

Wrap Cast

Materials:

cotton stockinette (approximately 2 inches wide)
 scissors .
 elastic webbing (approximately 1 inch wide)
 Yates clamps .
 bucket of water
 sheet (to keep plaster off the patient)
 skin marking pencil
 regular plaster bandage (approximately 3 inches wide)
 towel (to clean the patient's stump)
 parting agent for cast

The wrap cast extends proximally over the condyles of the humerus including the olecranon and the cubital fold in the wrap, as shown. Mark the prominence of the epicondyles of the humerus and other areas that may need relief in the socket.

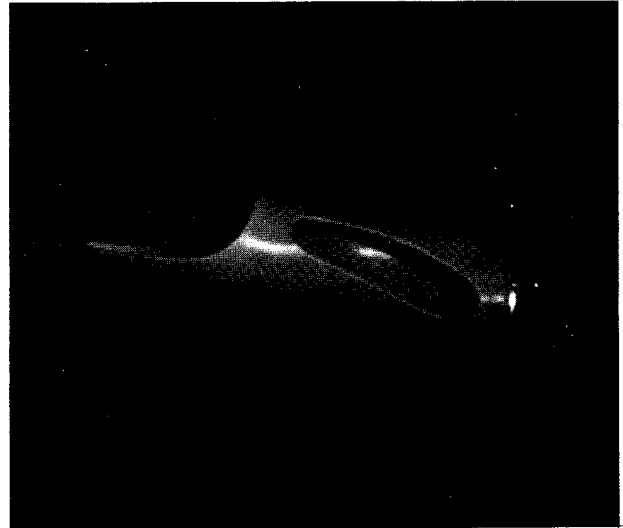


If the stump has a bulbous end, allowances must be made for the removal of the cast from the stump. This can be done in three ways. The first way is to wrap the stump with plaster, cut a slit in the cast for removal, and close the slit with plaster after the cast has been removed. This method is generally used when a window for entry and exit of the stump is planned in the socket. The second technique is to build up the stump with cotton stockinette proximal to the styloids; the stump can then slip out with no cut in the cast. This method is generally used when a socket is made that fits loosely proximal to the styloids; no window is then necessary for entry and exit of the stump. The third method

is to use alginate. This technique is sometimes used for a very bony stump; little modification is needed on the screwdriver shape to get wrist rotation with the socket. For more information on alginate, see page .

Before the cast is taken, decide what type of socket is to be used, with or without a window,

For a window cut in the socket, the amputee screws his stump into the socket. The window is not made along the ulna because that area on the socket bears the weight. This type of socket closely fits proximal to the styloids.



The amputee shown will not have the window. The socket fitting is somewhat loosely proximal to the styloids because of the stockinette added to the forearm. This method is preferred when the amputee does not have a boney, bulbous end stump.



To take the cast, sew across the end of the 2-inch wide cotton stockinette. Wet it. Pull it over the stump past the elbow and suspend it tightly with an elastic strap, as shown. A regular casting sock may be used instead of the cotton stockinette.



Position the stump for wrap casting at 80° of elbow flexion. At this angle the mass of tissue and muscle in the cubital fold will not bulge excessively and the olecranon will be sufficiently prominent to make a good indentation in the wrap cast. The radius and ulna must be in neutral pronation-supination or positioned in such a way that if the hand were present the thumb would be pointing upwards.

Apply at least two reverses over the end of the stump as shown.



Secure the reverses with circular wraps keeping the roll of plaster on the stump. Do not pull tightly on the wrap because spiral indentations will appear over the soft tissue areas. (The roll of plaster is held away from the stump for illustrative purposes only.)



Continue the wrap to the proximal line using a figure of eight wrap over the elbow area. At least three layers of plaster bandage are needed to form the proximal edge.



Complete the wrap with oblique spirals overlapped approximately halfway from the proximal to the distal end of the stump.



To obtain a wrap cast that will yield a comfortable socket and will meet the biomechanical requirements of function, the following molding methods should be used.

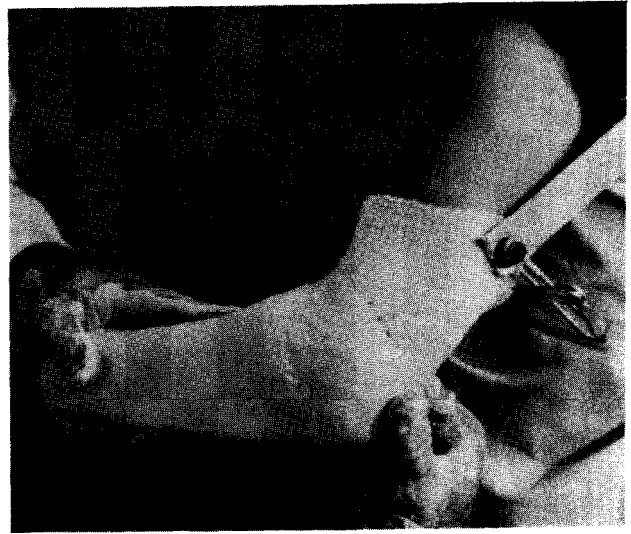
While the plaster is still wet and soft, massage the cast from the distal end of the stump to the proximal condyles. This massaging action tends to tighten the spirals on the stump.



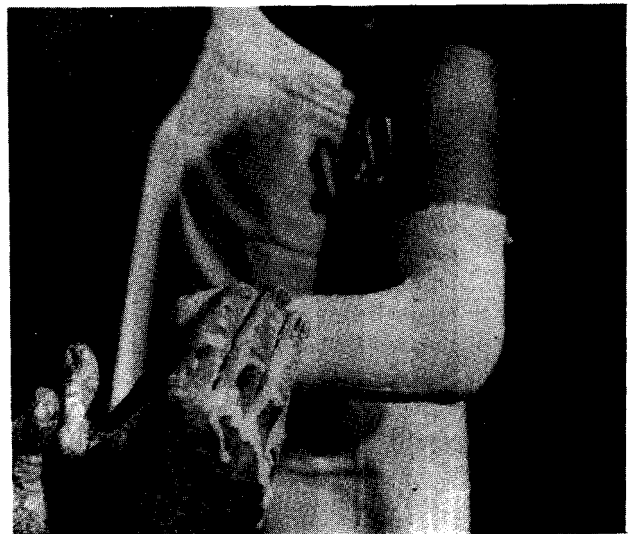
Continue to mold the cast. When the plaster becomes firm but still malleable, contour the wrap along the shaft of the ulna until it conforms to the shape of the long shaft of bone. (Do not allow the soft tissues to move over the posterior aspect of the ulna; this will cause the wrap to bend and will result in gapping along the long shaft of the bone.)



