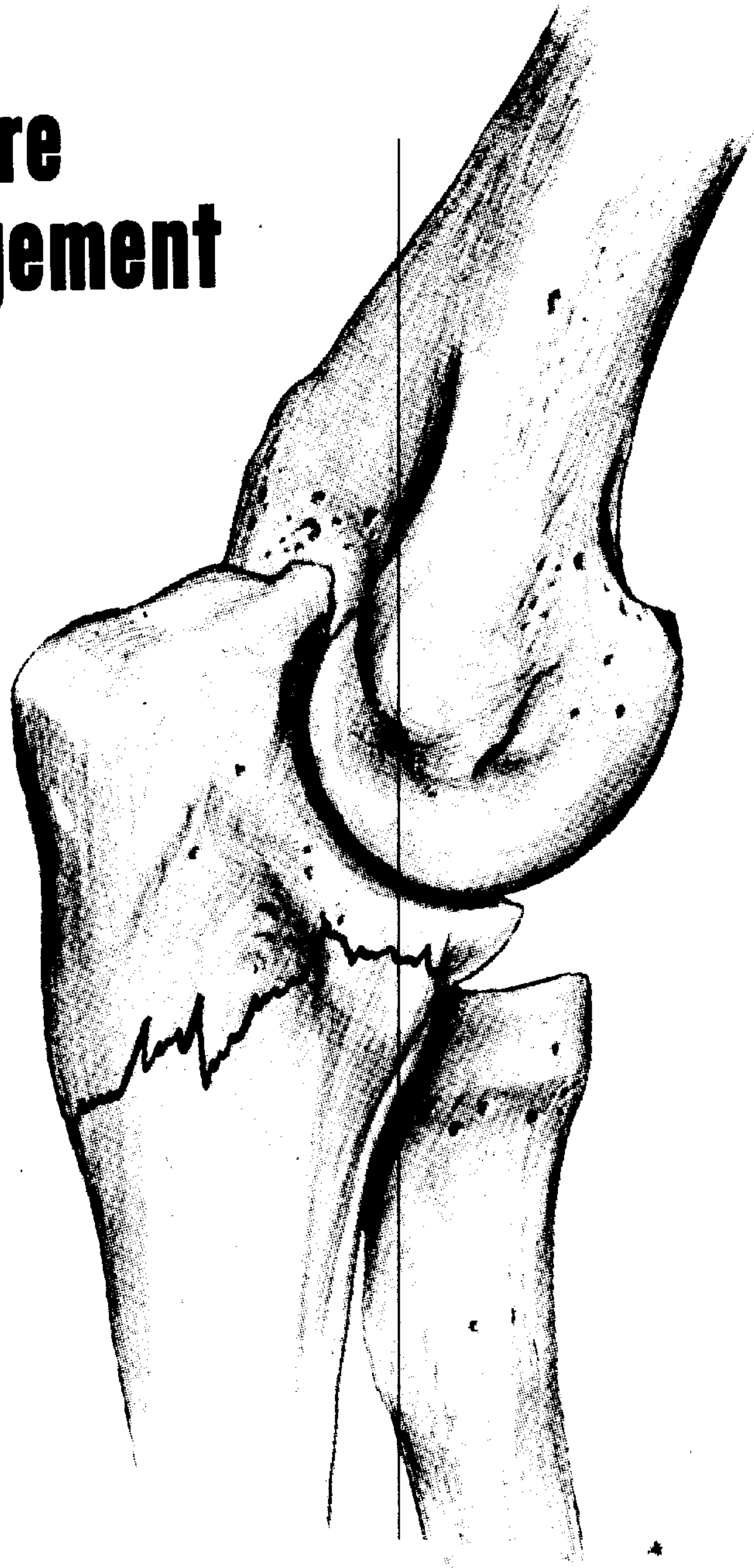
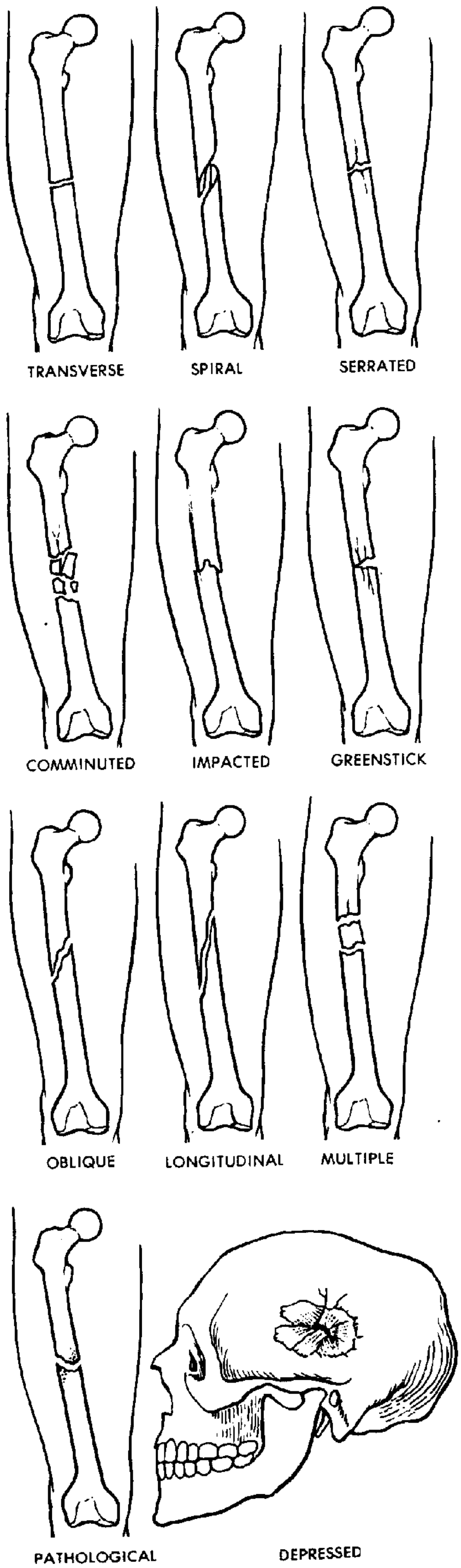
fractures and fracture management



