CHAPTER 3

The Above-Knee and Knee-Disarticulation Amputations

I. PREOPERATIVE INSTRUCTIONS
TO THE PROSTHETIST

1. When notified by the surgeon, obtain from him all necessary information required and available at this time.
   a. Side of amputation.
   b. Proposed level of amputation if this information is available.
   c. Any additional physical defects of the patient which might restrict or limit movement and/or weight-bearing and ambulation activities.
   d. Any existing or permanent flexion contractures.

2. Talk to the patient, explain your role, what you intend to do, and what is expected of him. He may be apprehensive and anxious; don’t make him more so. Explain the advantages to be derived from an immediate postsurgical prosthesis and from well-fitting prostheses, generally.

3. Consider any physical defects and/or flexion contractures noted by the surgeon which would influence casting and/or alignment of the prosthesis. Unit.

4. Take measurements for suspension waist belt.

5. Note approximate size of reticulated polyurethane distal pad required (3, 4, 5, or 6 in.). This interface material must be sterilized before application at surgery.

6. Note approximate size Orion Lyca stump sock required (see Table 2, Chapter 2, Section 1.6.). This sock must be gas sterilized before application at surgery.

II. PREOPERATIVE PREPARATIONS
BY THE PROSTHETIST OF MATERIALS
AND COMPONENTS

1. PKS ABOVE-KNEE SUSPENSION WAIST BELT FOR ADULTS:
The adjustable suspension waist belt is manufactured in five standard sizes and has been specifically designed and developed for immediate postsurgical prosthetic fitting. The sizes consist of extra small, small, medium, large, and extra large, for waist measurements ranging from 28 to 44 in. These are usually sufficient for all above-knee and knee-disarticulation applications. They are constructed for use on either right or left applications (Fig. 107).

After selecting the proper size, prepare the waist belt by removing the four distal suspension straps and buckles and the underlying portion of the felt apron opposite the amputation side (Fig. 108).

![Figure 107](image1)

![Figure 108](image2)
Above-Knee Suspension Waist Belt for Children:

A proportionately smaller and simpler version of a suspension waist belt for children is custom made for each individual prior to surgery. The basic design consists of a 2-in.-wide cotton webbing waist section incorporating a safety buckle which is located on the amputation side. The waist section is lined with ½ in. cloth-type cotton felt which extends diagonally 8 in. to form the protective felt upon the amputation side. The two shoulder and four cable suspension straps are made of 1-in.-wide cotton webbing and are sewn or one end to the waist section of the belt. These straps are adjustable by means of the corresponding safety buckles (Fig. 106).

2. Above-Knee Suspension Cables:

The two stainless steel Bowden cables are provided with 6-in. strap retainers on both ends. A portion of the cables is covered by a wire housing which is enclosed in plastic tubing. Two sets LARGE and SMALL are sufficient for most applications.

LARGE: 22 in. cable length 15 in. housing length
SMALL: 18 in. cable length 11 in. housing length

If necessary, other than the above sizes can be prepared. However, for all applications, standard or special, retain a minimum 3 in. free cable travel to allow for a minimum of 90 deg. hip flexion.

3. Select and assemble an appropriate adjustable above-knee prosthesis unit and pylon (Fig. 110). The ideal above-knee unit should include all the characteristics of the below-knee unit and in addition, be capable of providing constant friction in the knee joint with a minimal knee locking mechanism and extension stop.

4. Obtain a shoe from the patient at least one day prior to surgery and fit a SACH foot to it. If the patient is unable to walk or if the shoe should be unsatisfactory for proper fitting and alignment, a Kingsley Immediate Post-surgical SACH foot is selected. A neoprene rubber heel can be glued to a conventional SACH foot to level it in order to achieve proper static and dynamic alignment of the prosthesis when the patient stands.

Although for the sake of uniformity and simplicity...
THE MANAGEMENT OF LOWER EXTREMITY AMPUTATIONS

ABOVE-KNEE ADJUSTABLE PROSTHESIS

(-31) Socket Attachment Strap

(-32) Tube and Foot Attachment Plug

(-33) Metal Knee Clamp

(-35) Anterior-Posterior Slide Plate and Detachable Socket Attachment

(-35A) Thumb Screw

(-36) Wedge Disk

Adjustable Friction

Manual Knee Lock

(-37) Combination Base Plug and Medial-Lateral Slide Plate

(-37A) 5/16 Hex Nut and Washer

(-37C) Central Bolt

Fwax 110
Regardless of how limited ambulation activities may be in the days following surgery, a certain rhythm or gait pattern is being established and provides the patient with a varying degree of stability and function. The extent to which the components of the immediate postsurgical prosthesis resemble the definitive prosthesis is directly reflected in the transition of one to the other. If these components differ substantially (a friction knee versus a hydraulic swing-phase control unit, or a SACH foot versus a mechanical ankle joint), the patient is forced to adopt a new gait pattern to compensate for the new sensation and prothetic function.