When molding the plaster over the elbow joint area, make a good definition of the olecranon. Avoid compression of the wrap over the epicondyles of the humerus.



If flexible hinges are to be used, shape the distal end in such a way that the stump can retain rotation. This rotation can be used for the prosthesis.



Moderately compress the wrap the width of three fingers on the volar and dorsal aspect of the stump. The radius should be superior to the ulna. Position the stump midway between its range of motion.

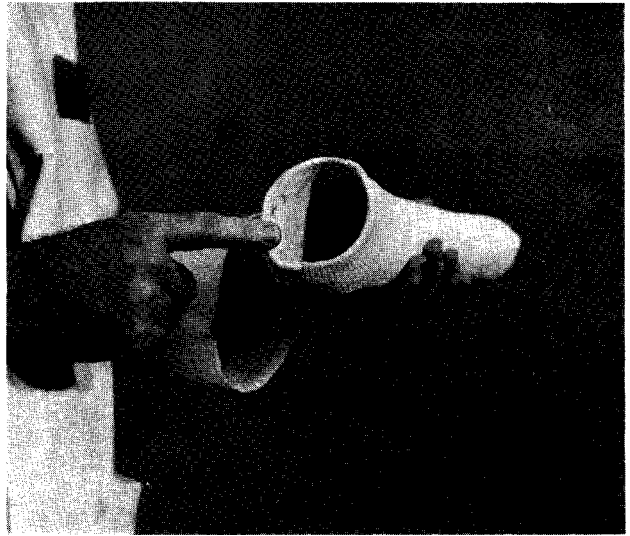
After the wrap has hardened, carefully remove the cast by first pulling away the skin from the proximal brim to break the suction. Then gently pull the cast off the stump. If necessary, shake the cast a little to get the skin loose from the sides.



If the stump is slightly bulbous, the stockinette build-up can be used to facilitate removal.



Inspect **the** inside of the wrap for wrinkles, bulges, or indentations. None should exist. The inside of the wrap should also extend proximal over the **condyles**. If the cast is satisfactory, put a parting agent on the inside for making the model. If the amputee plans to wear a stump sock, remove the stockinette from the cast.



WAX CHECK SOCKET

The prosthetist's use of the check socket technique is analogous to the technique of a fine tailor who, after taking many measurements, cuts the material and temporarily assembles it for a trial fitting. The tailor knows that despite the measurements, he will not be able to make a perfectly fitting suit until the customer tries it on and tests it for comfort and utility. During the trial fitting, the tailor alters the suit. Only after the customer and the tailor decide that the suit is satisfactory, is the garment put through the final stages of fabrication.

The fitting and fabrication of an upper extremity socket is further complicated by the fact that the socket is made of rigid material. In the case of a below elbow amputee, the socket is placed on a stump which has sensitive bony projections with little soft tissue protection. When the patient uses the prosthesis it is in constant motion; the socket transfers stresses, strains, torques and pressures upon the stump. To achieve physical comfort as well as a satisfactory biomechanical stump-socket relationship, a thorough examination of functional performance and static fit must be made. A check or trial fitting socket is used for this examination.

Two techniques are commonly practiced in the fabrication and fitting of a check or trial socket. These two differ only in the use of materials and thus sequence of steps; ultimately, however, both yield equally satisfactory results.

The first technique evolves from the early development of the upper extremity program; the most commonly used material for the check socket at this time was beeswax impregnated into stockinette. Beeswax was and still is readily available and economical but it has a very low melting point. It is so low that body heat from the stump or the prosthetist's hands will cause it to deform too easily during fitting. It must be handled cautiously. Immerse it frequently in cold water so that various functional tests can be made. It is so easily malleable, however, that it is easy to shape and conform to the general contour of the below elbow stump.

When beeswax is used, its malleability on the stump necessitates only minimal modifications of the wrap cast mode. Merely remove all unwanted bumps, ridges, and plaster over the soft tissue areas for the desired circumference, and smooth the model before proceeding with the layup and impregnation of the stockinette with the beeswax.

During fitting, when problems arise about contour or bony pressure areas, the beeswax can be easily molded and the problems solved. After the static part of the fitting is over and fit and contour have been achieved the beeswax socket should be covered with wrapped plaster or Paris bandage. It should harden before the functional test begins; the functional test requires greater force than the beeswax alone would permit.

The second and more recently developed technique involves the use of rigid synthetic waxes. Waxes most commonly used are Warco, #150 and #180. These waxes have a much higher melting point and, if the layup of the check socket has the proper thickness, allow the prosthetist to apply force during the functional tests without excessive deforming.

The following steps are for the rigid synthetic waxes but all types of material may be used to make a trial fitting socket.

Check Socket Model

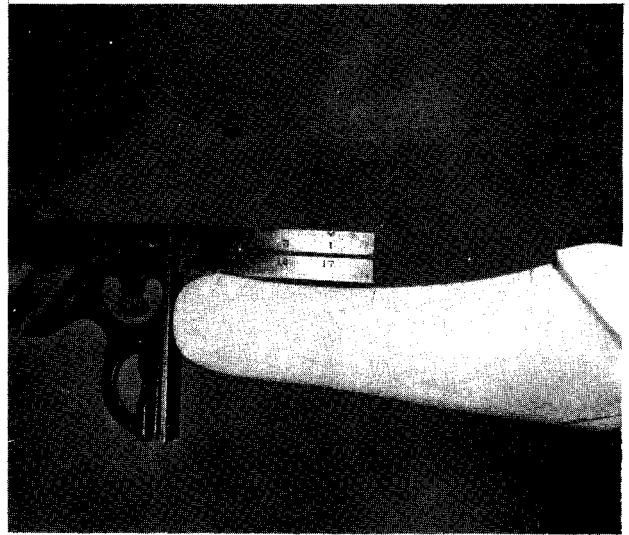
Materials:

plaster
mandrel
knife
tape measure
straight edge ruler
sureform files
sandpaper
outside calipers
parting agent for model

