LESSON ASSIGNMENT

LESSON 5

Procedures in Orthopedics.

LESSON ASSIGNMENT

Paragraphs 5-1 through 5-40.

LESSON OBJECTIVES

After completion of this lesson, you should be able to:

5-1. Identify the procedures used in reducing fractures of the leg, thigh, hip, knee, ankle, foot, shoulder, arm, forearm, and wrist.

5-2. Identify the procedures used in treating a dislocation of the hip.

5-3. Identify the procedures used in A-K amputation.

5-4. Identify the procedures used in repairing severed tendons in the fingers.

5-5. Identify the types of plaster casts, their uses, and the procedures used in applying the casts.

SUGGESTION

After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 5

PROCEDURES IN ORTHOPEDICS

Section I. GENERAL ORTHOPEDIC SURGERY

5-1. INTRODUCTION

Orthopedic surgery is concerned mainly with disorders of the skeletal system, particularly with those parts having to do with locomotion, and usually, not the bones of the anterior chest and the head. Fractures, dislocations, deformities, and other disorders of the skeletal system are included in the area of concern. Orthopedic surgery should hold the interest of the OR specialist for several reasons: The operative areas involved are usually large enough or accessible enough so that the specialist may see the procedure easily. The functional results are often obvious and gratifying even at the time of operation; and the exacting preparation and care of the patient and of the special surgical instruments used challenge the skill of the OR specialist.

5-2. DUTIES OF THE SPECIALIST

Duties of the specialist in the preparation of the patient and the OR are much the same for orthopedic surgery as for other kinds of surgery. However, special problems in orthopedic surgery involved with the preparation of both the patient and the OR require emphasis.

5-3. SPECIAL PROBLEMS IN PREPARATION OF THE PATIENT

a. Traumatic Conditions. Patients with acute injuries may present intensified problems of pain, shock, hemorrhage, and respiratory difficulties. In addition, orthopedic patients with open wounds or contusions in or near the proposed operative field present problems in the preoperative skin prep.

b. Psychological Conditions. The patient scheduled for orthopedic surgery may be looking forward to his operation as a means of relief from long suffering. On the other hand, he may be quite apprehensive about his postoperative future. He may await surgery with great dread, fearing disfigurement, dependence on others, or necessity for relying on prosthetic devices. Such fears may be all out of proportion to the more likely situation. The specialist must recognize the fact that an attitude of fear and dread, no matter how unrealistic the patient’s fear may seem, presents real problems for both the patient and the specialist. The specialist is to do the following when he is prepping the patient:

(1) Be especially alert when the patient seems either anxious or depressed. Watch for any indications of suicidal tendencies.
(2) Be an especially good listener if the patient wants to talk.

(3) Report to the surgeon any extreme behavior that the patient exhibits.

c. **Preparation of the Skin.** The general principles of skin preparation apply to preps for orthopedic surgery. Carry out procedures based on these principles as painstakingly as possible because bacteria left on the skin may get into the incision and produce bone infection. Bone infection is difficult to control and may cripple the patient for life. Therefore, never rely on antibiotics as a substitute for good preparation technique. In addition, exercise great care not to cut or otherwise traumatize the skin while shaving and scrubbing the appropriate skin area. If the patient is to have an enema, wait until this treatment has been completed (if feasible to do so) before starting the prep.

(1) When ordered, perform a regular skin prep procedure such as that described in paragraph 1-10e, preferably 24 hours prior to orthopedic surgery.

(2) Immediately after completing thorough and atraumatic shaving, scrub the prep area with antibacterial detergent for 10 minutes (or such length of time as is prescribed locally), then rinse the area with clear water and dry it. This scrubbing procedure for orthopedic surgery is sometimes referred to as a "sterile" prep. (If the area to be prepped appears particularly grimy or hard to cleanse, soak it in a warm water solution of the antibacterial detergent for 30 minutes prior to this scrub).

d. **Cleansing of Orthopedic Open Wounds.** Regardless of the orthopedic operation that is to be performed, all open orthopedic wounds should be thoroughly cleaned and irrigated either before the surgical prep is done, or as a part of the sterile prep immediately prior to the operation (with the patient anesthetized).

(1) The wound should be cleansed of any dirt or other foreign matter, as their continued presence would tend to result in osteomyelitis postoperatively. Osteomyelitis is an inflammation of the bone and bone marrow caused by bacterial infection and is sometimes very difficult to control. Varying amounts of bony tissue are destroyed. Systemic reactions include fever, pain, swelling, and other evidence of general infection. The chief results are weakness of bone and deformity. The bones most frequently affected are the femur, tibia, and humerus.

(2) The circulator should prepare for the cleansing of such wounds by having ready extra flasks of normal saline, asepto syringes, pans used to catch the waste solution, and hand scrub brushes and orangewood sticks for the removal of imbedded dirt.

(3) Because of the possibility of bone infection, extremely rigid adherence to aseptic techniques is practiced in orthopedics. More than the usual preparation of skin may be done both in the area prepared and in the duration of the scrub.
e. **Prep of Area Covered by a Cast.** Procedures for prepping areas covered by a cast are determined by the individual case, and policies vary among hospitals for these procedures. The cast may be bivalved (split in half lengthwise, in order that it may be removed) or a "window" may be made in the cast. In addition, the patient may be anesthetized for the cast to be removed and the prep to be done (usually done in the OR or the cast room). The surgeon may do these procedures with the specialist assisting. If the specialist does the skin preparation, he must use extra care in order not to nick or otherwise damage the sensitive skin that has been enclosed in the cast. The local policy must be followed.

f. **Immediate Preoperative Prep.** For the immediate preoperative prep for orthopedic surgery, rubber sheeting is placed beneath the part of the patient's body to be prepped so that the sheet under the patient will not become saturated. Otherwise, the procedure is as previously described (see para 1-12c). If the surgery is to be performed upon a limb, the circulator lifts the limb from the table and holds it during the prep.

5-4. **SPECIAL PROBLEM IN PREPARATION OF THE OPERATING ROOM**

During most orthopedic operations, X-rays are taken at various times during the surgery. The specialist should allow for the extra space needed for the X-ray machine by removing all unnecessary furniture from the room. In addition, extra drapes are needed because the foot of the table is often draped. Moreover, the X-ray cassette must be covered with sterile pillowcases cases before it is placed in the region of surgery. The crowded conditions caused by the presence of the X-ray machine may make the use of sterile back-jackets necessary for the "sterile" members of the operating team.

5-5. **OPERATIONS FOR DISCUSSION**

a. **General.** For purposes of discussion, each different type of operation listed in b below is described as it is performed on a specific body part. However, the orthopedic operations may be performed upon various bones and joints. As an example, arthrodesis operations (fusion of a joint) may be performed upon joints other than the knee or hip whenever it is desirable to eliminate motion in the joint. When arthrodesis of the spine is performed, the prep, position, drape, and the setup of the OR are modified to meet the needs of the operation to be done.

b. **Specific Operations.** The operations listed below are discussed in paragraphs 5-7 through 5-33.

   (1) Closed reduction of femoral shaft fracture with traction.

   (2) Basic technique--open reduction of fractures.
(3) Bone-grafting of fractured bone.
(4) Treatment of fractured hips.
(5) Intertrochanteric fracture.
(6) Intramedullary femoral fracture.
(7) Dislocation of the hip.
(8) Arthroplasty of the hip.
(9) Total hip replacement.
(10) Arthrodesis of the hip.
(11) Intramedullary pinning for tibial fracture.
(12) Operation for tibial shaft fracture.
(13) Compression plating of fractures.
(14) Patellecctomy.
(15) Reconstruction of the patella.
(16) Arthrodesis of the knee.
(17) Arthrotomy of knee joint.
(18) Treatment of fractures of the ankle and foot.
(19) Excision of exostosis.
(20) Bunionectomy.
(21) Bankart operation.
(22) Treatment of fractures of arm, forearm, and wrist.
(23) Closed suction drainage.
(24) A-K (above knee) amputation of leg.
(25) Tenoplasty of fingers.
5-6. **SKELETAL ANATOMY**

Refer to Subcourse MD0006 to review the anatomy of the skeletal system.

5-7. **REDUCTION (SETTING) OF FRACTURES**

This is the correct approximation of the broken portions (fragments) of the bone.

a. **Closed Reduction (External Fixation).** In closed reduction (external fixation), the fracture is realigned to normal position through external manipulation of the part. Closed reduction is accomplished under x-ray control to be certain that the fracture is in correct position. Closed reduction is the method by which closed fractures are reduced most commonly. Then the alignment is maintained by immobilizing the part by either of two methods.

   (1) A plaster cast may be applied to hold the fragments in correct alignment after a fracture has been reduced.

   (2) The other method of external fixation is the application of skeletal traction by means of special pins or wire inserted through the soft tissue into bone that is distal to the fracture.

b. **Open Reduction (Internal Fixation).** This is the reduction of a fracture by the application of mechanical devices (see figure 5-1) (screws, plates and screws, pins, intramedullary nails) through an incision directly to the bone.

5-8. **CLOSED REDUCTION WITH TRACTION OF FEMORAL SHAFT FRACTURE**

a. **Definition.** This is the reduction of the fracture by the insertion of a sterile pin or wire through the soft tissue and bone distal to the fracture (usually the upper part of the tibia) and the application of skeletal traction.

b. **Indications.** This method of fixation is indicated whenever contraction of the powerful muscles in the area prevents the correct approximation (manually) of the broken fragments.

c. **Special Preparation of the Operating Room.** A sterile tray called a Kirschner wire (K-wire) set may be used. If a set is not to be used, however, the following items should be prepared:

   (1) **Instruments.** A sterile scalpel, needed to make small skin incisions (nicks) at the points of insertion and exit of the wires or pins. Other sterile instruments needed are as follows:
Figure 5-1. Types of internal fixation

(a) A heavy wire cutter, needed to cut off the excess length of wire or pin.

(b) A drill of appropriate size, used to pass the wires or pins through the soft tissue and bone.

(2) Other equipment and supplies needed.

(a) Sterile Steinmann pins or Kirschner wires (K-wires). Because the femur is a large bone surrounded by strong muscles, surgeons usually prefer Steinmann pins for its fixation.

