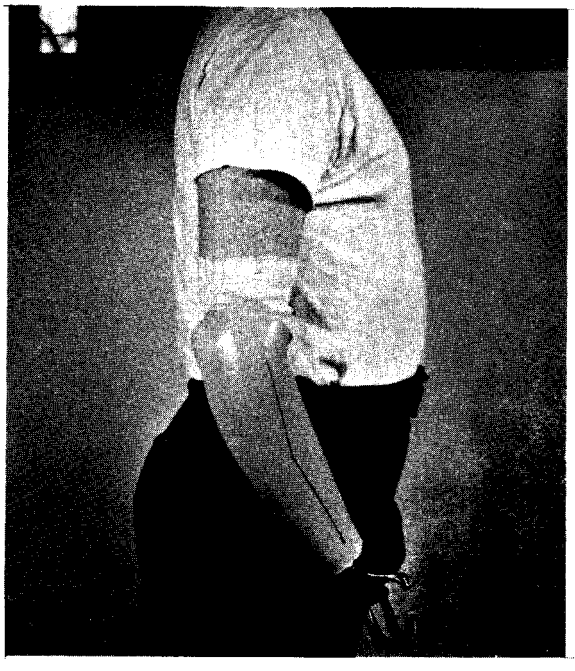


Initial Flexion 35°

The two illustrations below may help the prosthetist or clinic team and the amputee to more fully understand the biomechanics of the Muenster prosthesis.



The active elbow joint flexion is 105°, the forearm extension, 20°. The patient can reach his mouth with a slight flexing of his neck.



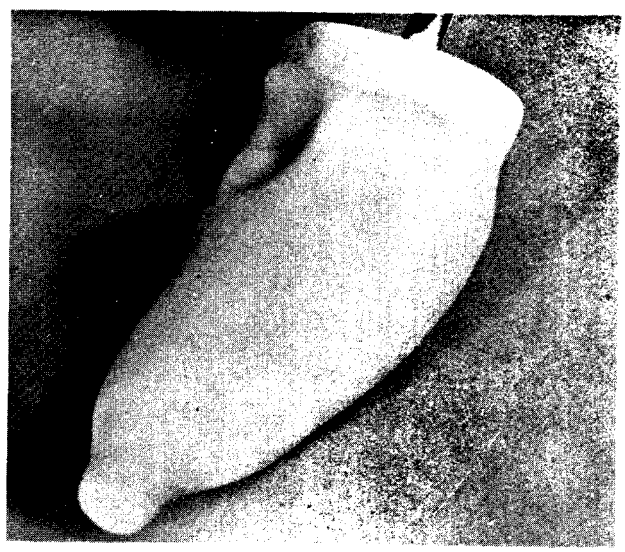
In the natural hanging position the prosthesis is similar in appearance to the normal arm.

The prosthetist should now be able to establish the desired preflexion angle in consultation with the patient. The amputee must accept the appearance of the prosthesis. A common complaint about the preflexed forearm extension and initial flexion angle is that the arm does not hang down the side. Instead, it gives the appearance of being bent at right angles all the time. Another complaint is the banana like shape. This is generally limited to the cosmetically conscious patient for whom the prosthesis is constructed with passive hand. This type of patient requires little preflexion of the forearm extension.

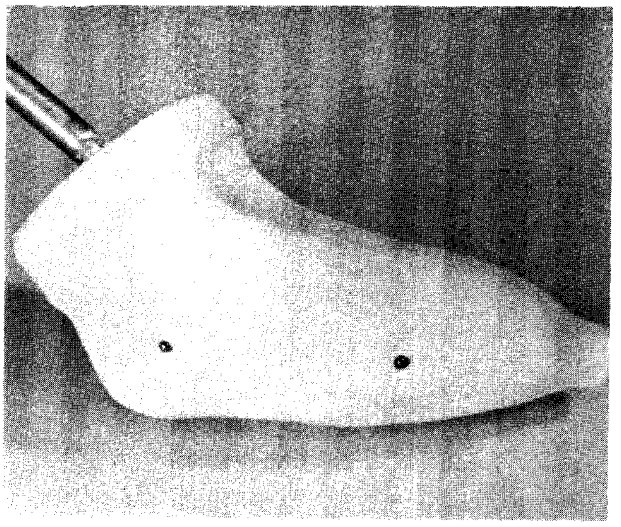
Mold Preparation For Socket Lamination

Apply a parting agent to the inner surface of the check socket and fill the socket with liquid plaster of Paris. Before the plaster hardens, insert a hollow pipe into the plaster. Make a recess in the plaster around the pipe at the proximal end of the mold approximately 1- 1-1/2 inches in diameter and 1-1/2 inches deep. To facilitate vacuum lamination, drill (approximately 1/4-inch in diameter) in the pipe towards the bottom of the recess. After the mold hardens, puncture the wrap with an awl marked earlier on the reference line. Be sure to penetrate into the mold. Project a round head screw or BB from the puncture for future alignment reference.