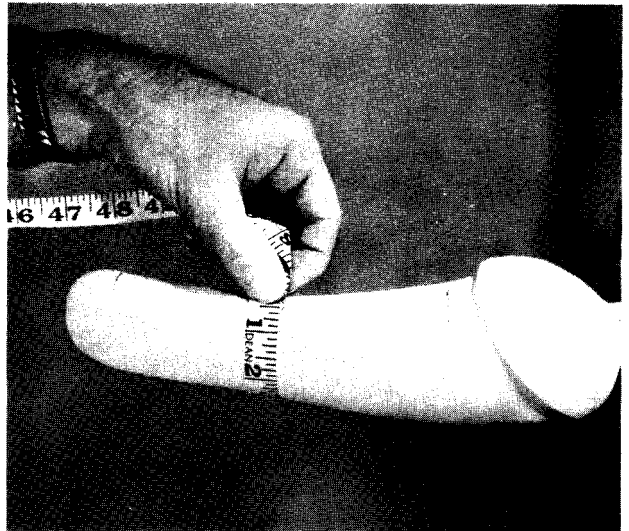
Pour a smooth mix of plaster and water into the cast. Pour along the side of the cast and then tap the cast to prevent air bubbles. As the plaster starts to harden, insert a mandrel to use for holding the model. When the plaster hardens, carefully remove the wrap.



From the prosthetic information form obtain the circumferences of the stump and the levels at which they were made. Transfer the measurements on the model as illustrated.



Refer again to the measurement form to identify bony or sensitive areas. File the circumferences of the model until they conform to the original stump measurements.



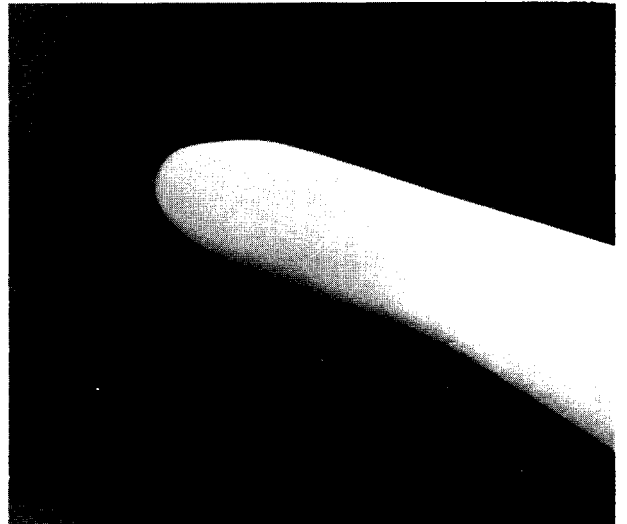
Flatten and flare the anterior-proximal area of the model to provide a good grip on the socket by the stump. Remove only enough plaster to conform to the circumference measurements of the stump.



Make buildups with plaster slurry for relief of bony or sensitive areas. Consult the prosthetic information form for any unusual conditions.

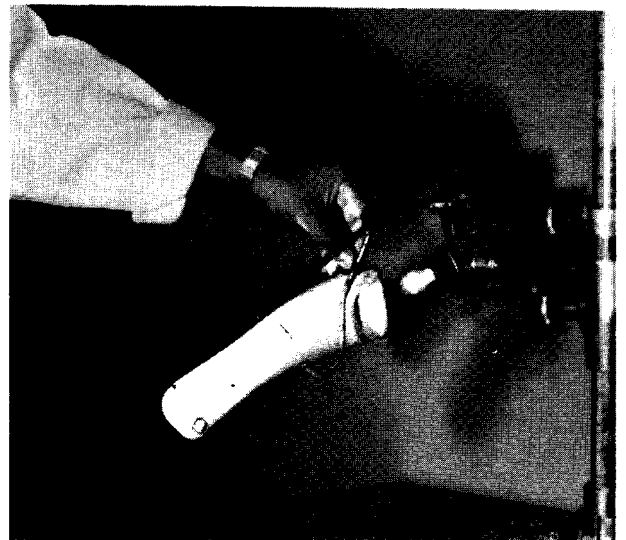
If the styloids of the radius and ulna are present, cover the area on the model with plaster 1/8-inch thick. The prominences of the radial styloid particularly need space in the socket. To obtain a good "screwdriver" effect of the stump in the socket, do not put plaster on the volar or dorsal sides of the model.

If the styloids are not present and the bony ends are without subcutaneous tissue padding and project distally, add plaster approximately 1/4-inch thick over the ends of the bony projections. A tack can be used to gauge the correct distance and placement of the slurry, as shown in the illustration.



Flexible Hinge

If a window is needed, measure the width of the styloids on the model with calipers. Set the calipers at this width. Move them proximally until the same width is reached again. To locate this level on the wax check socket, measure with a straight edge ruler the distance from the distal end. Record this on the information form.



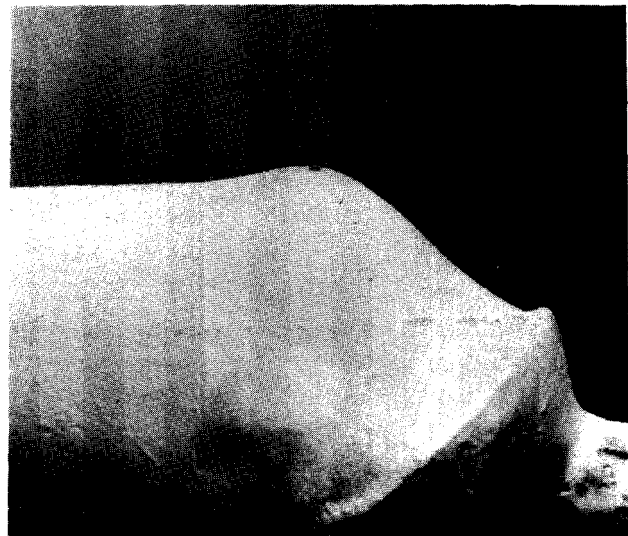
Proximal End

TO make the buildup over the olecranon, drive a tack or nail into the model at a 45° angle to the shaft of the ulna at the posterior radius of the olecranon. Allow it to project 1/4 - 3/8-inches. Add plaster of this thickness over the area, covering the full medio-lateral width of the olecranon, and maintaining the natural contour of the model. DO not make a sharp point on the buildup.