(b) Tractor bows (sterile) of appropriate size for the pins selected. Figure 5-1 D illustrates a tractor bow for use with either Kirschner wires or Steinmann pins.

(c) Sterile cotton or fine mesh gauze for dressing the skin wounds.

(d) Plaster of Paris bandages, as ordered by the surgeon.
(e) Weights sufficient to supply the amount of traction desired by the surgeon.

(f) Corks, to be placed over the ends of the wire.

d. **Preparation of the Patient.**

(1) **Anesthesia.** The anesthesia of choice is local. The specialist assists.

(2) **Position, prep, and drape.** The patient is placed in a supine position, with knees over the break of the table. The skin area must be shaved and scrubbed as described in paragraph 5-3c since the insertion of a pin is a sterile procedure. The sterile prep done just prior to surgery is as described above. Draping is as has been described for the draping of an extremity for orthopedic surgery, except that no tourniquet is used for external fixation.

e. **Special Precautions.**

(1) **Aseptic technique.** The most stringent precaution to be observed during all orthopedic surgery is the maintenance of strict aseptic technique--and it must be maintained by all personnel throughout the procedure. This precaution deserves particular emphasis because any break in technique can produce a serious postoperative bone infection (osteomyelitis).

(2) **Other precautions.** Other precautions to be observed by the specialist when assisting with either the external fixation or internal fixation of fractures are as follows:

(a) When moving or positioning the patient, the specialist must support the limb both above and below the site of the fracture, correctly maintaining manual traction when traction is necessary. (The maintenance of traction may require the assistance of four or five people.)

(b) The specialist is required to hold the limb in an elevated position while the immediate preoperative prep is done. Since the prep requires 10 minutes or more, the circulator must use good body mechanics when he assumes his stance or he may suffer strain or injury to his back. The circulator can maintain good body mechanics while holding an extremity by supporting his elbows against his body and keeping his back in line directly over his feet. The circulator should stand on a footstool while elevating a patient's foot for the sterile prep. This will place him in a better position for holding and will give the sterile team space enough to drape without contamination.
(c) The scrub waits until the antiseptic solution used to prep the leg is dry before handling any drapes.

(d) The specialist should exercise care to ensure that the sharp working surfaces of the orthopedic instruments are not dulled or made blunt. Dull instruments inflict unnecessary trauma upon the patient.

f. Handling of Specimen. No tissue specimen is obtained during this procedure.

g. Suturing Types Used. Since the only incision made is a small nick or nicks in the skin, no suturing is done.

h. Treatment of Other Fractures by Closed Reduction with Traction.

(1) Indication. In general, closed reduction with traction is done on other bones when a fracture is mechanically unstable, as is seen in certain fractures of the wrist and in oblique fractures of the forearm or the leg. See figure 5-2 for types of fracture lines.

(2) Sites. The most common sites for closed reduction with traction in addition to that described above are the olecranon (elbow), the calcaneus (heel), the lower tibia, tibial tubercle, and the metacarpals. In addition, K-wire fixation without traction is frequently employed for breaks of the phalanges. Such procedures on the phalanges are entered on the OR schedule as "fixation distal interphalangeal (DIP) joint" or "fixation proximal interphalangeal (PIP) joint."

(3) Specialist's role. The specialist's role, in assisting with the treatment of any fracture by closed reduction with traction, is as that described above for a femoral shaft fracture. The adaptations necessary are those having to do with the part of the body being treated and the size of the pins or wires needed.

5-9. BASIC TECHNIQUE--OPEN REDUCTION OF FRACTURES

a. General. This procedure is used to repair broken fragments by means of pins, nails, and screws, or with plates and screws, through an open wound. A blind method of fixation may be used by applying a short nail (Smith-Petersen) or a long nail (Kuntscher or Lottes) through the bone without opening the fracture site. Internal fixation is used when a satisfactory closed reduction cannot be obtained or maintained or when soft parts are situated between the fractured fragments. Whenever possible, this operation is done before swelling has occurred or after swelling has subsided. It is not routinely done in the presence of an infection.

b. Preparation of the Patient. Routine skin cleansing and draping are carried out according to the site of the operation.
(1) The stockinette, if used, is cut with bandage scissors to expose the proposed incisional site. The skin and subcutaneous tissue are incised with a scalpel. The skin edges are protected with towels or gauze pads that are secured in place with sutures or metal skin clips. A synthetic surgical skin drape may be used, eliminating the need for towel clips.

(2) The muscles are separated and retracted (with retractors). With a periosteal elevator, the periosteum is divided and elevated. Scar and granulation tissue is removed. Bleeding is controlled with hemostats and fine gut ligatures or cautery. Bone wax may be needed to control bleeding of the bone. The fractured bone ends are grasped and approximated by means of bone-holding forceps or with clamps.
(3) The fractured fragments are fixed by means of the desired plates and screws. The drill bit used should be approximately the same diameter as the body of the screws. This is accomplished with the screw measure and guide. Holes are drilled in the bone in this fashion. An asepto syringe filled with normal saline solution is used to prevent the spread of bone dust and eliminate unnecessary heat from the drilling process. The screws are inserted when the desired holes are obtained.

(4) The periosteum, muscle, and fascia are closed with chromic gut or silk sutures. The skin drape, towels, or pads are removed. The wound edges are protected with clean towels. The subcutaneous tissue is approximated, skin edges are sutured together, and dressings are applied to the wound.

(5) When applicable, the extremity is immobilized in a cast.

5-10. BONE-GRAFTING OF FRACTURED BONE

a. General. This procedure involves exposure of the fractured fragments, attachment of healthy bone onto the bone fragments, and insertion of screws through holes made in the graft and into the cortex of the fragments. The amount of grafting material used and the type of graft done generally depends on the location of the non-united bone, the condition of the ends of the fragments, and the preference of the surgeon. The procedure may be used in the following circumstances:

(1) To fill cavities or defects resulting from cysts, tumors, or other causes.

(2) To bridge joints and thereby provide arthrodesis.

(3) To bridge major defects or establish the continuity of a long bone.

(4) To promote union or fill defects in delayed union, malunion, fresh fractures, or osteotomies.

b. Patient Preparation. Routine skin cleansing and draping are carried out according to the site of the operation.

c. Operative Procedure.

(1) The skin overlying the fractured bone is incised and the scar tissue is excised, as in open reduction. To encourage healing, the sclerosed bone may be drilled or removed to stimulate granulation tissue foundation.

(2) The graft is obtained, and the affected fragments are prepared to suit the graft. To form a bed for an onlay graft, the periosteum and a portion of the outer cortex are removed from the fragmented ends of the bone. To perform an inlay or sliding graft, a special slot is made in the bone fragments for the reception of the graft. Occasionally, a sliding graft is used for tibial fractures. The graft is cut from the proximal fragment of the fractured bone and is slid into the prepared bed over the distal fragment of the bone.
(3) To obtain an inlay graft from the tibia, a curved incision is made along the anteromedial surface of the tibia, with its convexity to the medial side. The periosteum is incised and reflected with an osteotome. The graft is outlined with drill holes, and removed with an electric oscillating bone saw that has a double blade. A fracture of the entire thickness of the donor bone may occur if the osteotomy is not outlined by drill holes.

(4) In an onlay grafting operation, bone-holding forceps are used on the operative site as the drill holes are placed through both the graft and fragments. Screws are then inserted through the holes of the graft and into the cortex of the bone’s fragments. In some cases, bone chips are laid over the fragments to be united.

(5) A cancellous graft consists of spongy bone, usually taken from the crest or wing of the ilium. Depending on the position of the patient, the anterior or posterior third of the ilium is used. Exposure of the ilium is relatively easy, but considerable bleeding may occur. An incision is made along the subcutaneous border of the iliac crest. The muscles on the outer table of the ilium are elevated. If chip grafts are required, they are removed with an osteotome parallel to the crest of the ilium. After removal of the crest, the cancellous bone maybe obtained by curetting the cancellous space between the two intact cortices.

(6) The wounds are closed in layers and dressings applied. A plaster casing may be applied to the fractured extremity.

Section II. SURGERY OF THE HIP

5-11. TREATMENT OF FRACTURED HIPS

a. Definition of Terms. Fractures of the hip are in reality fractures of the upper end of the femur and are classified under three main groups: (1) the intracapsular types, which include the capital, subcapital, and transcervical fractures; (2) the extracapsular types, which include the intertrochanteric fractures; and (3) the upper femoral epiphyseal separation, usually occurring in young obese boys. The term intracapsular refers to the inside of the hip joint; extracapsular to the outside of the hip joint.

b. General.

(1) A subcapital fracture is one that occurs in the upper end of the femur, within the hip joint just beneath the femoral head. Older persons usually are the sufferers because they may fall more often. A subcapital fracture, which may be impacted or grossly displaced, may be caused by indirect violence, such as slipping on a rug or polished floor. The bone gives way, and the patient falls to the floor. After the injury, the leg becomes externally rotated if the fracture is not impacted.
(2) The patient with a displaced subcapital fracture is treated by the insertion of a suitable appliance at the earliest time his general condition permits. If the fracture is close to the femoral head, internal fixation may be supplemented by means of a bone-grafting operation. Delay or nonunion may occur in subcapital fractures, especially in those where the fracture line is unstable. The strong pull of the hip muscles often tends to produce a loss of normal angulation between the shaft and femoral neck, resulting in shortening, external rotation, and adduction deformities. Subcapital fractures are sometimes impacted. These are frequently managed without surgery if they are inherently stable.

(3) A transcervical (intracapsular) fracture occurs in the mid-portion of the femoral neck. These fractures usually require surgery. If possible, internal fixation of the fracture is carried out. Otherwise, a femoral head prosthesis may be used.

(4) An intertrochanteric fracture is located farther from the region of the trochanter and may occur when the person falls directly on the trochanteric region or when his leg is twisted. After the injury, the limb intertrochanteric fractures usually run in different directions, but they generally heal.

(5) Reduction of intertrochanteric fractures may be maintained by plaster hip spica cast, external fixation and traction, or open operation. The latter includes the insertion of a pin or nail into the neck of the femur and the attachment of a plate and screws, such as Jewett nail and plate, a Smith-Petersen nail with a McLaughlin plate, or a Neufeld angled nail and plate, to the other side of the femur.