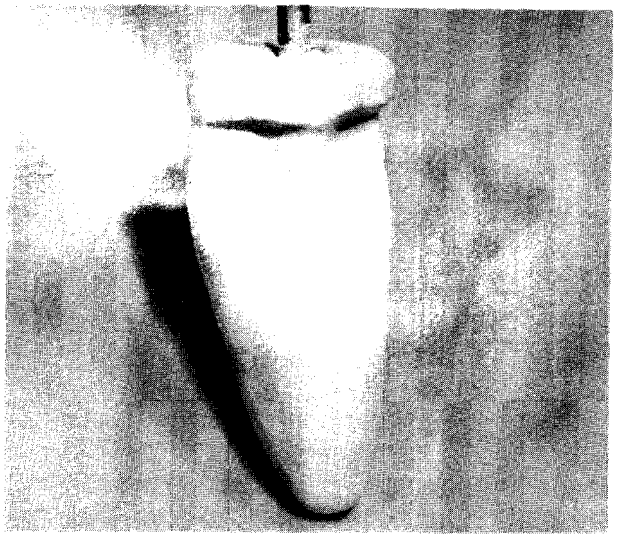
Remove the plaster wrap and smooth the mold. Do not change the proximal brim line.

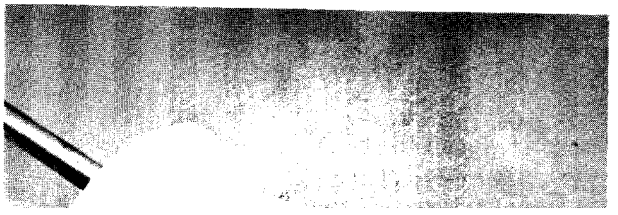


Insert the BB's or round head screws into the reference marks.



Buildups are not commonly made in this technique. If, however, the patient does have a very boney stump, build up the boney or sensitive areas previously established during the check socket fitting. Cover the model with a parting agent.





The model is now ready for socket lamination"

Plastic Socket and Forearm Extension

Materials:

dacron felt

nylon stockinette (approximately 2 inches wide)

string

PVA

scissors

heat pad (for PVA)

polyester resin, catalyst, promoter and color pigment

sander

cardboard

wrist unit

masking tape

straight edge ruler

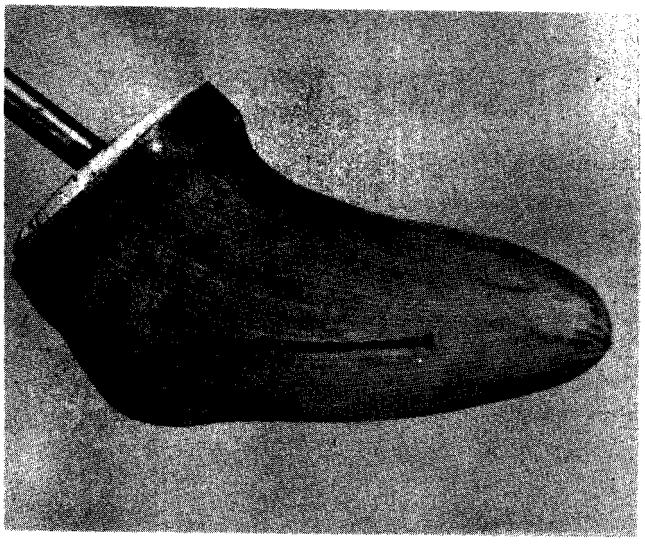
goniometer

polyurethane foam

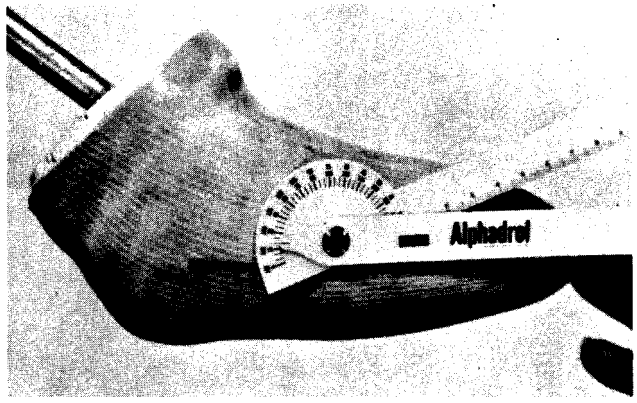
paint brush (cheap)

Standard procedure is recommended for socket lamination. The use of vacuum will make a light but strong socket (see page).