fractures and fracture management



A fracture is a break in the continuity of a bone. The bone fragments need not be separated and often the bone may only be cracked. Fractures are generally classified as either simple or compound. A simple or closed fracture consists of a break in the bone without a break in the exterior surface of the skin. A compound or open fracture consists of a break in the bone that connects with the exterior surface of the skin. A bone fragment may protrude through the skin, or there may be a wound channel — such as that produced by a bullet or shell fragment — which extends from the surface of the skin down to the break in the bone. This type of fracture is the type most commonly seen in battle casualties. The mortality rate for this type of injury should be low if patients are given prompt treatment and proper measures are taken to prevent shock and infection.

CLASSIFICATIONS OF FRACTURES

There are many classifications of fractures with regard to position, number, and shape of bone fragments.

1. **Transverse** . . . A fracture, usually in a straight line, more or less at right angles to the long axis of the bone.
2. **Spiral** . . . Two fragments with the fracture line spiral or S-shaped. These fractures are produced by twisting injuries of the type occurring among ski troops or by torsion produced by muscular contraction.
3. **Serrated** . . . Two fragments with saw-tooth edges along the fracture line.
4. **Comminuted** . . . Three or more fragments resulting from the fracture.
5. **Impacted** . . . The broken ends are jammed together so that they more or less telescope each other.
6. **Greenstick** . . . An incomplete fracture of the bone usually resulting in a broken convex surface while the concave surface remains intact. This type of fracture is more common among children in whom the bones are more elastic.
7. **Oblique** . . . The fracture line extends obliquely across the bone.
8. **Longitudinal** . . . The fracture line splits the bone lengthwise.
9. **Multiple** . . . The bone is fractured at more than one spot.
10. **Depressed** . . . This type occurs in flat bones, such as the skull. A fragment is driven below the surface of the rest of the bone.
11. **Countrecoup** . . . The fracture is on the opposite side from the point of injury. A fracture on the right side of the skull may result from a blow on the left side.
12. **Pathological** . . . These fractures are the result of a disease process within the bones, which causes a gradual weakening. Parathyroid disease, syphilis, bone tumors, and other diseases can weaken a bone in this way and the stress required to fracture it may be slight. The simple act of catching an arm or leg in the sheets while turning over in bed may cause a fracture.
13. **Complicated** . . . Any fracture plus injury to other structures such as nerves, arteries, or internal organs.

fractures and fracture management

FRACTURE REDUCTION (Setting)

This may be performed in the surgeon's office or in the hospital, depending upon the particular bone involved and the extent of the injury. Anesthesia or local anesthesia with novocaine injection is all that is required in some cases, while in others, general or spinal anesthesia must be used.

Reduction procedures are classified as:

1. **Closed reduction . . .** When the bones are brought into proper anatomic alignment by external manipulation of the fragments without resorting to surgery.

2. **Open reduction . . .** When surgery is performed and the site of the fracture is exposed. The orthopedic surgeon achieves realignment of the broken bones by manually straightening them and bringing the ends of the fragments together and maintaining them by one of several means.