(6) A separation or slipping of the upper femoral epiphysis (adolescent coxa vara) may occur quickly or gradually. This condition causes a decrease of the angle between the femoral neck and shaft. When this occurs, the femoral head rotates posteriorly and interiorly, and the femoral shaft and neck move forward. This lesion usually is seen either in obese children between the ages of 10 and 16 or following a traumatic injury. Acute displacement or a chronic disability in the hip is usually accompanied by a limp.

(7) An acute displacement of the upper femoral epiphysis is treated by manipulative reduction and introduction of multiple pins across the epiphysis or by manipulative reduction and immobilization with a plaster spica cast. Procedures that are more elaborate are required when a chronic condition exists and is accompanied by gross displacement.

5-12. INTERTROCHANTERIC FRACTURE (SEE FIGURE 5-3)

a. General. This is repaired by making an open wound and fixing the fragments with a metal appliance such as a Jewett angled nail, a Smith-Petersen nail with a McLaughlin or Thornton plate, a Neufeld nail, a Blount-Moore blade plate and screws, or a Lorenz screw nail and plate. Frequently, a nail alone is not adequate for holding the parts in alignment. Therefore, a nail-plate combination is needed to give fixation to the shaft of the femur.
b. **Special Preparation of the Operating Room.** Besides a basic orthopedic setup, metal appliances as chosen by the surgeon, screws, and screwdrivers will be needed.

c. **Preparation of the Patient.** The patient is placed in a supine position on the fracture table. The hip region is cleansed, and sometimes the prep is extended to include the entire extremity, the abdomen, and the anterolateral portion of the chest. The patient is draped, using a fenestrated sheet and regular sheets.

![Image](image-url)  
**Figure 5-3.** Open reduction of intertrochanteric fracture, with Neufeld nail inserted into neck and head and down shaft of femur, using divergent screws. Nail is one-piece stainless steel with V-shaped flanges into neck and head. (From Larson, C.B., and Gould, M.: Orthopedic Nursing, ed. 7, St. Louis, 1970, The C. V. Mosby Co.)

d. **Operative Procedure.**

1. With a scalpel, a skin incision is made in the thigh, beginning at the level of the superior aspect of the greater trochanter and extending along the shaft of the femur. Bleeding is controlled. Wound edges are protected with skin towels or pads.

2. The deep fascia is incised and retracted with retractors, and the lateral great muscle is split and retracted to expose the shaft and trochanter of the femur.
(3) With a Kirschner or Smedberg bone drill, a hole is drilled at a point midway between the anterior and posterior cortex of the femur, using at the same time an Asepto syringe filled with normal saline solution.

(4) The desired guide wire is inserted at a 45-degree angle to the shaft and may be changed by starting the insertion of the wire at a lower point on the shaft of the femur. The guide pin is driven up the neck of the femur. This is checked by X-ray films. The guide pin may be removed before, during, or after insertion of the nail appliance.

(5) A desired nail appliance of the appropriate size is driven into the bone so that its plate will be flush with the shaft. The plate attachment is fixed to the shaft with appropriate size screws. X-ray films are taken before closure to determine the proper location and fixation of the nail.

(6) If the fracture is subcapital or intracervical, multiple Knowles pins or a Smith-Petersen nail may be used. The exposure need not be as extensive as for the nail and plate combination since no side plate is attached to the femoral shaft. If multiple pins are used, they are placed in much the same manner as a guide pin. Usually, four are inserted parallel to each other in a boxlike pattern.

(7) If the fracture is subcapital or intracervical, the surgeon may decide to use a primary prosthesis rather than attempt fixation of the fracture.

(8) The wound is closed in layers. Skin towels or pads are removed; dressings are applied, and in some cases, plaster of Paris is applied.

5-13. INTRAMEDULLARY FEMORAL FRACTURE

a. General. The surgery for the repair of an intramedullary femoral fracture involves insertion of a nail through the intramedullary canal of the proximal and distal fragments of the femur, usually through a posterolateral incision. Most fractures of the femoral shaft are caused by direct violence, which results in short, oblique, or transverse fractures; few result from indirect violence, which produces a torsion force. The latter situation usually causes a spiral fracture. Others are considered pathological fractures due to the presence of metastatic carcinoma, Paget's disease of the bone, and dysplasia. Patients with a fractured femur suffer severe pain and shock not only due to the injury itself, but because of associated injuries.

b. Special Preparation of the Operating Room. Besides a basic orthopedic setup, plates with screws and intramedullary nails such as the Kuntscher, cloverleaf-shaped, or Hansen-Street diamond-shaped nail will be needed according to the directions of the surgeon.
c. **Patient Preparation.** In addition to regular prep, position the patient on his side. Proper supports to stabilize the patient will be needed along with X-ray equipment.

d. **Operative Procedure.**

(1) Through a posterolateral incision made with a scalpel, the fracture site is exposed and retracted, and wound edges are protected. Bleeding vessels are clamped and ligated or cauterized.

(2) A nail is selected and tested to fit the distal portion of the fractured bones according to their width and size and then the proximal fractured fragments. The fragments are reamed with a reamer that is the same size as the nail.

(3) The proximal fragment usually is reamed out up through the isthmus. This is the narrowest portion of the intramedullary canal, where the nail might get caught during its insertion.

(4) A guide wire is driven in retrograde fashion up through the proximal fragment and out through the greater trochanter until the guide wire emerges through the skin at the level of the posterior lateral buttocks. Before this step is carried out, the thigh must be abducted and flexed so that the guide pin will not be driven up into the chest or abdomen.

(5) A skin incision is made around the guide pin; then a reamer is inserted over the guide wire. A hole is reamed into the top of the femur at the greater trochanter; then the nail is driven down over the guide wire until it emerges at the fracture site. The guide wire should be withdrawn as soon as the nail is firmly seated in the proximal fragment. Otherwise, the nail may bind on the guide pin.

(6) The fracture is reduced and aligned correctly in regard to rotation. The nail is then driven into the distal fragment (see figure 5-4) and its position is checked with X-ray films.

(7) The wound is closed and dressings are applied. The affected leg usually is placed in balanced suspension, and, on occasion, traction is applied. On the other hand, the leg may merely be placed on a pillow.
Figure 5-4. A-Fracture of upper end of shaft of femur. Displacement fracture at subtrochanteric site with interposition of torn vastus muscle. This is most common type of fracture in upper end of shaft causing nonunion

5-14. DISLOCATION OF THE HIP

a. General. Although dislocation of the hip does not commonly occur, it may be caused by a severe blow that displaces the head of the femur out of the acetabulum. In some injuries, the head of the femur is pushed centrally, carrying with it the floor of the acetabulum. In such conditions, the lower extremity on the affected side appears to be shortened, and occasionally the rim of the acetabulum or head of the femur may be fractured.

b. Pathological Dislocation. A pathological dislocation of the hip may be caused by (1) a severe infectious disease such as scarlet fever, typhoid fever, or tuberculosis; (2) infantile paralysis; or (3) a chronic arthritis resulting in destruction of the femoral head or the acetabulum.

c. Congenital Dislocation. The term congenital dislocation includes various degrees of displacement of the femoral head from its normal position, as well as subluxations. In some advanced cases, a shelf reconstruction operation is done; however, open reduction sometimes is necessary in the early stages of the disease.

d. Mode of Treatment. The choice of operation depends on the degree of injury and the condition of the patient. The types of operations that may be done to treat a dislocation of the hips include (1) closed reduction with immobilization by plaster spica cast, (2) open reduction with screw fixation for reducible fragments, (3) arthrodesis, or (4) arthroplasty.
5-15. ARTHROPLASTY OF THE HIP

a. General. In this operation, the diseased joint is severed, the hip dislocated, and the articulating surfaces remodeled with the aid of a metallic cup or a prosthetic replacement. This is frequently done when the joint is damaged by a degenerative disease such as arthritis or by a pyogenic infection. Sometimes the femur is simply covered; but in other cases, it is replaced by a plastic or metal prosthesis.

b. Preparation of the Operating Room. A basic orthopedic setup is needed plus appropriate appliances, as well as special retractors, rasps chisels, osteotomes, gouges, extractors, and reamers.

c. Preparation of the Patient. The patient is positioned on the operating table in a supine or lateral position, the operative skin area is cleansed, and the patient is draped.

d. Operative Procedure: Mold Arthroplasty.

  (1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery or ligatures.

  (2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

  (3) The capsule of the hip is incised or excised as necessary.

  (4) The hip is dislocated to expose the head of the femur and the acetabulum.

  (5) These are shaped and reamed to accept the mold or cup of choice.

  (6) The hip is reduced, and the position is checked.

  (7) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

  (8) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

e. Operative Procedure: Prosthetic Arthroplasty.

  (1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery of ligatures.
(2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

(3) The capsule of the hip is incised or excised as necessary.

(4) The hip is dislocated to expose the head of the femur and the acetabulum.

(5) The acetabulum is examined and reamed if needed.

(6) The neck of the femur is osteotomized and the medullary canal reamed at the proper angle to accept the appliance of choice.

(7) The prosthesis is seated in the femoral canal and the hip reduced.

(8) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

(9) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

5-16. TOTAL HIP REPLACEMENT

a. Room and Patient Preparation. Preparation of the room and patient are the same as for paragraph 5-15 above.


(1) The skin is incised with a scalpel, and the bleeding vessels are controlled by cautery or ligatures.

(2) The necessary muscles are divided or moved with their attachments to expose the hip joint.

(3) The capsule of the hip is incised or excised as necessary.

(4) The hip is dislocated to expose the head of the femur and the acetabulum.

(5) The acetabulum is shaped and reamed to accept the acetabular portion of the appliance. The proper angle of this component is very important.

(6) The acetabular component is placed and stabilized, either by the use of methyl methacrylate or by employing the proper guides and positioners for the appliance.
(7) The neck of the femur is osteotomized, and the medullary canal is reamed at the proper angle for the chosen prosthesis.

(8) The femoral component is seated and stabilized as required.

(9) The hip is reduced, and the position is checked.

(10) The wound is closed in layers, reattaching or transplanting as needed all muscles that were interrupted. Dressings are applied.

(11) Postoperatively, abduction and neutral alignment must be maintained until the patient is capable of controlling this himself.