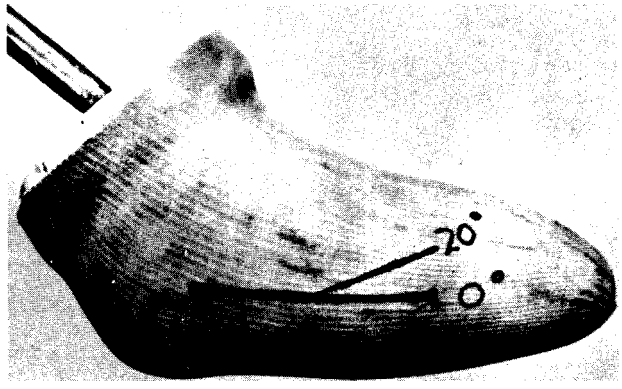
When the lamination has cured, roughen the socket so that it will bond with the final lamination. Scribe or mark a reference line from the projections on the lateral wall of the socket. If possible, this line should correspond to the long shaft of the ulna.



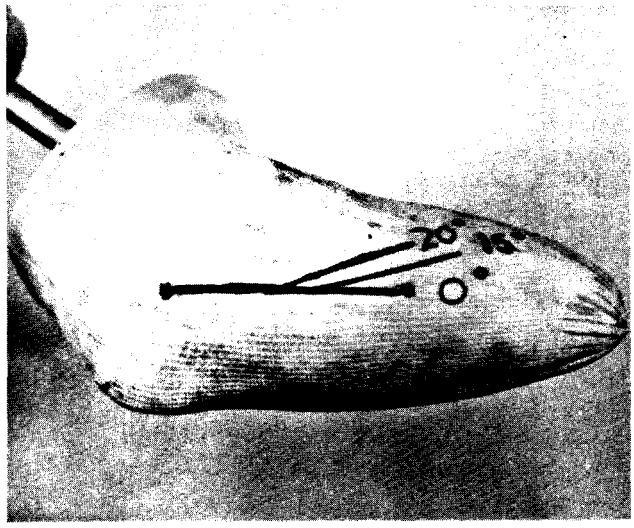
To determine the amount of preflexion of the forearm extension, use a protractor. Draw a line from the reference just established toward the anterior side of the model.



In the illustration at right, the line is drawn at a 20° angle.



The forearm extension should project distally from the 20° line. On short stumps, as much as 35° has been used.