If a hydraulic knee is indicated or required, the Hydra-knee swing-phase control unit mounted in a Hydra-Cadence frame and adapted to pylon use, can be quickly interchanged with the conventional constant friction knee pylon since the two types have identical adjustable prothetic units and disconnect features (Fig. 113 and 114).
Using these available interchangeable units and components enables a simple, quick, and reasonably accurate assessment of prosthetic performance and determines patient requirements even prior to the time when the stump is ready for cast and measurements for the definitive prosthesis. This procedure provides the entire clinic team with an economical and effective diagnostic tool to determine the most suitable prosthetic component to be used in the patient’s definitive prosthesis.

5. Assemble components and materials required for above-knee or knee-disarticulation rigid dressing application (Fig. 115) (see Appendix B for List of Suppliers):

a. Stock interface material (reticulated polyurethane sled pad)
b. Sterile Orlon Lycon stump sock
c. 23 in. long, 6 in. wide biaxial stocking or equivalent
d. Knee-disarticulation felt relief pad, if required
e. Above-knee suspension belt
f. Above-knee suspension cables
g. Prosthetic unit, tubing, and hose clamp to form immediate prosthesis
h. Immediate postsurgical SACH foot with belt
i. Dow Corning Medical Adhesive Spray, Type B
j. 3 rolls of 5 in. elastic plaster bandage
k. 2 rolls of 4 in. conventional plaster bandage, extra fast setting
l. 9 plaster splints, 4 in. x 15 in., extra fast setting
m. PRS above-knee casting fixture, right or left

6. Assemble kit of tools required for fitting prosthesis immediately after surgery (Fig. 116). All tools except stainless steel tools, have been stripped, polished, and chromed to allow for repeated sterilization when required.

a. Straightedge
b. Tube cutter
c. Metal shears
d. Cottonwood screwdriver
III. THE ABOVE-KNEE AMPUTATION SURGERY

The patient is prepared for surgery in the usual manner. When possible a tourniquet is provided high on the involved extremity. The tourniquet should be inflated only when the circulation is found to be adequate. A standard ("fish-mouth") incision is made through the skin to depth of the fascia starting medially and laterally just distal to the level of intended bone transaction. Short equal anterior and posterior flaps are formed, each of which measures in length approximately two-thirds of the diameter of the thigh at the level of amputation. The skin flaps including fascia are carefully dissected proximally up to the level of intended bone transaction. Generous skin flaps must be provided to avoid a common error in above-knee amputation—wound closure under excessive tension.

The anterior musculature is divided sharply with a large scalpel blade or with an amputation knife. The muscle is sectioned well beyond the level of intended bone transaction to permit muscle stabilization. It is especially important that the anterior muscle flap, i.e., the quadriceps flap, is left moderately long since it will be used in the combination myodesis-myoanastomosis for stabilizing the muscles. The bone is sectioned, then major vessels and nerves are treated appropriately, and the amputation completed leaving the muscles long. The posterior fascial-cutaneous flap should be left adequately long laterally and medially for appropriate coverage and closure.

Stabilization of muscles in the above-knee amputation is now carried out. A tension myodesis is formed by placing approximately six drill holes circumferentially around the distal cortex of the femur using a 3/16 in. drill. Muscles are then sewn with appropriate sutures, fixing the muscle groups to the bone while distal traction is applied to the muscles so that their resting length can be maintained. Care must be taken not to sew the muscle groups in such a way as to produce a flexion or adduction contracture. The long anterior flap is then left intact after other muscle groups have been sutured about 1 in. distal to the end of the bone suture line. The anterior flap is pulled over the end of the bone and sewn to the fascia overlying the posterior group as described by Musched (11) (Fig. 117).
Stabilization of muscles in the above-knee amputation is essential. If circulation to the thigh musculature is tenuous, mattress sutures should not be placed through the bulk of the muscle but can be placed through the deepest fascia layer. The fascia overlying the respective muscle groups is then used to stabilize the thigh musculature over the end of the bone. Thinning of the muscle groups may be necessary to reduce muscle bulk prior to stabilization (Fig. 118, 119, 120, and 121).