5-17. ARTHRODESIS OF THE HIP

a. General. This operation involves fusing together the articular surfaces of the hip joint by means of osteotomy, insertion of a bone graft taken from the ilium or femur, and internal fixation with a hip nail and screws. This may be done to treat tuberculosis of the hip or relieve pain and dysfunction due to trauma or other lesions such as tumor. Some hip deformities and those produced by muscle imbalance or instability may be treated by arthrodesis.

b. Preparation of Operating Room. This is the same as described for arthroplasty (see para 5-15b) plus a bone-grafting setup.

c. Preparation of the Patient. Although, the patient may be positioned on the table in a lateral position, prone or supine will often be used when a graft is to be taken from the femur.

d. Operative Procedure. This is similar to arthroplasty of the hip, as described in paragraph 5-15.

Section III. OPERATIONS ON THE TIBIA

5-18. INTRAMEDULLARY PINNING FOR TIBIAL FRACTURE

a. General. This procedure involves the insertion of a nail through a short incision made over the anterior aspect of the tibia and medial to the tibial tubercle. Proper alignment and apposition are quite important to the success of this operation, as well as an accurate fit in the medullary canal. This method obviates the need for plates.

b. Operating Room Preparation. A basic orthopedic setup will be needed, plus nails and other instruments as requested by the surgeon.
c. **Patient Preparation.** The patient is placed in the supine position, and either the leg is placed in traction to the foot or the table is bent so that the leg hangs freely, using gravity for traction.

d. **Operative Procedure.**

   (1) The fractured fragments are exposed in a manner similar to the procedure described for intramedullary nailing of a femoral fracture. The fracture is reduced.

   (2) A 3/8-inch drill hole is made through the outer cortex at the bend of the mid-portion of the tibial tubercle. The nail is inserted in the drill hole with its flange facing outward. It is driven down the fracture site and its position determined. X-ray films are taken.

   (3) The wound is closed with chromic gut and silk sutures. The affected extremity is encased in a cast.

5-19. **OPERATION FOR TIBIAL SHAFT FRACTURE**

   a. **General.** For simple transverse fractures and many oblique fractures, the fragments are reduced by external manipulation and the leg encased in a plaster cast. For severely fragmented fractures, skeletal traction or the insertion of an appropriate appliance may be used. Usually, these fractures are at the lower and middle thirds of the tibial shaft and at the junction of these two thirds. The fractures that result from a direct blow often are the transverse or comminuted types, whereas those that result from a twisting force are the spiral type.

   b. **OR Preparation.** Skeletal traction or plaster cast setup will be needed. If prescribed, the internal reduction setup with plates and screws of desired type and size, screws alone, transfixing wires, or an intramedullary nail will be used. In nonunion cases, a bone-grafting setup is also needed.

c. **Patient Preparation.** This is the same as in paragraph 5-3f.

d. **Operative Procedures.** This is the same as in paragraph 5-9c.

5-20. **COMPRESSION PLATING OF FRACTURES (SEE FIGURE 5-5)**

   a. **General.** The use of compression in achieving fixation and promoting union in cancellous bone is now well accepted. This plate relies on the mechanical compression prior to fixation for its function. It provides rigid fixation not only because of the compression, but also because it is a very thick, heavy plate. The advantages of compression are the fixation is more rigid, the gap between the fragments that must be bridged by new bone is narrowed, and the external immobilization required after surgery is reduced or may even be eliminated.
b. **Operating Room Preparation.** The basic orthopedic instrument setup is needed, with the addition of the compression plating set. Several instrument companies manufacture various types of compression instruments and implant systems. The purpose of such a system is to approximate the bone fragments under compression during the act of applying an appliance for rigid fixation.

c. **Patient Preparation.** Positioning and preparation of the patient depends on the fracture site.

d. **Operating Procedure.** After the fracture has been reduced, the proper plate and screws are selected. The periosteum is stripped in preparation for plating.

(1) To attach one end of the plate to the bone, the plate is centered over the fracture. Holes are drilled in proximal fragment using a hand-held drill guide. After the hole is drilled, a self-tapping screw is placed. (If the surgeon prefers, a separate tapping instrument is included in the set.)

(2) The plate is affixed to the proximal end with necessary screws. A locator drill guide hook is placed in the elongated slot on the distal end of the plate and an anchor hole is drilled. A Trinkle handle is provided which can be snapped to the locator drill guide.
(3) With compression clamp capstan handle in free position, the compression clamp foot is placed over the anchor hole. The anchor screw is inserted. The handles are pivoted toward the anchor screw and the compression clamp hook is engaged into the slot on the distal end of the plate. Capstan handles are locked across the compression clamp. Compression is applied by turning the capstan handle knob clockwise.

(4) All remaining bone screws are then placed with full compression applied. Compression is then released by swinging the capstan handle to a free position. The anchor screw and compression clamp are removed.

(5) The wound is closed in the routine manner. The affected limb may or may not be placed in a plaster cast.

Section IV. OPERATIONS OF THE KNEE

5-21. PATELLECTOMY

a. **General.** This operation involves the excision of the bone portion of the patella (kneecap) and repair of the quadriceps expansions. Fractures of the patella are of the transverse, comminuted (stellate) or linear type. They are usually caused by direct contusion or muscular stress. The fragments of bone, especially in a transverse fracture, may separate when the torn quadriceps muscle pulls them apart. If this occurs, the quadriceps mechanism must be repaired. Linear or comminuted fractures in which the fragments do not separate are immobilized in a cast. If one pole of the patella is avulsed, it may be excised and the quadriceps repaired. A patellectomy is done to aid knee function if the patella is diseased or too severely injured to be repaired.

b. **Operating Room Preparation.** The setup is the basic orthopedic setup, including Cave knee retractors and Kocher retractor, bone awl, and rongeurs.

c. **Patient Preparation.** The patient is placed on the operating table in a supine position, with the affected knee joint at a level with the break of the lower section of the table. The foot section of the table is lowered, or the knee is flexed by placing a suitable sandbag beneath its posterior aspect. The extremity is cleansed, and the patient is draped with sheets, as for draping a lower extremity.

d. **Operative Procedure.**

(1) A curved, transverse, or paramedian incision is made over the knee, and the capsular tendon ligament of the joint and the quadriceps are exposed.

(2) The patellar ligament is incised to expose the anterior surface of the patella.
(3) The fragments of the patella are removed from the surrounding tendon by sharp dissection.

(4) In some cases, the quadriceps and patella tendon are sutured with chromic gut or fine stainless steel wire.

(5) The defect in the patellar ligament is closed with sutures. The wound is closed and the extremity immobilized in a cast.

5-22. RECONSTRUCTION OF THE PATELLA

a. General. This operation involves the fixation of the patella tendon and its bony attachments to the tibia or application of the soft tissues on the medial side of the patella tendon. Its performance is prompted by recurrent dislocation of the patella tendon, which may originate from a blow against the inner side when the knee is flexed. More often, it is a congenital developmental phenomenon associated with a shallow groove in the femoral condyles, a ball-shaped patella, or knock-knee.

b. Operating Room Preparation. The basic orthopedic setup is needed, including a textile pack for the lower extremity, plus instruments for internal fixation of fractures or patellectomy (see para 5-21b).

c. Patient Preparation. The patient is prepared as described for patellectomy (see para 5-21c)

d. Operative Procedure. One of several operations may be done, depending on the condition. The most common operations are (1) transfer of the patella tendon and its bony attachments inward on the tibia, similar to arthroplasty, (2) wedge osteotomy of the lateral femoral condyle, similar to arthrodesis, or (3) tendon or fascia lata fixation of the patella to the inner condyle of the femur, similar to patellectomy.

5-23. ARTHROPLASTY OF THE KNEE JOINT

a. General. In this operation, the tibial articular surfaces are replaced by a metallic prosthesis that articulates with the femur. It is done in case of severe arthritic changes in the knee when the joint appears salvageable. Otherwise, arthrodesis is done.

b. Operating Room Preparation. This is the same as that described for basic orthopedic setup and patellectomy, including bone curettes, osteotomes, chisels, raspatories, and rongeurs.

c. Patient Preparation. The patient is placed on the operating table in a supine position, with the knees at the level of the lower break section of the table. The knee may be flexed by breaking the table. The posterior portion of the knee should be supported by a pad, and the leg should rest on the table pad.
d. **Operative Procedure.**

(1) With a scalpel, a long skin incision is usually made down through the quadriceps tendon, which is dissected free from the femur by means of curved scissors, tendon strippers, and an elevator. Bleeding is controlled with hemostats and fine sutures. Skin towels are applied and secured to the wound edges if a synthetic skin drape has not been used. The patella is separated from the femur, using a tenotomy knife and bone hooks.

(2) The patella is elevated and inspected. Sometimes it is removed by means of bone elevators, gouges, and rongeurs. The bony surfaces are smoothed.

(3) A prosthesis (McKeever or Sbarbaro) is inserted for restoration of the anatomical contour and for elimination of friction with the opposed cartilage. The prosthesis is anatomically contoured and fits into the upper end of the tibia. It is designed to reestablish the anatomical outline of the articular surface. A flat surface on the tibial condyle is first created with a saw or osteotome, and the prosthesis is inserted.

(4) The wound is closed in layers. Surgical dressings are applied to the wound and secured with bandages. The leg is immobilized in a plaster splint.

5-24. **ARTHRODESIS OF THE KNEE**

a. **General.** This procedure involves osteotomy and fusion (thus immobilization) of the joint with insertion of metal screws or a nail. Compression arthrodesis by means of transfexion by pins inserted through the femur and tibia and incorporated in turnbuckle clamps may be used.

b. **OR Preparation.** This is as described for arthroplasty of the knee, with suitable appliances such as Charnley clamps, knee plates and screws, or intramedullary rods.

c. **Patient Preparation.** This is the same as for arthroplasty of the knee (see para 5-23c).

d. **Operative Procedure.** Similar to that described for arthroplasty of the knee joint (see para 5-23d).
5-25. ARTHROTOMY OF KNEE JOINT FOR EXCISION OF TORN CARTILAGE (SEE FIGURE 5-6)

a. General. In this operation, the knee joint is exposed and explored through an anteromedian, paramedian, or oblique incision, and the torn meniscus (cartilage) is removed. This operation is needed because of an injury caused by a twisting motion which ruptures the internal and external semilunar cartilages. This injury may cause the anterior or posterior horn to become detached from the upper tibia. Or the cartilage may split, allowing one portion to enter the central region of the knee joint and the other portion to remain in its normal position along the outer margin of the joint.