There are a great many methods of maintaining the fractured bones in good position throughout the period necessary for healing. The commonest of these is to apply a plaster cast. This is adequate for the great majority of fractures which are not too difficult to reduce. However, in the more complicated fractures, one of the following methods of keeping the bones in proper alignment is employed:

1. **Traction . . .** Weights and pulleys are attached to the injured area to line up the bones and to overcome muscle pulls which might cause the fragments to slip out of line. Sometimes the traction can be applied merely by placing adhesive tape on the skin and attaching pulleys and weights to it. In other cases, it is necessary to drill a pin through a bone beyond the fracture site and to apply the pulleys and weights to such pin. This is called skeletal traction.

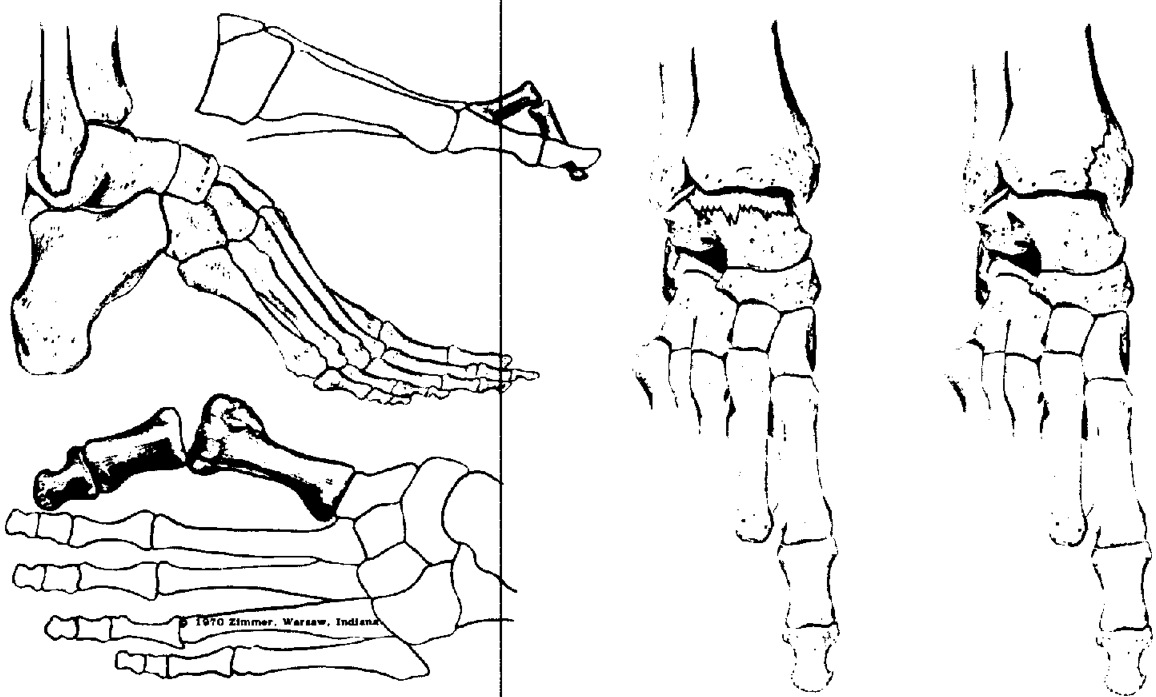
2. **Application of screws** is often performed after setting the fracture at open operation. Such screws are most useful in oblique fractures as they pass through both fragments and hold them in place.

3. **Application of plate and screws . . .** This method is used at operation where the fracture is straight across, or transverse. A plate is laid alongside the set fracture extending above and below the fracture site. It is held there by placing screws through it into the fragments.

4. **Wiring** is done at operation by encircling the broken bone. This technique is occasionally sufficient to keep the fragments in good alignment but is not used very widely today.

5. **Nails or Pins . . .** This method employs nails or pins which are hammered through the marrow of the bone and engage both fragments, thus keeping them in line. The fractures of the neck of the femur at the hip are most often treated in this manner.

fractures and fracture management



Triple arthrodesis is a stabilization procedure performed for a number of deformities or muscle imbalance involving the foot. (Some surgeons feel that if any of the tarsal joints need arthrodesis, all should be fused.) The three joints are the subtalar; calcaneocuboid, and talonavicular. The procedure consists of removing articular surfaces of each of the three joints and removing wedges of bone sufficient to correct the deformity. Staples are sometimes used to hold the raw bone surfaces together. Plaster is usually required.