**Figure 118.** Above-knee flap amputation with major muscle groups prepared for stabilization.

**Figure 119.** Muscle stabilization by myodensal-mysplate.

**Figure 120.** Wound closure with drainage.

**IV.**

Knee

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THE ABOVE-KNEE AND KNEE-DISARTICULATION AMPUTATIONS

IV. THE KNEE-DISARTICULATION SURGERY

Knee disarticulation is used by many surgeons as the primary major amputation for peripheral vascular disease. It has the advantages of simplicity, relative lack of surgical shock, and modest blood loss. It can provide an effective end-bearing stump which has good tolerance to weight bearing and fits comfortably in an appropriate prosthesis. Knee disarticulation postures have so improved recently that appearance is acceptable; also most intrinsic knee mechanisms including hydraulic assist can be incorporated into the limb.

The classical knee disarticulation utilizes a long anterior flap. With the below-knee amputation which we perform for peripheral vascular disease using long posterior musculaterdorous and skin flaps, essentially the same anterior skin is utilized as would be needed in the classical knee disarticulation. For this reason we prefer the below-knee amputation and seldom employ knee disarticulation in the ischemia patient.

Under other circumstance, specifically trauma, infection, and neoplastic disease, knee disarticulation may be the amputation of choice. This is particularly the case with active, younger males. The long, strong, femur lever arm, the broad irregular distal condyles, and the opportunity to stabilize surgically the powerful crossknee musculotendinous structures into the femoral intercondylar notch make for excellent prothetic tolerance and function.

Knee-disarticulation management with immediate prosthetic fitting has been quite successful. The surgery is performed in the classical manner with a long anterior skin flap. Muscles are routinely stabilized according to the technique of Murdoch (11).

suturaing the patellar tendon to the remaining stump of the cruciate ligaments in the intercondylar notch and also drawing one or more of the medial hamstring tendon and biceps tendon into the notch thus stabilizing the hamstring muscles also. The patella is ordinarily not disturbed. The condyles of the femur are not shaved nor rounded unless unusually prominent. The synovium is not removed. The articular cartilage on the distal femur is not disturbed. Suction and/or Penrose drainage is routinely used. Postsurgical drainage is essential.

The resulting stump is strong with good quadriceps and hamstring muscle power. The somewhat bulbous terminal bony portion of the stump resulting from the contours of the condyles and patella can be easily managed by a flexible prothetic insert. The thigh portion of the socket need not be "fluted" to accept the stump. This somewhat bulbous and irregular contour augments rotary stability of the stump within the socket and increases the effectiveness of the stump socket control (Fig. 122, 123, 124, and 125).

FIGURE 121.—Healed above-knee stump with muscular cylindrical configuration.

FIGURE 122.—Patellar tendon and hamstring muscles sutured under tension in the intercondylar notch.

FIGURE 123.—Schematic drawing of Figure 122.
V. THE ABOVE-KNEE AND KNEE-DISARTICULATION IMMEDIATE POSTSURGICAL PROSTHESIS

A. PREPARATORY REQUIREMENTS BEFORE APPLICATION OF THE RIGID DRESSING

1. Position the patient on the operating table so that the entire stump and buttck area extends well over the side of the table. The sterile Orion Lyona stump sock, which is rolled on under tension to the level of the perium by the surgeon, is now cut vertically at the region of the adductor brevis (Fig. 126).

The desired depth of the cut extends 3⁄4 in. distal to the perium when the assistant is applying firm proximal pull on the stump sock. Tissue bunching such as an adductor roll or cutting of the stump sock into soft tissue causing tissue displacement must be avoided. Stump sock tension is satisfactory when the medial distal stump area appears well supported and compressed by the proximal pull on the stump sock. Now to what level the proximal portion of the stump sock extends on the lateral aspect of the hip or waist (Fig. 128).
The exposed skin including the waist and hip, and the entire inner surface of the stump sock are sprayed with Dow Corning Medical Adhesive, Type B (Fig. 130). Allow 5 seconds for the adhesive to become tacky.

3. Insert both hands between the stump sock and its folded back portion and stretch the material by expanding the hands in a lateral-proximal fashion. Slowly reapply the stump sock with firm even pressure, avoiding wrinkles in the application (Fig. 131). An assistant is useful in this application but not absolutely necessary.
4. The proximal portion of the stump is held suspended by an assistant (Fig. 132) or by the shoulder suspension harness (Fig. 133).

5. A 53-in.-long, 6-in.-wide bias-cut stocking or equivalent is prepared by spraying one of the leg borders 2 in. wide with Dow Corning Medical Adhesive, Type B (Fig. 134).