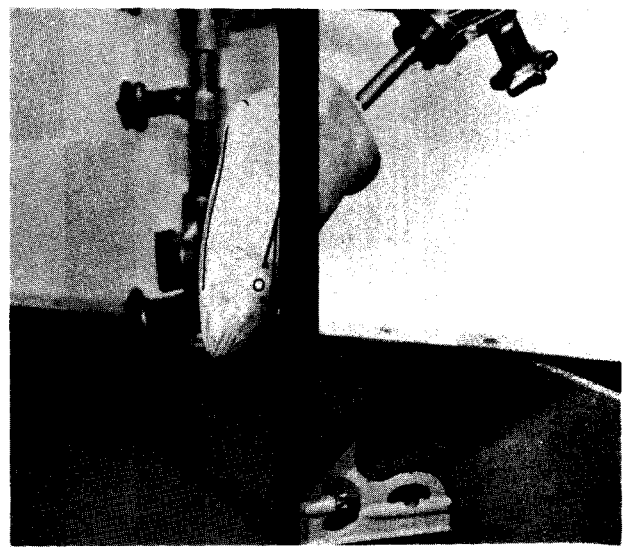


Forearm Extension Alignment

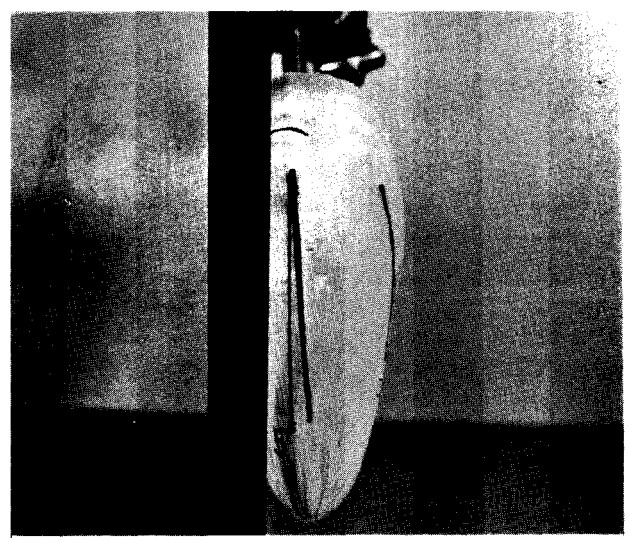
To establish the length of the below elbow prosthesis, a filler between the end of the stump and the wrist unit must be provided. This filler is the holding receptacle for the wrist unit. If the amputation is unilateral, the overall length of the prosthesis including the terminal device is equal to the length of the elbow to thumb tip on the sound arm. This is a standard procedure; variations do occur, however, for congenital anomalies or special occupational requirements. If the amputations are bilateral, consult the anthropometrical chart on page .

Materials used to form the extension vary according to stump length, and the nature of the prosthesis, exoskeletal or endoskeletal. Place the socket in a holding device. In the pictures below, the Milmo alignment jig is used. However, any suitable holding fixture may be used.

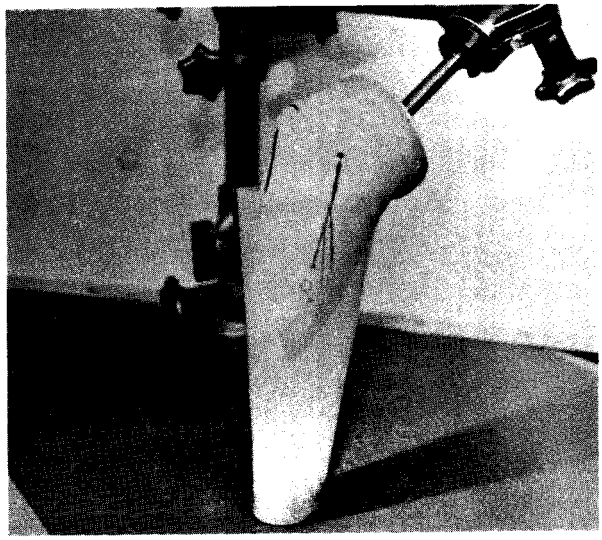
Adjust the jig to the correct length. Measure from the flat level surface up to the mark (olecranon, epicondyle or the joint spacer, whichever method is being used). At the same time align the jig to the preflexion angle reference line, as illustrated.



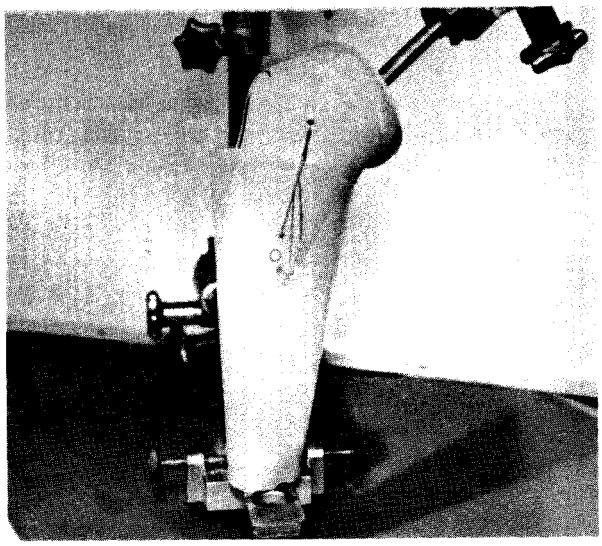
Using the reference drawn on the socket line as a guide, align the socket as follows: Viewed from the posterior aspect. To bring the terminal device inward towards the body (ulnar flexion). Tilt the socket so that it leans toward the body at the proximal end. A right arm prosthesis is illustrated. Change directions for a left arm prosthesis. Caution: Re-check both angles with a protractor. They must be correct. An error at this juncture would ruin the prosthesis. Secure the holding device so that it will not move.