![Bucket-handle tear of internal semilunar cartilage](From Richards, V. Surgery for General Practice, St. Louis, 1956, The C. V. Mosby Co.)

b. Operating Room Preparation. Setup is as described for patellectomy (see para 5-21b), including a cartilage osteotome and tenotomy knives.

c. Patient Preparation. This is the same as for patellectomy (see para 5-21c).

d. Operating Procedure.

(1) An incision is made in the knee joint and carried through the subcutaneous tissue; wound edges are protected, as described for internal fixation.
(2) The capsule of the knee is opened, and its edges are retracted; the synovial membrane is opened.

(3) The medial and lateral menisci are identified, and the structures of the knee joint are examined, using elevators and retractors. Broken cartilage and loose body or synovial tabs are removed, using Ochsner forceps, a long knife, tenotomes, meniscectomy knives, and tissue forceps. The knee joint is irrigated, using an asepto syringe filled with normal saline solution.

(4) The synovial layer is closed with plain gut number 3-0 swaged to 1/2-circle, trocar point Murphy needles.

(5) The wound is closed in layers and covered with dressings. The extremity is sometimes stabilized in a splint or cylinder cast.

Section V. OPERATIONS ON THE ANKLE AND FOOT

5-26. TREATMENT OF FRACTURES

a. General. These procedures involve the reduction of fractures and immobilization of fragments by external fixation or by open reduction with fixation sutures, bolts, or screws.

b. Operating Room Preparation. The instrument setup is similar to that for a patellectomy (see para 5-21b), using smaller-sized items to suit anatomical structures.

c. Patient Preparation. Draping of extremities is discussed in paragraph 1-27.

d. Operative Procedure. This depends on the exact location and extent of the damage.

(1) A fracture displacement of either the lateral or medial malleolus may involve a rupture of a main supporting ligament on the opposite side of the ankle from that sustaining the damaging blow. This ligament rupture would usually require surgery to avoid interposition and malreduction.

(2) A posterior chip fracture of the tip of the tibia, which involves more than one of the articular surfaces, is treated by internal fixation if it cannot be reduced by a closed reduction operation.

(3) A rupture of the lower tibiofibular ligament, situated just above the ankle joint, usually is repaired by means of a transfixion bolt or screws.
(4) In falls from a height, the os calcis may become fractured, and the attachment of the Achilles tendon may be avulsed (torn away) by muscular contraction. The avulsion of the Achilles tendon at its insertion or the displaced fracture of the tuberosity may be treated by open reduction and insertion of sutures. If there is marked involvement of the subtalar joint, arthrodesis may be done several weeks after the original injury.

(5) Fractures and separation of the internal malleolus are usually treated by open reduction and fixation with screws or sutures.

5-27. EXCISION OF EXOSTOSIS

a. General. This procedure involves the removal of the bony protuberances about the tendon or muscle insertions on a bone. It is done to restore function of a joint.

b. OR Preparation. The setup includes a basic patellectomy set, with fine chisels and osteotomes, curettes, and rongeurs.

c. Patient Preparation. The position and draping of the patient will depend on the operative site.

d. Operative Procedure.

(1) An incision is made over the prominence of the exostosis, using a scalpel, scissors, and tissue forceps.

(2) The exostosis is dissected free and cut off at its base where it connects with the cortex of the normal bone, using heavy scissors, tenaculum, Ochsner forceps, chisels, elevator, osteotome, and mallet. The remaining bony surfaces are made smooth with a rongeur and file.

(3) The facial layer is closed with interrupted silk or chromic gut sutures numbers 3-0 and 2-0, and the skin edges are approximated with fine wire, nylon, or silk. Surgical dressings are applied to the wound and secured by applying a gauze bandage.

5-28. BUNIONECTOMY (SEE FIGURE 5-7)

a. General. The Mayo operation includes a partial excision of the head of the first metatarsal. The Keller operation includes a resection of the proximal part of the first phalanx of the great toe. The McBride operation includes the attachment of the adductor muscles of the great toe to the shaft of the first metatarsal. The Silver operation includes the excision of the exostosis, formation of a capsular flap, and insertion of sutures in the distal flap to adduct the great toe.
Figure 5-7. Bunionectomy. 1, Bunion: A-exostosis of metatarsal head; B-hallux valgus deformity; C, overlying bursa. 2, Operations for hallux valgus. (From Richards, V.: Surgery for General Practice, St. Louis, 1956, The C.V. Mosby Co.)

b. Operating Room Preparation. The instrument setup is as for arthroplasty of a small joint and is similar to that for excision of exostosis. Refer to paragraph 5-27b.

c. Patient Preparation. The entire lower leg and foot are prepped, and drapes placed in such a way as to support the foot as well as cover the parts not exposed for the procedure.

d. Operative Procedure. A curved dorsal incision is made over the metatarsophalangeal joint on its medial side, and the bursa and exostosis are removed, as described in paragraph 5-27d. The wound is sutured with fine sutures, dressings are applied, and the foot is usually immobilized in a plaster boot.
Section VI. OPERATIONS ON THE SHOULDER, ARM, FOREARM, AND WRIST

5-29. BANKART OPERATION (SEE FIGURE 5-8 [A through H])

a. General. This operation is for repairing a defect of the glenoid cavity through a deltopectoral incision. In some cases, this is augmented by the Putti-Platt repair, which is the bringing together of the capsule and the subscapular muscle. The operation is indicated to treat recurring dislocation of the shoulder joint. Other operations used to treat the same symptom are Magnuson, DePalma, Neer, and Nicola operations.

b. Operating Room Preparation. The basic orthopedic setup will be needed and also an internal fixation set, including narrow curved osteotomes, chisels, bone drill and fine drill points, and a prosthesis or staples, if desired. The Neer operation requires a special shoulder prosthesis, which replaces the proximal humeral articulation. If bones are shattered, staples or wires may be needed for fixation of fragments.

c. Patient Preparation. The patient is placed on the operating table in a supine position, with his affected side turned at a 45-degree angle toward the other side and supported by sandbags and padded braces. The table is tilted to provide a longitudinal operative site. Routine skin preparation and shoulder draping procedures are done.

d. Operative Procedure.

   (1) A curved skin incision is made over the anterior aspect of the shoulder so that the distal end of the incision is over the deltopectoral groove.

   (2) The exposure is made between the deltoid and the greater pectoral muscles. The cephalic vein is ligated and retracted.

   (3) The coracoid process is divided by an osteotome and then pulled downward.

   (4) The tendon of the subscapular muscle is exposed, clamped, and divided.

   (5) The joint capsule and the glenoid ligament are reattached to the exposed bone either by means of sutures, which are inserted in drill holes with staples, or by means of pullout wire sutures, as described for tendon repair. The redundant capsule is attached to the stabilized glenoid ligament and to the periosteum on the neck of the scapula.

   (6) The subcapular muscle is reattached to the lesser tuberosity, and the coracoid process is reattached. The muscle, subcutaneous tissue, and skin are closed in layers.
(7) Dressings are applied to the wound. The shoulder is supported by applying a Velpeau bandage with the arm positioned close to the chest and the elbow flexed at about a 40-degree angle.

Figure 5-8. Bankart operation (technique of Cave and Rowe) (continued). (From Crenshaw, A.H., editor: Campbell's Operative Orthopaedics, ed. 5, St. Louis, 1971, C. V. Mosby Co.)
E--Subscapular tendon has been retracted medially.

F--Holes are being made through rim of glenoid.

G--Free lateral margin of capsule is being sutured to the rim of the glenoid.

H--Medical margin of capsule had been lapped over lateral part and sutured in place.

Figure 5-8. Bankart operation (technique of Cave and Rowe) (concluded).
5-30. TREATMENT OF FRACTURES OF THE ARM, FOREARM, AND WRIST

a. General. Treatment of fractures involves the reduction of the fragments of bones by means of external or internal fixation.

(1) In fractures of the humerus, there is often overriding. Injury to the radial nerve is not common. In supracondylar fractures of the humerus, the distal fragments may be displaced, resulting in tension of the nerves, tendons, and vessels. If supracondylar fractures and dislocations of the humerus cannot be reduced, they are treated by internal fixation using wires or plates and screws, or they may be treated by overhead external skeletal traction applied through the olecranon.

(2) Fractures of the olecranon process are commonly treated by open reduction with insertion of wire sutures, Rush nails, or long malleable screws.

(3) Fractures of the forearm bones in children are usually treated by closed manipulation and casting. In adults, however, these fractures usually require open reduction and internal fixation in order to restore anatomical alignment. Plates, intramedullary nails, or compression devices may be used. Occasionally, bone grafts are applied at the time of surgery.

(4) Fractures of the wrist bones generally are treated by closed manipulation and casting, although some nonunions of the scaphoid may require bone grafting.

(5) Fractures of the bones of the hand may require open reduction and pin fixation, although most can be treated with traction or closed manipulation and casting.

b. Operating Room Preparation. The setup includes a basic orthopedic set, plus intramedullary nailing or plating instruments as requested.

c. Patient Preparation. The patient is placed in a supine position and the affected extremity supported. Routine skin cleansing and draping are carried out.

d. Operative Procedure. This is the same as in paragraph 5-9c.

5-31. CLOSED SUCTION DRAINAGE OF THE ARM, FOREARM, AND WRIST

a. General.

(1) The use of suction drainage has become routine for most procedures involving the medullary bone in which complete hemostasis cannot be obtained by the usual methods. It is important to prevent the formation of hematomas since there appears to be a connection between these and wound infections.
The removal of blood and fluid in arthrodesis results in reduction of excess swelling and closer apposition of bone chips, and should facilitate revascularization. There is the possibility that by removing blood, less granulation and scar tissue is formed. This could result in better motion, particularly in arthroplastic surgery.

b. **Operative Procedure.**

(1) A malleable needle comes with the closed-suction system. It is threaded onto small drainage tubes. By using the needle to make stab wounds, the tubes are brought out beyond the area of the incision.

(2) These tubes are connected to a larger tubing that is part of the set.

(3) The larger tubing is connected to an evacuator. This unit exerts constant negative pressure and has clear, marked walls to permit determination of the quality and quantity of drainage.