Also apply medical adhesive on the stump sock in a 2-in.-wide circle starting at the proximal border in the prepuce, the Scarpa's triangle, over the rectus femoris to an area just proximal to the greater trochanter. Posteriorly stay slightly below the gluteal fold and the level of the ischial tuberosity (Fig. 135, 136, and 137).
Allow 5 seconds for the adhesive to become tacky and apply the perineal apron by applying some stretch to the stockinet which will avoid wrinkles in the material. (Fig. 136 and 139).
6. To avoid circumferential socket displacement, the rigid dressing or cast socket, is contoured into a modified quadrilateral shape. The PRS above-knee casting fixture developed for this purpose is fitted with the stump usually in an adducted and slightly flexed position. The anteroposterior dimension is approximately \( \frac{1}{2} \) in. larger than one would normally use in constructing an ischial weight-bearing socket. This procedure places the ischial obturator inside the cast socket and not on the posterior socket wall. This results in a gluteal weight-bearing situation only, which prevents possible proximal constriction to blood flow by the rigid dressing, and assures distal tissue support (Fig. 140).

![Figure 140](image)

Once all adjustments have been completed, the handle of the PRS above-knee casting fixture is placed in the open position and the fixture is removed from the stump. To compensate for the initial elastic plaster bandage wrap, the anteroposterior and mediolateral dimensions of the fixture must be increased between \( \frac{1}{4} \) and \( \frac{1}{6} \) of an inch.

7. A sterile reticulated polyurethane distal pad of the proper size is selected, trimmed, and shaved and applied over the distal end of the stump (Fig. 142).

![Figure 142](image)

B. APPLICATION OF THE RIGID DRESSING

1. For the initial wraps, elastic plaster bandage is used rather than conventional plaster. When using an elastic plaster bandage, the elasticity provides safe and beneficial compression of the stump while conforming well to its contours, providing a smooth rigid dressing. Continuous tension must be maintained on the stump sock until the plaster has hardened.
Wraps 1 and 2:
The wrap is always started on the distal lateral aspect of the stump. Cover the proximal feathered edge of the polyurethane distal pad with the elastic plaster bandage. Minimal tension is applied to the bandage with this circumferential wrap, clockwise for a right stump and counterclockwise for a left stump when viewed anteriorly (Fig. 143).

One and three quarter circumferential turns will secure the polyurethane distal pad in place and anchor the elastic plaster bandage to itself (Fig. 144).

Wrap 3:
The wrap is now at a point posterolaterally. Now bring it anteriorly up over the distal LATERAL portion of the stump pulling the plaster bandage almost to the limit of its elasticity (Fig. 145). At the anterior stump margin release the tension and carry the wrap medially and then posteriorly with only a light pull on the plaster bandage.
Wrap 5:
The fifth turn is brought anteriorly up over the distal **medial** aspect with the same controlled tension to the bandage (Fig. 147).

**Figure 147**

Wrap 6:
To achieve desired cast strength, a second diagonal layer of elastic plaster bandage is applied by repeating wrap 5 (Fig. 148).

**Figure 148**

Wrap 7:
... followed by wrap 4, again altering the direction of the wrap medially. This will cover the distal **center** of the stump with the second layer of plaster (Fig. 149).

**Figure 149**

Wrap 8:
Repeating wrap 3 will now cover the distal **lateral** stump with the second layer of plaster bandage (Fig. 150).

**Figure 150**

The remainder of the elastic plaster bandage is wrapped in a circular manner proximal on the stump, overlapping partially each previous turn (Fig. 151).

**Figure 151**
2. Still maintaining continuous tension on the stump sock, a second roll of elastic plaster bandage is started slightly distal to the level where the previous wrap terminated (Fig. 152).

This new wrap is carried proximally on the stump 2 1/2 to 3 in. past the level of the perineum on the posterior, lateral, and anterior aspects (Fig. 153). Only minimal tension is applied to the plaster as the wrap proceeds proximal, with none exerted at the upper third of the rigid dressing brim. This is to avoid proximal constriction to the blood flow.

Note: The circumferential wraps are smooth and even and overlap half of each previous turn. The elastic plaster will curl backwards on the proximal cast-socket brim if the desired tension is exceeded.

Be certain to bring the wrap high enough anteromedially (Scarpa's triangle) and posteromedially (ischial tuberosity) to insure a smooth well-rounded socket brim (Fig. 154 and 155).

FIGURE 152

FIGURE 153

FIGURE 154
3. (a) Following completion of the initial cast application and while the elastic plaster is still wet, the FRS above-knee casting fixture, with the handle DOWN in the "open" position, is applied over the plaster wrap (Fig. 156). Position the posterior brim of the cast fixture at the level of the ischial tuberosity. This usually provides sufficient clearance between the medial-proximal socket wall and perineum when the stump is adducted.

(b) Being the handle of the casting fixture gently in the UP (closed) position (Fig. 157). Place the stump in its proper attitude of adduction and flexion and make corrections to the A-P and M-L dimensions if the plaster allowance proves excessive or insufficient. Hold the lateral wall of the casting fixture distally against the stump and check for proper contours, adjust if necessary. Check for ¼ in. clearance between the perineum and the medial-proximal socket wall.