RIGID HINGE

In addition to the preceeding seven steps, add plaster 1/4-inch thick over the medial epicondyle. If the stump is bony, the area covered should be large enough to provide complete freedom of the humeral condyle.



Add plaster over the lateral epicondyle on bony stumps making the build-up 1/8-inch thick.



Smooth the model and apply a parting agent.



128

WAX CHECK SOCKET

Materials:

cotton stockinette
string
molten wax
knife
skin marking pencil
wood burning tool
powder
heat gun
goniometer

For Rigid Hinges Only:

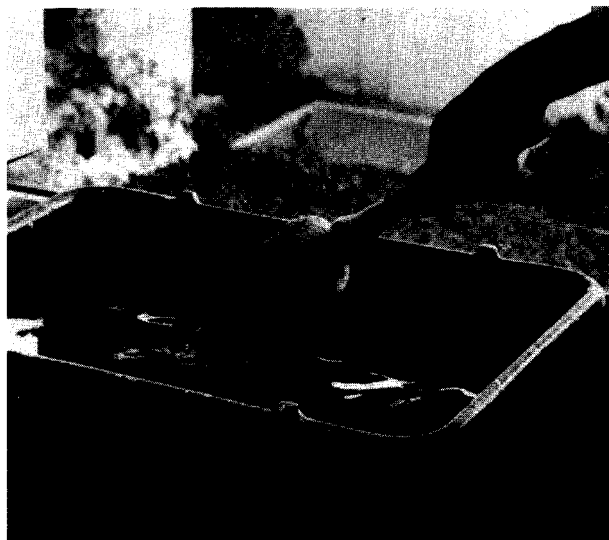
outside calipers
1/2-inch bag punch
elbow joint spacer assembly
parting agent for wax check socket

Use six layers of cotton stockinette to make the check socket layup. Cut and sew the layers to the general contour of the distal end of the socket.

Tie the stockinette. Impregnate it thoroughly with molten wax (see page , Chapter IV, Materials and Techniques). (Gloves should be worn with hot wax.)



Immerse the model into cool water to harden the wax. Leave it in the water until it turns light in color. Do not reach into the water to feel the wax. When the wax is cool enough to touch, form it over the model to avoid bridging any areas where indentations exist.

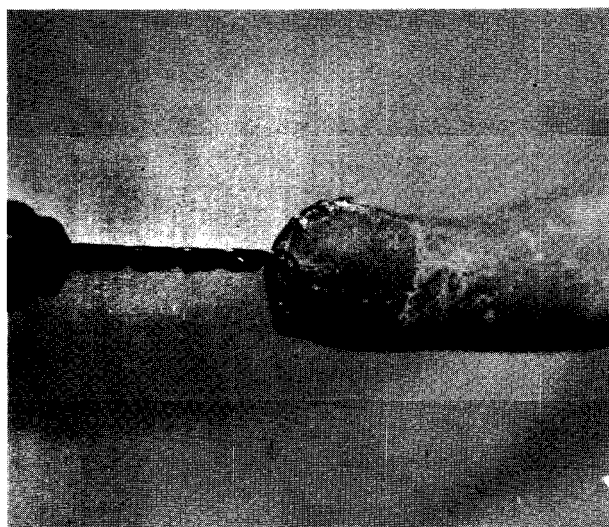


Flexible Hinge

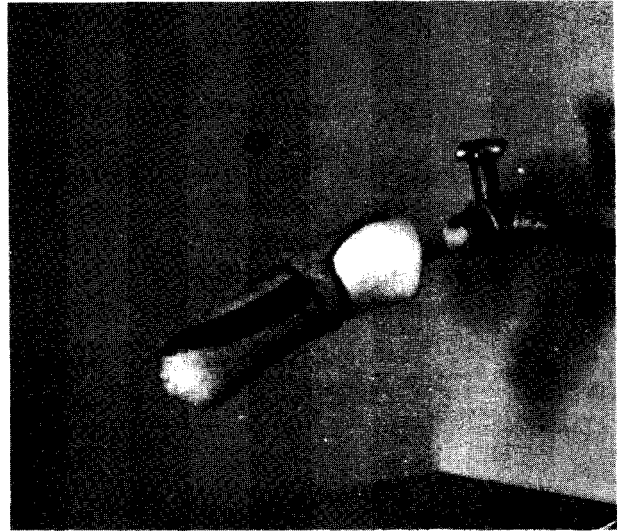
Cut the wax check socket to the approximate desired trim and pull it off the model. Heat it if necessary for removal.



The wax check socket can also be removed by inserting an air hose into a hole at the distal end and blowing the socket off the model. Save the model in case another wax check socket must be made.



If the stump has a bulbous end or the styloids are present, make a window on the wax check socket by first marking the proximal edge of the window according to the distance found in step page . Mark the distal edge of the window at the level of the styloids and then draw the window. It can be put on either the dorsal or volar side.



Cut out the window and pull the wax check socket off the model. Enlarge the window if necessary for removal. Refer to step , page

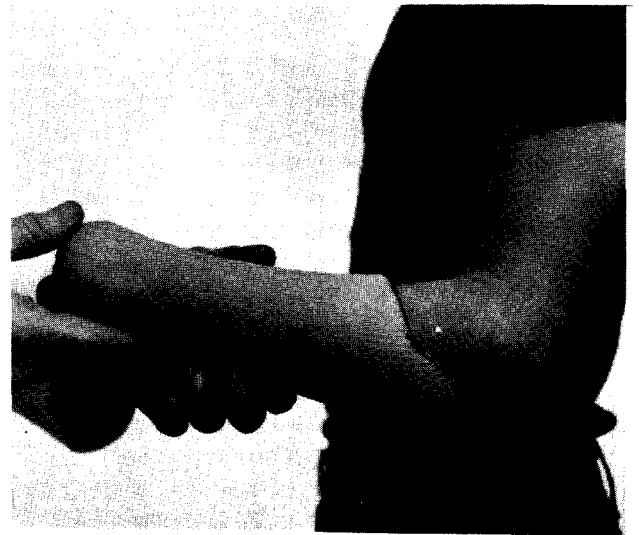


Round and smooth any sharp edges.