(4) The evacuator may be emptied without disturbance of the system.

(5) A retaining suture of silk number 2-0 may be passed through the skin and tied around each of the drainage tubes. This minimizes the possibility of their accidental removal.

**Section VII. PLASTIC AND AMPUTATION PROCEDURES**

5-32. **A-K AMPUTATION OF LEG**

a. **Definition.** A-K amputation is the removal of a leg above the knee (B-K means below the knee). The amputation may be either closed or open. Closed amputations are those in which the stump is sutured at the time of surgery, while open ones are left to drain and are closed by a subsequent procedure. Above-knee amputations are performed through the shaft of the femur. The ideal length of stump is 10 or 11 inches measuring from the tip of the trochanter.

b. **Indications.** This procedure is necessitated by one of three causes. The most frequently encountered cause is traumatic injury to the extent that the limb is not expected to survive. Another cause is gangrene--death of the tissues caused by a lack of oxygen and nutrients resulting from hampered circulation of blood to the affected part, seen in certain disease processes. The final condition necessitating amputation is the presence of malignant neoplasms or cancerous tumors of the bone or soft tissues of the limb.
c. Special Preparation of the Operating Room.

(1) **Instruments.** These comprise the routine setup for the amputation of a limb, and any additional instruments that may be requested by the surgeon. Both a saw and an amputation knife should always be included in the setup.

(2) **Other items needed.**

(a) A pneumatic tourniquet may be used, as ordered by the surgeon.

(b) A rongeur.

(c) A bone-cutting forceps.

(d) A periosteal elevator.

(e) A bone raspatory.

(f) An asepto syringe.

(g) An injection syringe and needle.

(h) A basin is used for the specimen.

d. Preparation of the Patient.

(1) **Anesthesia.** General (inhalation) anesthesia is used.

(2) **Position.** The patient is placed in a supine position with the knee of his affected leg flexed and the leg supported.

(3) **Surgical prep and drape.** The area is prepped and draped as described previously (see paras 1-27d, e; 5-3c).

e. Special Precautions.** These are as described in paragraphs 5-3 and 5-4.

f. **Handling of Specimen.** If bone from the amputated leg is to be sent to the bone "bank," it is processed as previously described (see para 2-13). All specimens are labeled with the appropriate information, and the amputated leg is disposed of according to hospital policy.

g. **Suturing Type Usually Used.**

(1) Chromic gut size 2-0 or 3-0 on curved, cutting-edge needles- used to close fascia and muscle-interrupted stitches.
(2) Fine nylon or stainless steel wire size 5-0 or 4-0 used to close the skin flaps.

h. **Comparison with Amputation of Other Limbs.** The specialist prepares for and assists with other amputations in a way similar to that described above. Necessary modifications are made in the size of instruments and in the draping and positioning procedure, according to the area involved.

5-33. **TENOPLASTY OF FINGERS**

a. **Definition.** This procedure is the operative repair of severed tendons in the fingers.

b. **Indications.** The operation is indicated when a tendon (or tendons) is transected, since the hand depends for its normal function upon the adequate movement of its small joints. This movement is attained through the functioning of the tendons.

c. **Special Preparation of the Operating Room.**

   (1) **Instruments.** The basic setup is as indicated on the instrument card for tendon repair of the hand. Additional instruments requested by the surgeon for the case are included in the set.

   (2) **Other items needed.**

      (a) A pneumatic tourniquet.

      (b) Plaster splint and elastic bandages.

      (c) Metal splints for the hand and arm, if ordered by the surgeon.

      (d) Stools for the surgeon and his assistant to sit upon.

      (e) Electrocoagulation (Bovie) machine, if ordered.

d. **Preparation of the Patient.**

   (1) **Anesthesia.** Regional nerve block anesthesia is usually preferred.

   (2) **Position.** The patient is placed in a supine position with the affected arm extended and supported.

   (3) **Surgical prep and drape.** The area is prepped and draped in a similar manner to that described previously.
e. **Special Precautions.** These are the precautions discussed previously (see para 1-15e).

f. **Handling of Specimen.** If a specimen is obtained, it is processed for the laboratory as described previously (see para 2-11).

g. **Sutures Usually Used.**

   (1) Silk or monofilament (single strand) stainless steel wire sutures, size 34- or 35-gauge, 10 inches and 18 inches long are used on straight, Bunnell needles or fine, curved (3/8) needles. The short end of the wire is twisted tightly around the strand. This suture is used to approximate the severed tendon ends. The silk suture is used if the surgeon does an end-to-end union of the severed tendon; wire is often used for end-to-end pull-out sutures and is also usually used for tendon-to-bone fixation. The ends of the pull-out suture are brought through the skin and secured to a button.

   (2) Chromic gut is used to approximate the tissue layers.

### Section VIII. APPLICATION OF PLASTER CASTS

#### 5-34. INTRODUCTION

a. **General.** Plaster-of-Paris casts are the most frequently used means of providing external support to maintain a desired position of a body part. Casts are often used following surgical procedures; as examples, a cast may be applied to hold the bone in position until it heals following open reduction of a fracture and following an osteotomy. Casts may also be applied following certain plastic surgical procedures. Since the OR specialist may often be required to assist with casting, he should be familiar with certain aspects concerning the application of casts. He should also know the types of casts.

b. **Definition.** Plaster-of-Paris is technically known as gypsum of anhydrous calcium sulfate. The equipment needed for application of plaster casts includes plaster bandage. This is a gauze impregnated with plaster-of-Paris. When the impregnated bandage is soaked in water, a chemical reaction occurs causing the compound to set or harden.

c. **Setting Time of Plaster.** There are three types of plaster: slow setting, fast setting, and extra fast setting. The slow setting, which is infrequently used, sets in approximately 18 minutes, the fast setting hardens in about 8 minutes, and the extra fast sets in about 4 minutes. Slow setting plaster is usually used in applying large casts, such as body casts or hip spicas, where it may take a few minutes to get to the next layer. The slow setting plaster gives the needed time. The fast and extra fast plaster is used for small parts such as an arm or leg, where extra time is not needed. Setting time of plaster can be adjusted by using the following techniques.
(1) **Setting time can be retarded by:**

(a) Adding sugar to the water used to soak plaster.

(b) Using cold water.

(c) Permitting excessive water to remain in the plaster roll after soaking.

(2) **Setting time can be accelerated by:**

(a) Adding salt to the water.

(b) Using warm water (not over 80°F).

(c) Removing most of the water from soaked plaster.

### 5-35. TYPES OF CASTS

a. **Cylinder Cast.** See figure 5-9 for a long leg cylinder cast. The cylinder cast is the most commonly used type of cast, and therefore is the type with which the specialist most frequently assists. It is a rigid plaster dressing, which encases a limb made by wrapping rolls of plaster bandage around the limb. The cast should include the joint above and the joint below the affected site when it is applied to immobilize a part, as is the usual case (see para 5-35f below, for exception). It may be used following open or closed reduction of fractures of bones of the limbs or following operations on them. A cylinder cast may be either padded or unpadded. It may also be modified in some special ways. A cylinder cast that is modified is typed or classified in accordance with the modification (walking cast; wedge cast; and hanging cast).

![Figure 5-9. Long leg cylinder cast.](image)
(1) **Padded cast.** For this cast, the skin is padded with sheet wadding and felt. A cylinder cast is usually padded and in particular, a padded cast issued for severe, fresh fractures, over infected areas, when excessive swelling exists or is anticipated or immediately after surgery.

(2) **"Skin-tight" cast.** This cast is unpadded except for the use of stockinette, if desired.

b. **Walking Cast (See Figure 5-10).** This cast is made by the incorporation of a rubber "heel," a portion of tire tread, or other durable material under the foot encased in a cylinder cast, thus enabling the patient to be up and walking. The "walker" is fixed securely in place with plaster bandage.

![Figure 5-10. Walking cast.](image)

c. **"Wedge" Cast (See Figure 5-11).** This is a cylinder cast from which a wedge-shaped piece has been removed to correct angulation (poor positioning) of a fracture following the application of plaster-of-Paris. The angulation is corrected by manual pressure, then a team member holds the edges of the cast together while another team member applies plaster bandage to maintain the correction. This procedure may be done following osteotomy of a bone, and following a recent fracture.

d. **Plaster Splint (Reinforcement Strip) (See Figure 5-12).** This splint may be used for either temporary immobilization or for the immobilization of a part in certain instances. The splint is wet, applied to the posterior part of the extremity, and bound snugly in place with a bandage of cotton or elastic.

e. **Hanging Cast.** This cast is usually used when plaster is applied following open or closed fixation of fractures of the humerus. A heavy cylinder cast is applied to the arm (from axilla to knuckles) with the elbow flexed at a 90-degree angle. A loop of either wire or plaster is incorporated at the wrist, and the arm is suspended by passing a strip of muslin bandage through the loop on the cast. This cast does not immobilize the humerus, but reduces the fracture as the result of the traction exerted.
f. **Body Casts.** These casts are applied to immobilize the spine. Two kinds of body casts are used:

1. **Body jacket.** This cast encircles the trunk and extends from the axilla to the hips. It may be used for immobilization following fractures or operations of the middle or lower portion of the spinal column and as treatment for back pain.

2. **Minerva jacket.** This cast is used when the upper part of the spinal column needs to be supported and immobilized (as in fractures of the cervical or upper thoracic vertebrae). The cast includes the head, lower jaw, and the neck, and extends downward to the pelvis.
g. **Spica Cast.** In order to provide adequate immobilization of a joint, a cast must include the body part or parts adjacent to the joint. A spica cast includes a plaster "rope" brace. Examples of spica casts are discussed below.

1. **Hip spica (see figure 5-13).** This cast may be used following hip operations and certain fractures of the femur. There are several variations of the hip spica cast, but all are applied to include a part of the trunk and one or both legs (or a portion of the legs).

2. **Shoulder spica (see figure 5-14).** This cast may be used following some operations on the shoulder or the humerus or for a fracture of the humerus. The cast includes the entire trunk and it extends to the knuckles of the affected arm, leaving the fingers and thumb free.