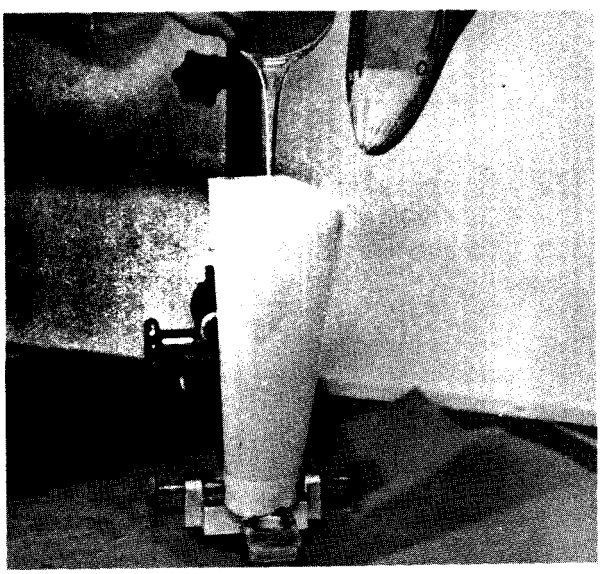
Using the prescribed wrist unit, mask the threaded hole and seal the vital parts with clay or playdough. Cover the knurled portion with masking tape to keep it clean for subsequent lamination. Make a cone for the forearm extension, (see Chapter IV, Materials). Attach the cone securely to the wrist unit. Temporarily place the wrist unit and cone into position. Adjust them for size and length desired in the buildup.



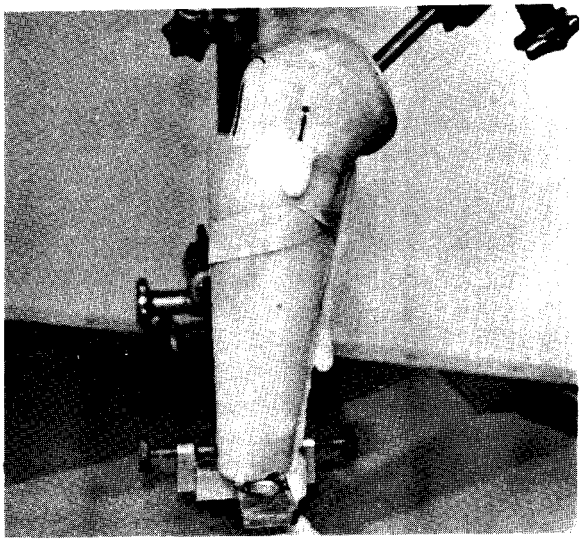
Center the wrist unit on the preflexion angle reference line on the lateral and posterior aspect of the socket. If an oval wrist unit is used, rotate it internally about 20° until it appears to hang at a natural angle and can be used on flat surfaces with a terminal device. Fasten the wrist unit and cone; they should not move. Clay is satisfactory for fastening if additional support is provided during the foaming action. A more elaborate holding device than clay is illustrated.



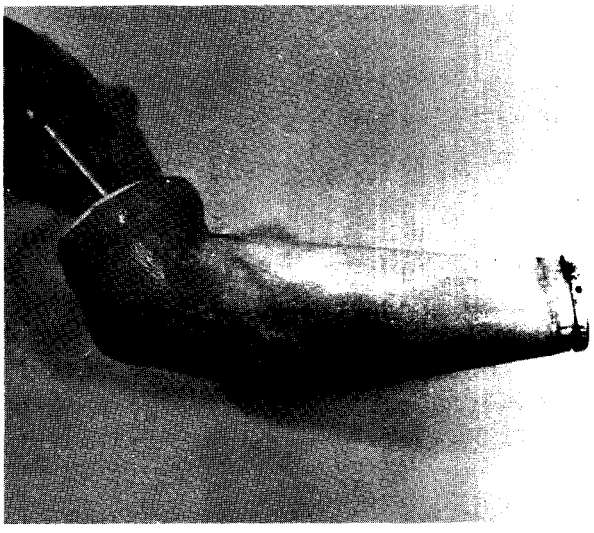
Prepare the foaming mixture (see page , Chapter IV, Materials). Pour the mixture into the cone. Safety precautions should be taken for polyurethane.



The build-up should contain ample material for shaping.



Shape and contour the foam to match the sound side as much as the wrist unit will allow. Remove all foam at the proximal trim line of the socket. Paint all of the model except the wrist unit with mixed polyester resin. This seals the foam and eliminates air bubbles during lamination. Sand the model until it is smooth; the final lamination will then bond.



Mask off the end of the wrist unit.

Final Lamination: Make a lay-up of two layers of nylon stockinette over the model; double back one piece and tie it at the groove in the wrist unit. For a heavy duty prosthesis increase the layers of stockinette. Make a PVA bag. Mix the resin, and laminate. [See page , Chapter IV, Materials .)