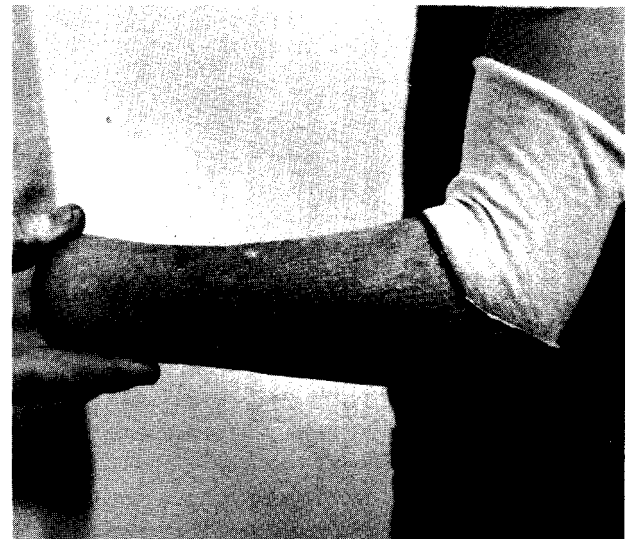


Wax Check Socket Fit

To prepare the amputee for the fitting, put on the stump sock, if any, that he plans to wear with the finished socket. Apply the check socket, using ample powder.



Observe the manner in which the stump goes into the socket. It should slide in easily with minimal force and fit snugly. Ask the amputee if it feels similar to the wrap cast. When he contracts the muscles of his stump, they should "grip" the socket. The stump should feel comfortable in the socket. If the check socket meets these criteria, proceed with the fitting.



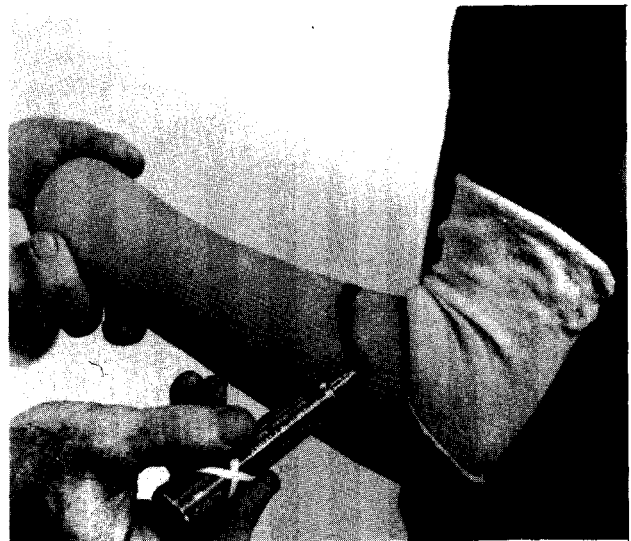
If the stump has a bulbous end, put the socket on the stump to see if the window allows entry and exit. Enlarge the window if necessary.



The socket is too loose if it goes on freely, feels loose to the patient, or falls off when the patient hangs his arm down. If the patient can wobble his stump in the socket, it is too loose. Take new measurements of the stump and rework the model as indicated to correct the fit. Make a new check socket.

If the socket is too tight, examine the stump for edema. Remeasure the stump and compare the measurements with the original ones. If swelling of the stump has caused the tightness, snugly wrap it with an elastic bandage. An edematous stump is often encountered in immediate postoperative cases.

Trim the socket to meet the functional requirements of motion. The following procedure will quickly yield good results. Mark the anterior trim line. Conservatively estimate the amount of material to be removed. The patient should achieve 135° of elbow flexion without excessive or painful pressure from the socket on the bicep tendon. Remove the socket and cut off the excess material where marked.



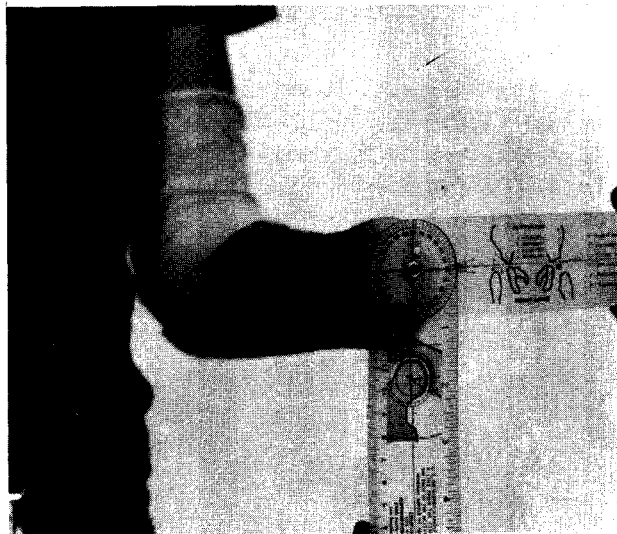
Replace the socket on the stump. Manually flare and roll the anterior trim to receive the tissues that expand at full flexion. If necessary, remove additional material from the anterior and cubital fold area. At full flexion the olecranon should remain in the socket.



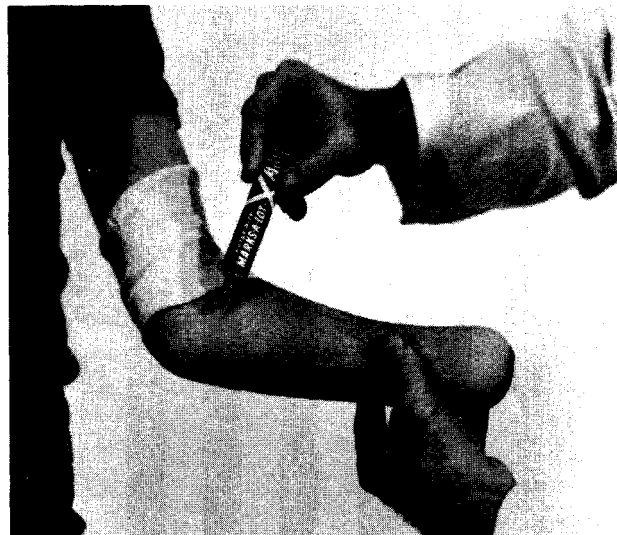
Supination - Pronation

An amputee with 60 percent or more of his normal forearm length usually retains the ability to rotate his stump. This rotation can be transmitted through the socket in acts of pronation or supination of the terminal device. The retention of this motion is of the utmost importance to the below-elbow amputee. The final prosthesis should provide the amputee with at least 50 percent of his stump motion.