   ![Figure 5-13. Hip spica cast.](image)

   ![Figure 5-14. Spica of shoulders.](image)

   *Note the "salute" position and the incorporation of a plaster rope for added strength.*

   *Note position of the plaster "rope," which adds to the strength of the cast.*

3. **Spica of the hand (see figure 5-15 A and B).** This cast may be used when it is desirable to obtain the most satisfactory immobilization of the thumb, and in some cases to hold a finger firmly.

   a. A spica of the thumb includes the forearm and extends to the end of the thumb (see figure 5-15 A).

   b. A spica or a finger includes the wrist and extends to the end of the finger (see figure 5-15 B).
5-36. PLACEMENT OF CASTS

Casts are applied in various lengths and sizes, depending upon the part of the body to be immobilized. A cast may be made by incorporating into it one or more plaster splints (reinforcement strips) or it may be fashioned by the use of plaster bandages only. The more usual procedure is to incorporate one or more splints into the cast. The particular method chosen by the surgeon depends upon such factors as the amount of stress that will be exerted on the cast and the expected duration of the patient's stay in it. If a cast is placed on a part that will undergo a considerable amount of stress (hip spicas, long leg casts) the cast can be applied more quickly and be made less bulky by the use of splints. All casts applied to immobilize a part should be long enough to encase the joint above and below the affected part. See figure 5-16 for a long leg cast.
5-37. QUALIFICATIONS OF A GOOD CAST

a. The cast must fulfill the function of maintaining a desired position and must not be too tight or too loose.

(1) If the cast is too tight, it may impair circulation (evidenced by swelling, numbness, discoloration, or temperature change of the fingers or toes); and it may exert pressure upon bony prominences (this causes pain, and if the pressure is not relieved, may result in the breaking down of the tissue over the bone).

(2) If the cast is too loose, it will not maintain the position desired.

b. The cast should be as light and comfortable as possible, yet remain inflexible.

c. The entire length of the cast should be of about equal thickness.

5-38. ROLE OF THE SPECIALIST

The OR specialist's role in cast application is usually that of assisting the surgeon or the cast room personnel. The specialist who is knowledgeable concerning them contributes greatly toward the successful application of a cast and thus toward the patient's recovery. The procedures for which the specialist is responsible have to do with the preparation of the patient; preparation of the supplies, equipment, and work area soaking and handling the plaster, and holding the part to be casted. When ordered, the specialist will also have the duty of cutting the cast.

5-39. PRINCIPLES OF APPLICATION

a. Introduction. The aim of the surgical team in the application of plaster is to produce a good cast. Success in achieving this goal depends upon adherence to principles, which should be observed whenever a cast of any type is to be applied. These principles are set forth in the ensuing text (b through e).

b. Preparation of the Patient.

(1) The patient must be prepared physically and mentally for this procedure. The specialist explains what is to be done and allays any fears. He tells the patient that casting the injured part will help relieve pain. The specialist positions him as comfortably as possible, for it may take a while to complete the procedure.
(2) The specialist prepares the patient's skin in the area to be casted. This is done to help prevent irritation to the skin and to keep it as comfortable as possible. The skin should be inspected for ulcers and rashes. The specialist should check local policy before preparing the patient. The usual preparation is to wash the area with soap and water, dry it well, and dust it with powder. When the cast is applied immediately following surgery, no additional preparation of the skin is done.

c. **Preparation of Equipment and Supplies.** The specialist should make sure that all items needed are at hand, because there must be no interruption once the application of a cast is started. To stop the procedure even temporarily may cause a cast to become laminated (layered) and thus weakened. Therefore, the specialist should prepare and have ready the following items:

   (1) **Plaster rolls and splints.** An adequate supply of these in the appropriate width for the cast to be applied should be placed on the worktable; they should be unwrapped and ready for use. (Standard items of plaster bandage include plaster rolls in widths of 3, 4, and 6 inches, as well as a plaster splint 4 x 15 inches for the arm and a splint 5 x 30 inches for the leg.)

   (2) **Instruments (see figure, 5-17).** These are used for trimming and cutting casts (monovalving and bivalving, e(3) below) and are mostly of a cutting type. A cast knife and a pair of bandage scissors are needed for trimming. An electric saw or a cast knife and a cast spreader are used for monovalving and bivalving.

![Cast-cutting and trimming instruments](image)

A  Electric cast cutter.           C  Plaster saw.
B  Plaster shears.                  D  Plaster cast spreader.

Figure 5-17. Cast-cutting and trimming instruments.
(3) Padding (see figure 5-18).

(a) The materials used for padding are stockinette, sheet webril, and felt or sponge rubber.

(b) The padding is placed before the plaster is applied. Most surgeons prefer the use of stockinette and sheet wadding as basic padding (see figure 5-18). The specialist usually measures, cuts, and applies the stockinette.

(c) All bony prominences are protected with an additional pad of felt or sponge rubber (see figure 5-18). The pad is made by cutting it so that the material surrounds the prominence instead of pressing directly upon it. When felt is used, it is never applied directly upon the skin; stockinette or sheet wadding is used beneath it. (In figure 5-18, the stockinette is omitted and the fitted pads are moved from the prominence for clarity of illustration.) Stockinette not only protects the skin under the cast, but it also absorbs perspiration and prevents body hair from becoming embedded in plaster.

Figure 5-18. Padding for casts.
(d) In the lower limb, points requiring pads are the heel, malleoli, the patella, the head of the fibula, and the greater trochanter (see figure 5-19).

(e) In the upper limb, the prominences are the inner epicondyle of the humerus, the tip of the elbow, and the styloid process at the wrist (see figure 5-19).

(f) Prominences of the torso are the sacrum and the anterior superior iliac spines (see figure 5-19). In addition, provisions should be made for the intake of food and distension of the abdomen when applying a body cast; otherwise, a portion of the cast must be cut out. Adequate space for the abdomen can be provided by inserting a folded towel beneath the stockinette over the abdomen. The towel is removed when the plaster hardens.

![Figure 5-19. Bony prominences that should be padded before application of casts.](image)

(4) **Buckets of water.** Tepid water (70º to 80º F) is used for soaking plaster bandages. The specialist should exercise care to ensure that the water is neither too hot nor too cold, since unsatisfactory soaking of the plaster could result, and the plaster would not be the right consistency to be applied. The water should feel neither hot nor cold when tested on the specialist's wrist. In addition, the specialist should prepare two buckets of water if a large cast is to be applied to prevent over saturation of the water with plaster. An excessive amount of plaster in the water prevents the bandages from becoming wet throughout. Usually it is necessary to change buckets after soaking five or six rolls.
(5) Protective covering. Paper and a piece of rubber or plastic sheeting is also needed. The paper (wrapping paper or newspaper) should be spread on the floor in the area being used for casting. The rubber sheeting should be placed beneath the part of the patient being casted in order to protect the table and linen from spillage of plaster.

(6) Soaking splints. A plaster splint is soaked by dipping it and drawing it rapidly through the water. The splint is then placed on a flat, smooth surface and the excess water is expressed from it by running the palms of the hands firmly over it.

(7) Soaking the plaster bandage rolls.

(a) The rolls should be placed on end and covered by the water in the bucket to allow complete water absorption.

(b) The bandages should not be disturbed while they are soaking because the plaster is easily washed out of the bandage.

(c) The rolls should be left in the water until the air bubbles stop escaping from the bandage. (This indicates that the bandage is sufficiently saturated with water.)

(d) The roll is then grasped by both ends, removed from the water, the ends compressed by the fingers and palm of each hand (to prevent the plaster from being squeezed out at the ends), and gently squeezed and twisted slightly (not wrung) to remove excess water. Too rapid or too vigorous squeezing distorts the roll and forces out too much water. Too rapid or too vigorous squeezing distorts the roll and forces out too much water, leaving the plaster too dry. (A roll should not be returned to the water once it has been removed, as to do so makes it useless.) Plaster that is too dry or that is over-soaked might dry too fast is unsatisfactory for use. The plaster bandage should be just dripping wet. If left excessively wet, the central part of the roll will telescope and the roll will be useless.

NOTE: A bandage that has dry spots should be discarded.

(e) Another way to avoid the waste of plaster is by soaking one roll at a time. When half of the first roll is applied, another roll is put into the water to soak. In this way, the specialist keeps just ahead of the person applying the cast.

(f) When the cast is near completion, the specialist should ask whether another roll is needed. Delay in having the next roll ready may result in lamination of the cast.
(8) **Handing the plaster roll.** When the roll has been squeezed, the specialist finds the end of the bandage, unrolls about 2 inches of the plaster, and hands it to the team member applying the cast, so that the roll is placed in the right hand and the end of the bandage in the left hand. This enables the team member to apply the plaster in one smooth, continuous movement.

d. **Smoothing the Plaster Bandage.** The team member applying the cast strokes and molds the plaster constantly as it is applied in order to make it conform to the body part and to make a strong, cohesive cast with a smooth surface.

e. **Cutting or Trimming the Cast.** This is done after the plaster is set. A cast is trimmed to make the edges smooth, thus preventing the injury of tissue and making the cast more comfortable. In all procedures of trimming or cutting a cast, the surgeon marks the part to be trimmed or cut. If the specialist is assigned to trim or cut the cast, he should carefully cut through the cast on the marked lines. He should avoid dripping pieces of plaster (plaster "crumbs") inside the cast since this could result in discomfort to the patient and could damage healthy tissues. The surgeon may order a cast cut for one or more of several reasons:

   (1) **To correct the length.** A cast may be applied somewhat above and below the desired area. When this is done, the cast must be cut to correct the length, as marked by the surgeon.

   (2) **To make a "window."** A "window" is a rectangular block cut from a cast. Usually, a window is cut to relieve pressure or to allow observation of a wound. A window should never be cut in a body jacket or a spica cast until the plaster has thoroughly dried because of the tendency of these casts to buckle. Whenever the specialist cuts a window from a cast, he should replace the piece cut out and secure it with adhesive tape or bandages; otherwise, the tissue underlying the window may swell ("window edema") and cause circulatory disturbances and ulceration at the edges of the window.

   (3) **To split the cast.** A surgeon may mark a cast to be split lengthwise in order to prevent the occurrence of circulatory disturbance. The cast maybe split by either monovalving or bivalving it.

      (a) Monovalving a cast is splitting it lengthwise, usually on the anterior aspect of the limb.