(c) Free one hand by holding the casting fixture in place with the stomach and pull firmly on the medial aspect of the perineal apron and the portion of the split stump sock (Fig. 158). This insures proper brim flare and clears the stump sock and stockinet of wrinkles. This same procedure should be repeated on the posterior-medial socket wall.
(d) At the anterior proximal cast socket brim, roll back any excess plaster bandage protruding past the Scarpa's pad of the casting fixture (Fig. 159). Form a relief in the same manner around the area of the rectus femoris to avoid contact with the iliac crest causing possible socket displacement distally when the hip is flexed to 90 deg.

(e) The stump and casting fixture are held in place with moderate pressure exerted in a proximal direction until the plaster has hardened.

(f) After the plaster has hardened, place the handle of the casting fixture in a DOWN (open) position and carefully remove the casting fixture from the cast socket (Fig. 160, 161, and 162).

*Note:* Have an assistant support the cast socket in a proximal direction at all times until the waist belt and cable suspension are attached.

*Variation:* The following optional procedure describes the construction and application of an acceptable above-knee quadrilateral cast socket brim which can be checked for smoothness, fit, and proper shape prior to surgery and which does not require the use of the PRS above-knee casting fixture. However, the procedure is more time consuming in its initial preparatory stage, and faulty stump measurements and/or plaster mold modifications might produce a cast socket brim unfit for application. For these reasons, the PRS casting fixture is still the more reliable technique since this method yields a custom made product on the stump itself and allows, if necessary, for repeated adjustments and applications.

1. The prosthodontis obtains a circumference measurement at the level of the ischial tuberosity and again 2 in. below, including the anteroposterior dimension of the patient's lower extremity, prior to surgery. Reduce the two circumference measurements to reflect muscle tone just as one would use in constructing a suitable socket to be worn with a three-ply stump sock. In order to avoid proximal restriction to the
blood flow and to assure continued distal tissue support, only gluteal weight bearing is sought and no attempt is made to achieve initial contact on the posterior socket wall. This requires the anteroposterior dimension to be increased from the usual practice ⅝ in. for stumps up to 15 in. of proximal circumference and ⅝ in. for all stumps exceeding 18 in. top circumference.

2. For economical reasons it is recommended that established above-knee molds with suitable measurements be used where few or no modifications are required.

a. Select a proper size tubular cotton stockinet to suit the stump circumference plus 2 in. for overlap when split on the lateral side. A 12 in. length stockinet is sufficient (Fig. 163).

b. Split along one side and locate on the cast model to the stockinet will extend past the distal and proximal trim lines of the finished plaster brim (Fig. 164). Overlap the split ends ⅝ to 2 in. on the lateral side (Fig. 165).

c. Fasten the stockinet with some small tacks making sure that no wrinkles remain in the material.

d. Cut four double layer 4 in. x 15 in. plaster splints from a roll of elastic plaster bandage. Begin the application on the lateral underlying (tongue) portion of the stockinet and work posteriorly around to the medial and anterior portion arriving laterally on the top of the wrap, overlapping where it began (Fig. 166). The length of the plaster brim is approximately 4 in. measured from the posterior wall distally. The lateral overlapping area including the most
distal portion of the plaster brim feathers out to only a single splint thickness plus the cotton stockinet to assure smooth blending when completing the rigid dressing (Fig. 167).

c. Reinforce the areas of the posterior, medial, and anterior proximal socket flares with folded 4 in. x 15 in. conventional plaster splints (Fig. 168).

f. Cover the entire brim with additional plaster splints to provide a final smooth finish of the socket brim (Fig. 169).

g. When the plaster has set sufficiently, remove the brim carefully from the model. Fold the proximal extending portion of the stockinet inside the cast brim and trim the excess plaster off to achieve a desirable trim line (Fig. 170).

h. Fold the stockinet back out over the cut edge of the plaster brim and fasten with additional plaster splints (Fig. 171).
i. Trim the excess stockinet off the distal end of the cast brace. The brace is now completed and ready for application on the patient (Fig. 172).

3. With the stump sock firmly suspended, locate the prefabricated plaster brim properly on the patient and wrap the remaining portion of the stump, including the reticulated polyurethane distal pad, with elastic plaster bandage as previously described. Extend the plaster wrap proximally and secure it to the plaster brim. Reinforce the elastic plaster section of the wrap with conventional plaster bandage.

4. Because of the inherent structural weakness of elastic plaster bandage, the initial wrap must be reinforced with conventional plaster bandages and splints.