With the elbow flexed 90° as illustrated, and the radius directly superior to the ulna, measure the range of stump motion without the socket on. Take this measurement again after the pronation-supination trims have been made with the socket on. The goal is at least 50 percent retention of the stump motion range.



Ask the patient to supinate his forearm. Observe the proximal brim line over the flexor muscle mass, and medial condyle. Trim the socket as illustrated. Remove small amounts of check socket material until the full range of supination has been achieved.



Ask the patient to pronate his stump. Repeat the procedures of the step above, trimming the material away from the extensor muscles and lateral condyle until full range of rotation in pronation is achieved. The socket should fit against the dorsal and volar surfaces at the distal end of the forearm.



DYNAMIC USE TESTS

Test For Elbow Flexion: Test the check socket with resistance to active flexion. Ask the patient to flex his elbow against resistance. The proximal ulna and the distal radius are the reaction points (see Chapter I, Functional Anatomy and Biomechanics). The amount of resistance used in testing should approximate load requirements of the patient's specific activities of daily living.



Discomfort can be avoided by making the posterior wall parallel to the long shaft of the ulna; the olecranon is then supported within the socket without impinging upon the epicondyles of the humerus.



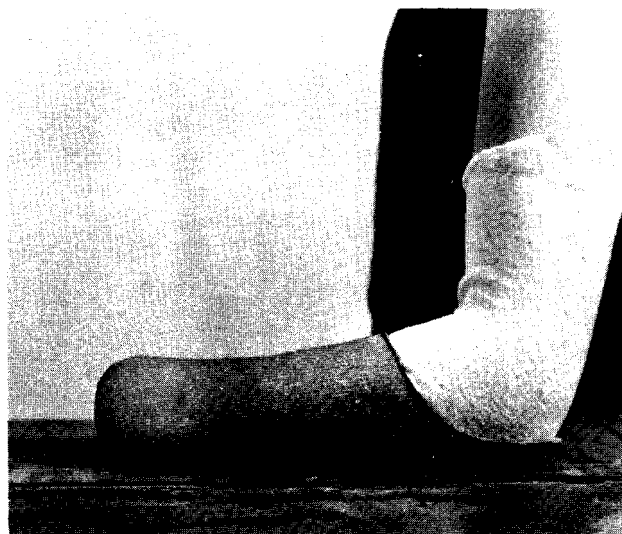
Test For Distal Stump Comfort: Ask the amputee to push into the wax check socket against considerable resistance to check for comfort. The terminal device is operated by a motion exerting a force toward the distal end of the socket as described above. Conically shaped stumps exerting wedge action against the socket or stumps with distal padding usually have little difficulty with excessive end pressures. Cylindrically shaped stumps or stumps with bony tips and no subcutaneous padding require either an open end or a R.T.V. elastomer for a distal end pad when discomfort is present during the test. (See Chapter IV, Materials and Techniques.)



Test For Rotation: To test for rotation, hold the check socket near the distal end. Ask the amputee to rotate the socket with his stump in one direction and then in the other direction. The socket should be stable enough to resist the rotational forces the amputee will create in performing tasks of daily living.



Test For Posterior Fit and Comfort: ask the amputee to force downward with the ulna against the socket wall as illustrated.



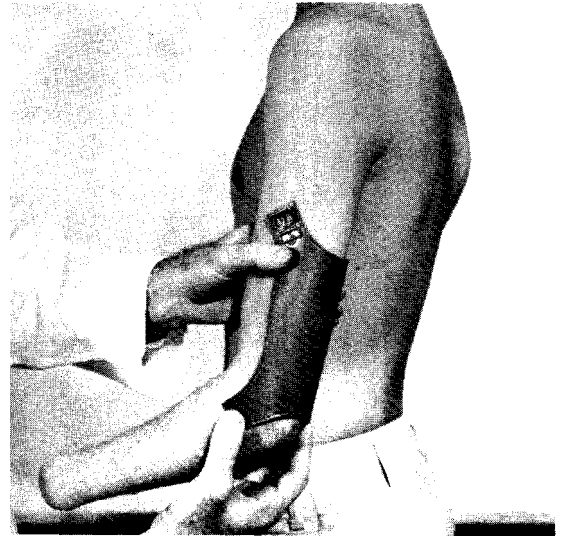
The short trial socket illustrated is recommended only for very light duty or for fitting passive hands.



Harnessing the Flexible Hinge Prosthesis

Figure-of-8 and Ring-type Harnesses

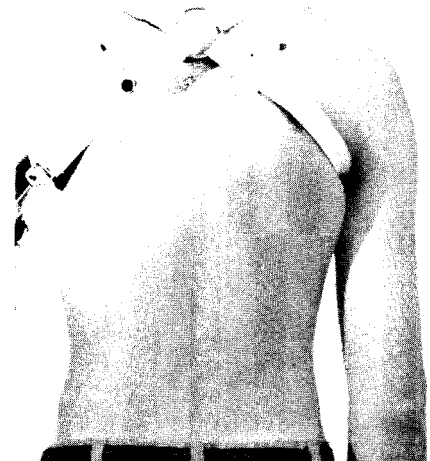
1. Apply the triceps pad to the arm, positioning the distal tabs over the epicondyles of the humerus, the upper tabs extending to the deltoid insertion. The points of attachment to the inverted Y-strap are centered on the medial and lateral aspects of the arm.



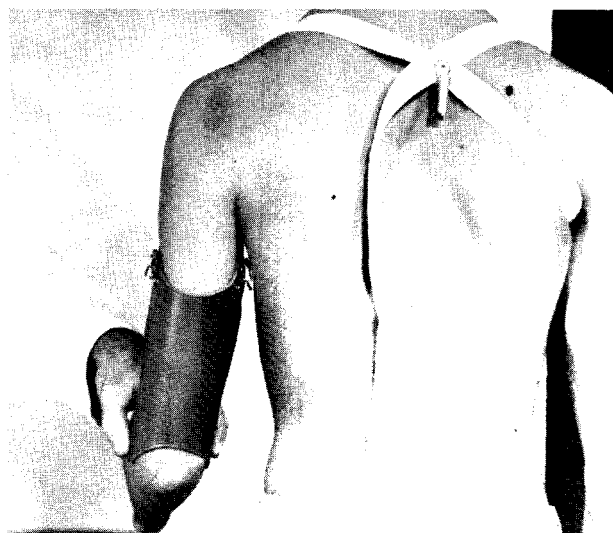
2. Attach the triceps pad to the Y-strap placing the Y approximately 2 inches superior to the pectoral tendon and lying in the delto-pectoral groove.