      (b) Bivalving a cast is splitting it lengthwise on both sides. If the cast is on a limb, it is split on the medial and the lateral aspects of the limb; if it is on the body, it is cut down the sides. A cast is often bivalved so that one part of the cast can be removed to dress wounds or prepare the skin for surgery. When the procedure is completed, both parts of the cast can then be secured with bandages.
5-40. PROCEDURES IN APPLICATION

In the ensuing text, procedure is given for applying a cast of the forearm. The steps set forth are those used for the application of any cast, with the necessary adaptations made in the fitting of padding material and in selecting the size and amount of plaster bandages for use.

a. Padding the Arm.

(1) First, the specialist prepares the stockinette; he measures it for length, cuts a hole for the thumb, and applies it.

(2) A piece of felt or sponge rubber is then cut to fit over the styloid process of the wrist.

(3) Sheet wadding is applied around the hand and arm to fill in the hollow spaces.

b. Preparing Plaster Bandage Rolls. The specialist soaks one roll of plaster, squeezes the excess water from it, and hands it to the surgeon as described above (see para 5-39c(8)). He keeps the surgeon supplied with bandages as described above.

c. Applying the Plaster Bandage.

(1) The bandage is permitted to lie where it falls naturally from the roll. Plaster bandage is never twisted or reversed, as is done with ordinary bandage. If it is necessary to alter the direction of the roll or to mold the plaster smoothly on the limb, a tuck is made by taking up the slack in the bandage, then rubbing the folded tuck flat and smoothing it.

(2) The arm is maintained in the position desired until the cast sets. The wrist is usually placed in moderate flexion.

(3) If reinforcement strips (plaster splints) are used, each is tied into the cast with a roll of plaster bandage.

(4) The team member who holds the arm must avoid digging his fingers into the plaster. He is allowed to touch the wet plaster with his palms only, and he must keep moving his hands by sliding them back and forth constantly in order that he will not put enough pressure in one place to distort the shape of the cast and to produce a pressure area.

(5) The plaster is rubbed and smoothed constantly as it is applied.
(6) The cast is not made any heavier than is necessary because a heavy cast is burdensome to the patient.

(7) Plaster crumbs should not be allowed to drop between the stockinette and the skin.

(8) Before the final roll is applied, the surgeon folds the stockinette over the edges of the cast on each end and applies plaster over it. He may also roll and mold the plaster at the edges at this time. This protects the patient from the rough edges of plaster.

d. Trimming and Cutting the Cast. When the plaster is set, the specialist, if ordered to do so, trims it around the thumb and the palm as marked by the surgeon. This trimming allows the patient full range of motion of the fingers if the surgeon desires that the cast be monovalved or bivalved, he marks it at the area he wishes it cut. The cast may be cut using an electric saw or cast-cutting knife.
EXERCISES, LESSON 5

INSTRUCTIONS. Answer the following exercises by marking the lettered response that best answers the question or best completes the incomplete statement or by writing the answer in the space provided.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. The type of cast which provides extra mobilization with a brace is called a:
   a. Body cast.
   b. Spica cast.
   c. Hanging cast.
   d. Cylinder cast.

2. You should have all necessary equipment at hand when a cast is to be applied. Stopping the application of plaster may produce what undesirable result?
   a. Lamination.
   b. Hardening.
   c. Softening.
   d. Wedging.

3. Arthrodesis of the knee joint is done in order to bring about what result?
   a. Restore movement.
   b. Produce immobilization.
   c. Establish limited movement.
   d. Depends upon individual cases.
4. Upon unrolling the end of a soaked plaster bandage roll, you note that the bandage is dry in spots. What should you do?
   a. Give it to person applying cast.
   b. Pour water on dry spots.
   c. Return it to the water.
   d. Discard it.

5. When rolls of plaster bandage are being soaked, a fresh bucket of water should likely be used after soaking how many rolls?
   a. 2 or 3.
   b. 5 or 6.
   c. 9 or 10.
   d. 14 or 15.

6. A patient is scheduled to have a closed reduction with traction of a femoral shaft fracture. You are assigned to circulate. Which of the following sterile instrument(s) will be needed?
   a. Scalpel.
   b. Hemostats.
   c. Retractor.
   d. Suture scissors.
7. Items that should be in readiness for the application of most plaster casts include:
   a. Stockinette.
   b. Plaster rolls.
   c. Plaster splint.
   d. Bandage scissors.
   e. All of the above.

8. Which of the following items will probably be included in the setup for tenoplasty of the fingers:
   a. Nerve tape.
   b. Tenotomy scissors.
   c. Pneumatic tourniquet.
   d. Screwdriver and screws.

9. When you are cutting or trimming a cast, you should avoid dropping plaster crumbs inside the cast because the presence of crumbs often results in:
   a. Buckling of cast.
   b. Layering of the cast.
   c. Damage to the patient's tissues.
   d. All of the above.
10. What kind of tissue specimen will be obtained during a closed reduction with traction of a femoral shaft fracture?
   a. Cartilage.
   b. Muscle.
   c. Bone.
   d. None.

11. Closed reduction of a fracture with traction is commonly done on the bone.
   a. Fibula.
   b. Radius.
   c. Clavicle.
   d. Calcaneus.

12. Open reduction of fractures is a means of fixing broken fragments with various appliances through an open wound.
   a. True.
   b. False.

13. Another name for a sliding bone graft is
   a. Inlay.
   b. Onlay.
   c. Osteotome.
   d. Subcapital.
14. A type of fracture, common in the elderly, which frequently results from a wrench or strain is called:
   a. Stellate fracture of acetabulum.
   b. Subcapital fracture of femur.
   c. Fracture of femoral shaft.
   d. Arthrodesis.

15. When is a patellectomy done?
   a. When the menisci are damaged.
   b. When the patella is fractured.
   c. When patellar ligaments are damaged.
   d. When the patella is unsalvageable or diseased.

16. Recurring dislocation of the shoulder may be treated by:
   a. Nicola operation.
   b. Bankart operation.
   c. DePalma operation.
   d. Magnuson operation.
   e. Any of the above.
17. Closed suction drainage may help prevent:
   a. Separation of bone chips.
   b. Excess swelling.
   c. Granulation.
   d. Scar tissue.
   e. All the above.

SITUATION FOR EXERCISES 18 AND 19. A patient is scheduled to have an open reduction of the femur, to be fixated using a plate and screws. You are assigned as the scrub.

18. The surgeon has just finished painting the leg with antiseptic solution. When should you start handing the sterile drapes?
   a. Immediately.
   b. After handing a scalpel.
   c. After handing towel clips.
   d. When the prep solution is dry.

19. Which of these items may be used to help control bleeding of the femur?
   a. Cautery.
   b. Free tie.
   c. Bone wax.
   d. Suture-ligature.
SITUATION FOR EXERCISES 20 AND 21.
You are assigned to prep a patient who is scheduled to have an open reduction of the distal third of the tibia.

20. The patient's foot appears very grimy. As part of the prep of the foot, what should you do in an effort to free it from dirt?
   a. Scrape it.
   b. Rinse it.
   c. Soak it.
   d. Nothing.

21. Upon completing the shave, what should you do to the shaved area?
   a. Scrub it with antibacterial detergent.
   b. Paint it with antiseptic solution.
   c. Wrap it with elastic bandage.
   d. Secure a tourniquet above it.

SITUATION FOR EXERCISES 22 AND 23.
A patient is scheduled for "excision of torn cartilage of the knee joint."

22. What will the surgeon remove?
   a. Menisci.
   b. Patella.
   c. Popliteal exostosis.
   d. Head of the gastrocnemius.
23. The patient prep for this operation is the same prep that is used for what other operation?
   a. Closed reduction with traction of a femur.
   b. Autogenous bone graft to a femur.
   c. Patellectomy.
   d. Tenoplasty.

SITUATION FOR EXERCISES 24 AND 25.
A patient is scheduled to have an arthroplasty of his right knee. You are the circulator.

24. You should place the patient in a modification of what position?
   a. Prone.
   b. Supine.
   c. Lateral.
   d. Trendelenburg.

25. What modification should you make in the patient's position?
   a. Tilt head of table skyward.
   b. Tilt foot of table skyward.
   c. Place knee in position to be flexed.
   d. Put his head on the cerebellar headrest.
**SITUATION FOR EXERCISES 26 through 30.** Each numbered item in Column I can be matched **BEST** by one of the lettered choices in Column II. You may use any choice in Column II for as many exercises as you wish.

<table>
<thead>
<tr>
<th>COLUMN I</th>
<th>COLUMN II</th>
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</thead>
<tbody>
<tr>
<td><strong>Distinguishing characteristics of casts.</strong></td>
<td><strong>Types of casts.</strong></td>
</tr>
<tr>
<td>___26. Made by the incorporation of some durable material such as a rubber heel under the foot encased in a cast.</td>
<td>a. Wedge cast.</td>
</tr>
<tr>
<td>___27. A cast that does not immobilize the fractured bone.</td>
<td>b. Hanging cast.</td>
</tr>
<tr>
<td>___28. A cast from which a piece is removed to correct poor positioning of the plaster-encased fracture.</td>
<td>c. Walking cast.</td>
</tr>
<tr>
<td>___29. A cast used to immobilize the spine.</td>
<td>d. Spica cast.</td>
</tr>
<tr>
<td>___30. A cast applied following certain operations of the hip.</td>
<td>e. Body cast.</td>
</tr>
<tr>
<td>___31. Reduces a fracture as the result of the traction exerted.</td>
<td></td>
</tr>
</tbody>
</table>

**Check Your Answers on Next Page**
SOLUTIONS TO EXERCISES, LESSON 5

1. b (para 5-35g)
2. a (para 5-39c)
3. b (para 5-24a)
4. d (para 5-39c(7)(d) NOTE)
5. b (para 5-39c(4))
6. a (para 5-8c(1))
7. e (paras 5-39c(1), (2), and (3))
8. c (para 5-33c(2)(a))
9. c (para 5-39e)
10. d (para 5-8f)
11. d (para 5-8h(2))
12. a (para 5-9a)
13. a (para 5-10c(2))
14. b (para 5-11b(1))
15. d (para 5-21a)
16. e (para 5-29a)
17. e (para 5-31a(2))
18. d (para 5-8e(2)(c))
19. a (para 5-9c(2))
20. c (para 5-3c(2))
21. a (para 5-3c(2))