(a) Double layers of 4 in. x 15 in. plaster splints are applied over the distal portion of the socket anteroposteriorly (Fig. 173) and mediolaterally (Fig. 174).

(b) Reinforce the area of the Scarpia’s triangle with a double layer of plaster splint folded three times (Fig. 173).

(c) Fold a double layer of plaster splints three times and again lengthwise to reinforce the medial socket brim (Fig. 176).
(d) Repeat this procedure to reinforce the posterior flue of the socket birm, overlapping slightly the previously applied split (Fig. 177).

5. A roll of 4 in. conventional plaster bandise is applied, starting at the proximal socket birm and carried distally, with every, overlapping circular wraps (Fig. 178). Avoid bridging of the plaster in the areas of the Scapul's triangle and posterior flue of the socket birm by providing some slack in the plaster bandise.

Two layers of plaster are usually sufficient. Lightly smooth the proximal third of the cast socket (Fig. 179).

6. Select an appropriate size set of Bowden cables and locate on the cast in the following manner:

(a) Expose all the stainless steel Bowden cable to one side of the cable housing and locate the retainer of the exposed section on the anterior iliac crest. With the cable housing, form an arc as large as possible on the lateral cast wall to minimize cable friction against the housing.

(b) Locate the other retainer at the level of and 1 in. lateral to the center of the posterior-proximal cast socket birm.

Note: The apex of the arc on the cable housing should be located below or above the drain site to facilitate drain removal.
(c) Tape the cable housing in place with a strip of 1 in. masking tape or a plaster-of-Paris splint.

(d) Locate the medial dural cable assembly in the same manner but maintain a 2 to 3 in. separation between the two retainers, both anterior and posterior (Fig. 180 and 181).

(Figures 180, 181, and 182)

(e) Secure the cable housing to the cast socket with two plaster splints or one-third of a roll of 9 in. conventional plaster bandage. Make sure the plaster contacts the underlying cast socket on the inside of the arc of the cable housing to provide a stable attachment (Fig. 182, 183, and 184).
C. APPLICATION OF THE PROSTHETIC UNIT

1. (a) Reposition the patient so that the pelvis is parallel to the foot edge of the operating table. Position the stump in a normal attitude of adduction and place the sound leg in neutral.

(b) Detach the socket attachment plate from the prosthetic unit by loosening the quick disconnect screw. Attach the socket attachment straps to the socket attachment plate with the machine screws provided and hold the assembly next to the cast socket to determine strap length (Fig. 185).
(c) Cut the straps 1 in. below the level of the exposed cable housing with metal shears (Fig. 186).

2. Bend the socket attachment straps so they conform closely to the exterior contours of the plaster socket. The socket attachment plate should be:
   a. parallel to the foot edge of the table,
   b. posterior from the distal socket center when viewed laterally, to achieve a desired TKA relationship,
   c. 90 deg. to the table top to accommodate the flexion angle in the cast socket, and (Fig. 187)
   d. . . outset so an imaginary vertical line drawn from the ischial tuberosity will bisect the medial border of the socket attachment plate (Fig. 188).

   Note: The socket attachment straps should be located so they will not interfere with the removal of the drain.

3. Recheck the position of the socket attachment plate and with indelible pencil mark the location of the two anterior socket attachment straps (Fig. 189). Reasonable care given to this alignment procedure
will result in proper bench alignment requiring little or no adjustment when the patient stands.

*Variation:* On a long above-knee or knee-disarticulation stump, attachment of the prostatic unit will unavoidably lower the effective knee center somewhat, in comparison to the sound side. Aside from comfort, prostatic function is hardly affected. However, on a short stump, the difference between the cast and the socket attachment plate must be filled with an appropriately sized round piece of balsa wood or styrofoam to place the prostatic knee center in a more functional position (Fig. 190).

(a) Bend the socket attachment straps so they closely conform to the exterior contours of the balsa wood or styrofoam and to the cast socket (Fig. 191).
(b) Recheck the position of the socket attachment plate and mark with indelible pencil the location of the attachment straps on the cast socket.

(c) Fold a double layer of 4 in. x 15 in. plaster splints three times and place it between the back of the socket attachment plate and the distal end of the wood or styrofoam extension (Fig. 192).

5. Laminate the socket attachment straps to the cast socket with one roll of conventional plaster bandage, making sure that the straps are covered entirely, down to the socket attachment plate (Fig. 194).

(d) Repeat the procedure between the proximal extension and the cast socket making sure all voids and hollows are filled solidly.

Note: Loose and broken socke attachment straps result if these last two steps are omitted.

4. If a socket extension is not required, only one double layer of 4 in. x 15 in. plaster splints is indicated as a filler between the socket attachment plate and cast socket (Fig. 193).
6. Trim all excess stockinet material from the proximal apron but retain 1 in. of overhang (Fig. 193 and 196).