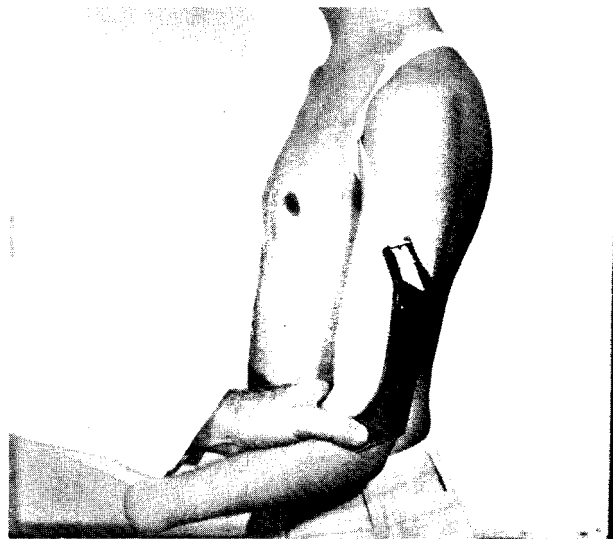
3. Continuing over the shoulder, come across the back to form the axillary loop around the shoulder and temporarily fasten it approximately 1 inch from the spine toward the sound side arm. When applying the ring harness adjust the axilla loop to center the ring at the mid-line of the body.



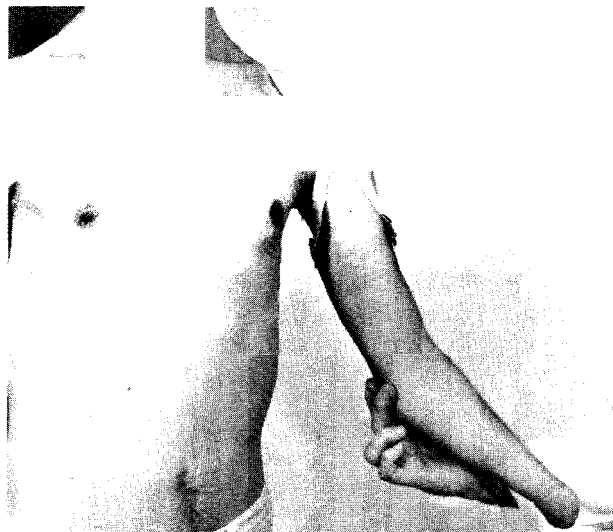
4. With the distal tabs located over the medial and lateral epicondyles, adjust the tension of the harness to lay smoothly on the body contours and without slack in it.



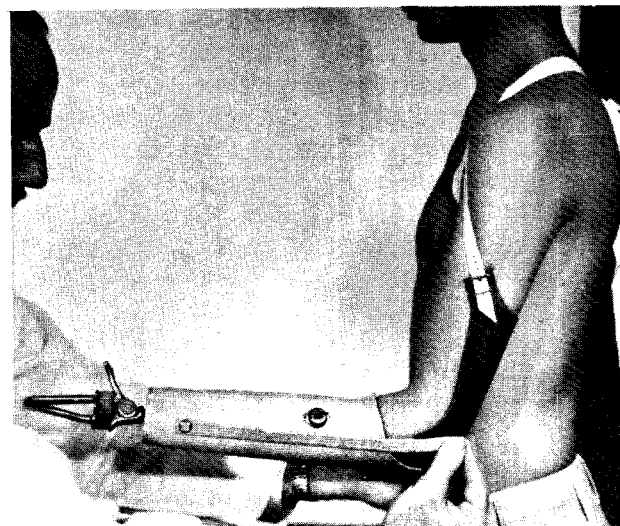
5. Have the amputee flex and extend his arm to evaluate placement of the inverted Y-strap.



6. It should not pinch the flesh or restrict the motions. Proper placement is illustrated.



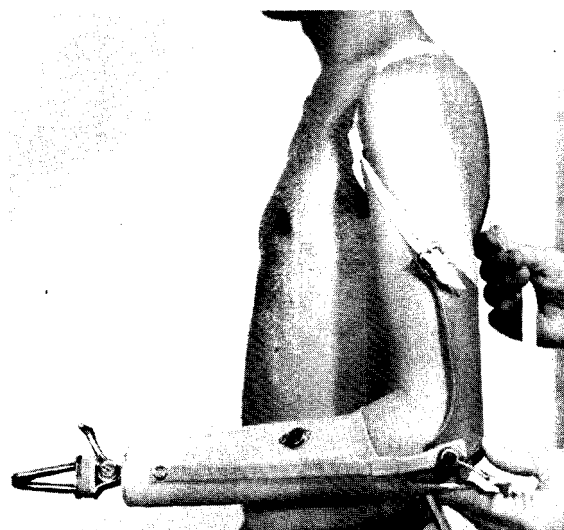
7. Continuing with the suspension system, apply the prosthesis to the stump. Use ample powder and whatever type of stump sock, if any, that was prescribed, with the elbow flexed approximately 90° and holding the medial and lateral flexible hinges over the epicondyles.



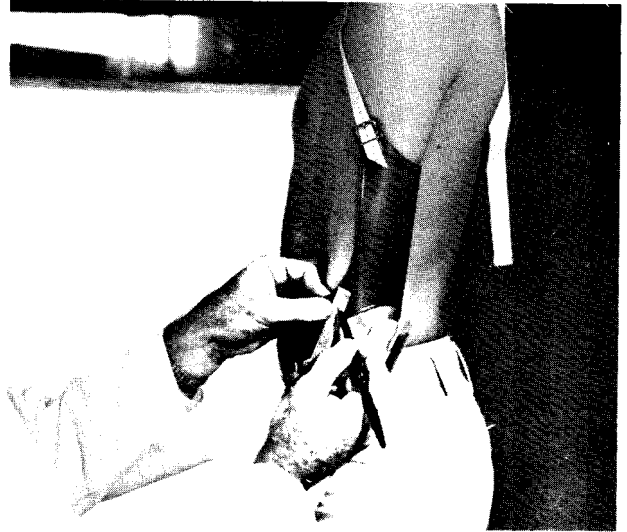
8. Locate the centers of rotation. Have the amputee slowly flex and extend the elbow.