7. Cut the 1½-in.-wide perineal portion of the stump sock in the same manner (Fig. 197).

**Note:** Do not disturb or trim the glued-on portion of the Orel Lyena stump sock around the hip and waist.

7. Only after all plaster work has been completed is the previously prepared suspension belt applied to the patient. This will keep the belt from getting soiled with plaster of paris.

(a) Locate the contoured waist belt on the patient so that the distal border rests just proximal to the iliac crest. Attach the waist straps anteriorly and tighten the two lateral adjustment straps sufficiently so the belt will not displace distally or rotate on the patient. Bring both shoulder straps over each shoulder after crossing them in back for men and in front for women. Attach the shoulder straps to the anteroproximal attachment buckles.

![Figure 193](image1.png)

![Figure 194](image2.png)

![Figure 195](image3.png)

![Figure 196](image4.png)

![Figure 197](image5.png)
(b) Place the felt apron between the cast socket and the exposed portions of the cables and housings. Trim the excess felt at the level where the housings emerge out of the cast socket, both anterior and posterior (Fig. 198).

(Figure 198)

(c) Thread both anterior suspension straps through the retainers of the Bowden cables and fasten them to each corresponding safety buckle, exposing at this time all available cable to allow for 90 deg. of hip flexion when the patient is sitting up (Fig. 199).

(Figure 199)

Firmly fasten the two posterior suspension straps to their corresponding safety buckles to maintain distal tissue support by suspending the cast socket and retaining it securely on the stump (Fig. 200).

(Figure 200)
Increase socket adduction by simultaneously loosening the lateral and tightening the medial cable webbing suspension straps. Reverse the process to decrease socket adduction.

8. The adjustable prosthetic unit with all adjustments in the neutral position is attached to the socket attachment plate by loosening the quick disconnect screw (Fig. 201).

9. Attach the pylon tube to the foot.

10. Recheck that the patient’s pelvis has remained level to the foot edge of the table and that the stump socket is in the desired attitude of flexion and adduction. With the ankle of the sound foot held in neutral position, the heel pad is compressed with a straightedge projected parallel to the bottom edge of the operating table, across to the heel of the artificial foot. The pylon tube will extend proximally past the prothetic unit up to the cast socket and is marked at the level of the base plug collar (Fig. 202).

Variation: When using a Kingsley Immediate Post-surgical SACH foot with built-in heel, add 1 in. to the overall length of the pylon tube to compensate for the absence of the shoe on the prosthetic side.
11. Cut the pylon tube at the established mark with a tube cutter (Fig. 203).

12. Remove the burr on the inside edge of the pylon tube with the knife provided on the tube cutter or with a reamer (Fig. 204).

13. Remove the prosthetic unit from the socket attachment plate by loosening the quick disconnect screw and connect the pylon tube to the base plug of the unit.

Retatch the prosthetic unit to the socket attachment plate and establish approximate toe-out. Tighten the bow clamp connection around the pylon tube with a screwdriver, fastening it to the base plug. Do not cut slots in the pylon tube at this time (Fig. 205).

14. Detach the completed assembly from the socket attachment plate by loosening the quick disconnect screw before the patient leaves the operating room.

THE WHOLE PROCEDURE OF CAST APPLICATION SHOULD NOT TAKE MORE THAN 30 MINUTES WITH PRACTICE.

D. THE KNEE-DISARTICULATION IMMEDIATE POSTSURGICAL PROSTHESIS

If circumstances make it necessary for the surgeon to excise the patella during surgery, proceed with the same rigid dressing technique as described for the above-knee amputation with the following exception:

STEP 1—APPLICATION OF THE Rigid DRESSING, WRAPS 1 THROUGH 8

In the classical knee disarticulation the skin incision is located posteriorly, approximately 1½ in. proximal from the distal end of the stump. Since one of the reasons for a rigid dressing is tissue support and immobilization, it is most important to alter the amount of tension exerted with the elastic plaster bandage.
when supporting the skin flaps. Controlled tension on the plaster bandage is directed to the surrounding area of the entire line where the two skin flaps meet in this case slightly proximal to the distal posterior stump margin. The tension of the elastic bandage must be released slightly as the wrap proceeds anteriorly past the distal stump end since it would have an adverse effect of displacing the anterior skin flap proximal resulting in tension to the sutures and causing a possible separation of the wound.

When the surgeon is forced through the lack of available skin to improvise on a closure resulting, for example, in medially skin flaps, this must be carefully considered and accordingly reflected in the casting technique. Support of the skin flaps in relationship to each other must always be provided by appropriate initial elastic plasters application.

When the patella is left intact and retained in the stump, it must be protected by an appropriate relief pad. Depending on the prominence of the patella, a ¾-in. to ½-in.-thick and 1½-in.-wide medium-hard felt pad is fashioned in the shape of an inverted horseshoe. The inner arc of the felt relief pad is trimmed to fit the outer border of the patella. The outer edge of the patellar relief pad is shaved thin so it will blend smoothly into the rigid dressing without leaving a ridge in the cast socket.

Locate the felt relief pad around the border of the patella so that the open end of the horseshoe points distally (Fig. 206 and 207).

As previously mentioned, efforts are now being made to replace all felt relief pads with a comparable grade of compressed reticulated polyurethane which can be gas or steam sterilized.

E. ABOVE-KNEE AND KNEE-DISARTICULATION PROSTHETIC CONSIDERATIONS

The basic theory of achieving a perfectly fitting cast socket remains the same as outlined in the below-knee considerations. However, the absence of the knee joint and the anatomical configuration of the thigh stump require not only additional prosthetic restoration of function but there is also a shift in emphasis on certain technical aspects of the rigid dressing application. The key to success is the maintenance of satisfactory suspension and rotary stability of the cast socket on the amputation stump. The gîtea technique has been abandoned in favor of the present waist belt and cable suspension system. This offers the patient more comfort and mobility allowing hip flexion up to 90 deg, while maintaining an effectively suspended stump/socket relationship. At the present time, indications for hip
upica are for the very short above-knee stump and for a fused hip joint on the amputated side. While it is difficult to describe in detail all possibilities of error, following are key considerations:

1. Avoid suspending the stump sock in such a manner that the proximal portion is pulling away from the thigh resulting in a loose cast in this area. At the same time, avoid proximal constriction or cutting of the socket brim into soft tissue.

2. Allow a sufficient amount of plaster on the posterior and anterior socket brim to insure a well-fitted brim in those areas. Keep the plaster bandage from rolling back on itself by relaxing the tension at this portion of the cast socket. If necessary, use an assistant to hold the bandage in place with his fingertips.

3. While it is recommended that full use be made of the stretch characteristics of the elastic plaster bandage, avoid overstretching when reversing the direction of the wraps; the large outer arc of the bandage can form a ridge in the underlying plaster bandage and/or stump sock (example: Wraps 4 and 7).

4. Insure sufficient clearance between the anterior proximal socket brim and the anterior-superior iliac crest to allow for 90 deg. of active hip flexion without causing cast socket displacement distally.

5. Never turn or twist a plaster bandage so that it will bunch or have a rope effect. Use the full width of the bandage partially overlapping each previous circumferential turn. If tucking distally appears to be a problem, use short plaster splints instead.

6. Failure to pull down firmly on the perineal apron medially and posteriorly including the split portion of the stump sock will result in difficulties in this area. Wrinkles in the stump sock or perineal apron and/or a sharp medial socket brim could cause abrasions, pinching, or pressure against pelvic rami.

7. Failure to adduct the stump properly before the elastic plaster has hardened will result in ramous or presumably pressure by the medial soft brim accompanied by looseness and slippage on the lateral proximal portion of the cast socket when the patient stands or ambulates.

8. Avoid an overly thick cast.

9. Unless there are specific reasons, do not delay application of the socket attachment plate to the rigid dressing at the time of surgery. The cast socket must dry at least 24 hours and if attachment is delayed, so are the standing activities of the patient.

10. Do not attempt to secure the pylons tube to the base plug while it is attached to a set cast socket. This practice could loosen the socket attachment plate and straps. Disconnect the adjustable prosthetic unit from the socket attachment plate with the disconnect screw before joining pylons tube and base plug.

11. Improper location of the socket attachment plate which exceeds the corrective capabilities of the adjustable prosthetic unit requires removal from the rigid dressing and correct reaplication. Instructions need to be carefully followed. (See Appendix A.)

12. If the patient is unable to ambulate, he will still benefit from the rigid dressing, but, of course, the prosthetic unit and pylons are withheld.

13. Occasionally it is necessary and helpful to improve the cosmetic appearance of the immediate postsurgical prosthesis. A cover made of semi-rigid plastic is located between the foot and pylons tube and fastened securely by tightening the foot bolt (Fig. 208). Storage and repeated use sometimes deform the con-
matic cover. With a heat gun render the cover pliable and restore it to its proper shape by forcing tissue paper between the pylon shank and the cosmetic cover.

When complications develop, they are usually traceable to deviations from the outlined techniques. Periodic checkups of alignment and fit are good preventive measures. Investigate patient complaints promptly and make corrections if necessary. Communicate and consult with the other team members frequently to stay informed about the patient’s progress.