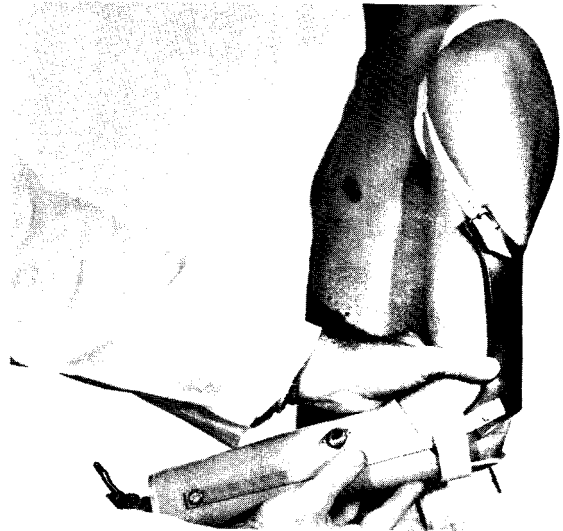
9. An alternate method is the use of clamps.



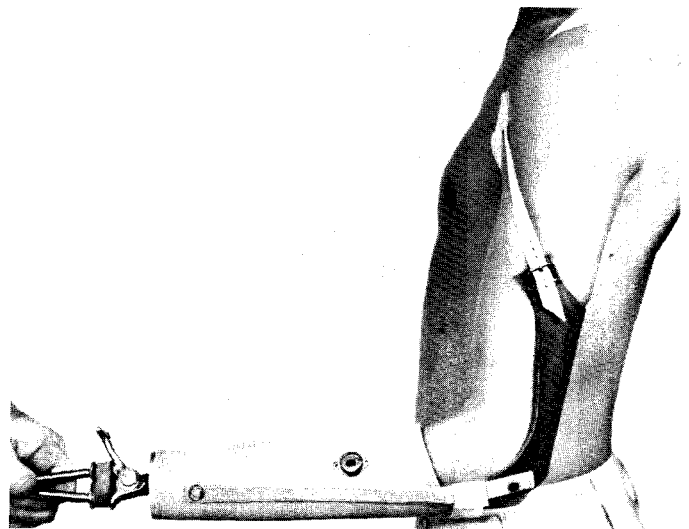
10. Mark the centers, remove the prosthesis and harness. Thread the crosshanger strap over the flexible hinges and rivet the hinges to the triceps pad. Do not tighten the rivets. The rivets should be loose enough to allow rotation. A teflon washer will prevent excess wear to the leather triceps pad.



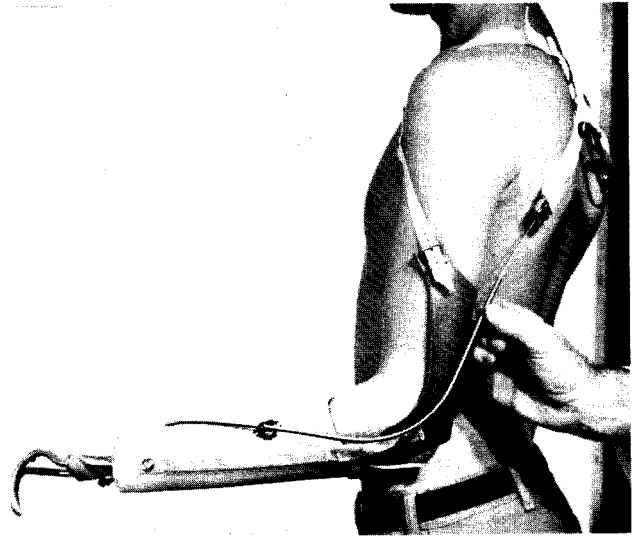
11. Apply the prosthesis and adjust the crosshanger so that it will maintain the hinge assembly over the axis of rotation. Have the amputee flex and extend his elbow to evaluate the location. Mark the location and secure the crosshanger to the flexible hinges.



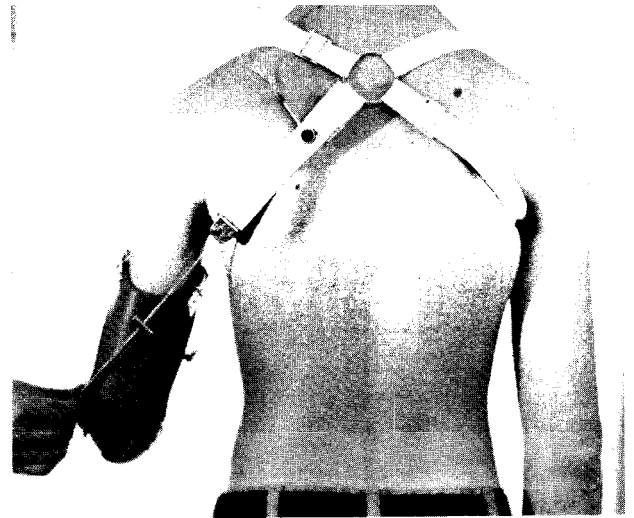
12. Hold the terminal device and direct the amputee to pull against the suspension system. The harness should maintain the socket securely on the stump.



13. Attach the controls system assembly to the prosthesis. With the hook **pronated**, apply the triple swivel to the operating lever of the hook. When a hand is used, attach it to the ball receiver. Apply the retainer to the socket baseplate. Place the control strap through the adjustable hanger doubling it back and adjusting the hanger position so that the cable will not be on the amputee's flesh. The control strap should cross the lower one-third of the scapula. Align the cable assembly to pass over the lateral epicondyle.



14. Position the cross bar so that the attachment point will be centered on the arm and at mid-humeral length. Do this by spinning the cross bar on the cable housing. Mark the location for the attachment.



15. Remove the prosthesis and attach the leather loop of the cross bar assembly to the triceps pad with a rivet.