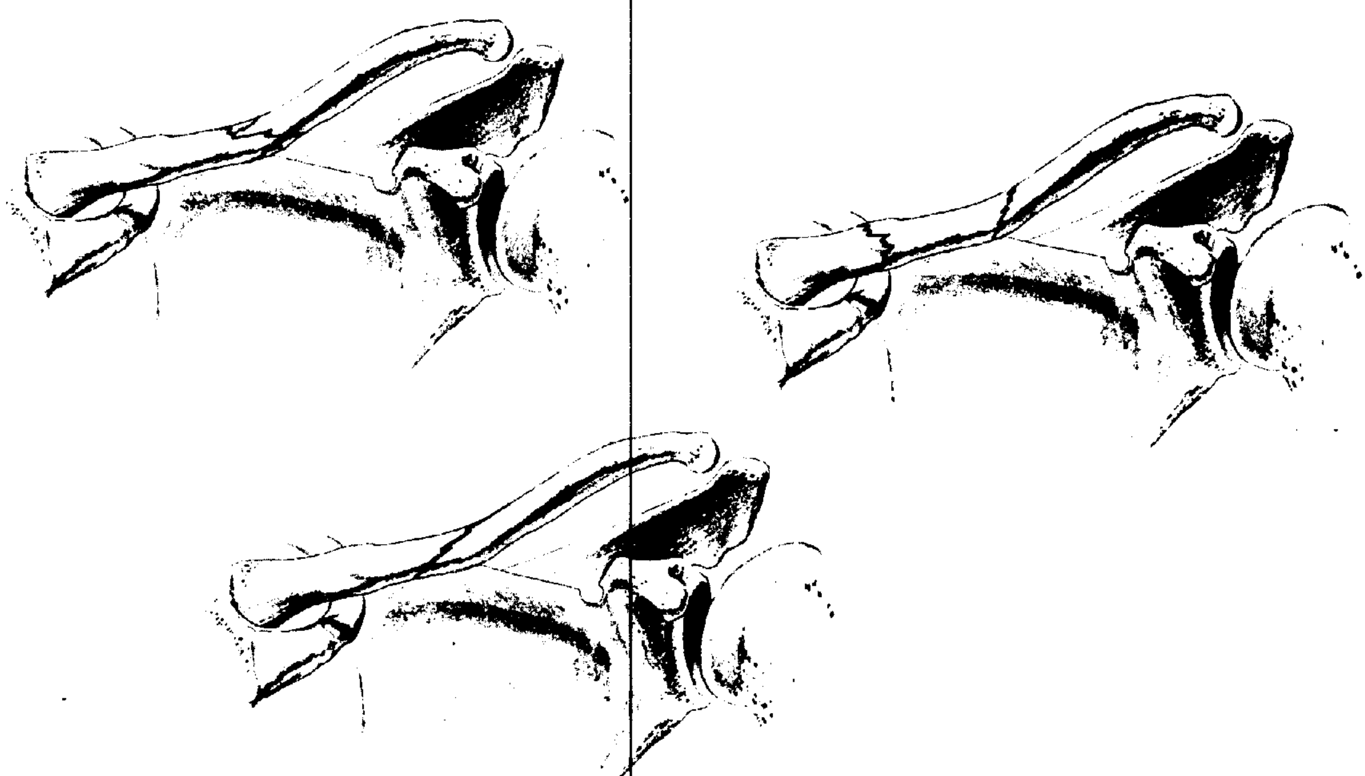
Arthrodesis of the ankle may be done with a Bagby angled compression plate. The blade is driven into the talus; when the screws are tightened, the beveled edge of the head forces the plate rearward, producing compression. Plaster is usually required.

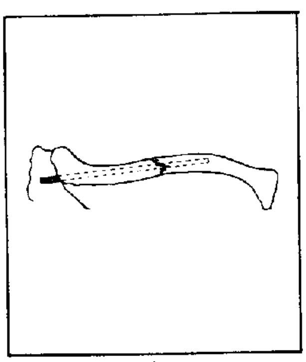
When the malleoli are fractured and the fragments separated, surgical intervention may be required. A long screw may be placed obliquely and proximally through the malleolar fragment and into the lower end of the tibia. Plaster is usually required.

A bunionectomy is done to relieve pain. Bone is resected to relax the contracted soft structures and to place the proximal phalanx of the great toe in satisfactory position in relation to the first metatarsal. Plaster may be required.

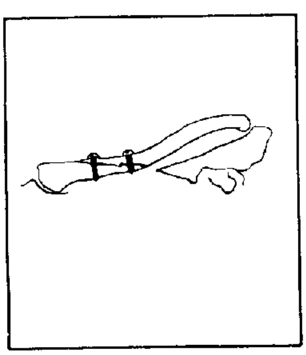
In hammertoes, the proximal interphalangeal joint is flexed and the distal interphalangeal joint is either flexed or extended. The proximal interphalangeal joint is resected to shorten both bones, which relaxes the contracted soft structures. The phalanges are then frequently fixed in a straight line with an intramedullary wire.

Metatarsal shortening may be performed to relieve pain caused by plantar callosities. The involved metatarsal is shortened and may be angulated to relieve undue pressure on the sole of the foot by the metatarsal head. Osteotomy may be performed through the shaft of the bone or the metaphyseal arc, and the ends are apposed and fixed with suture inserted through holes drilled in the bone. Plaster is usually required.



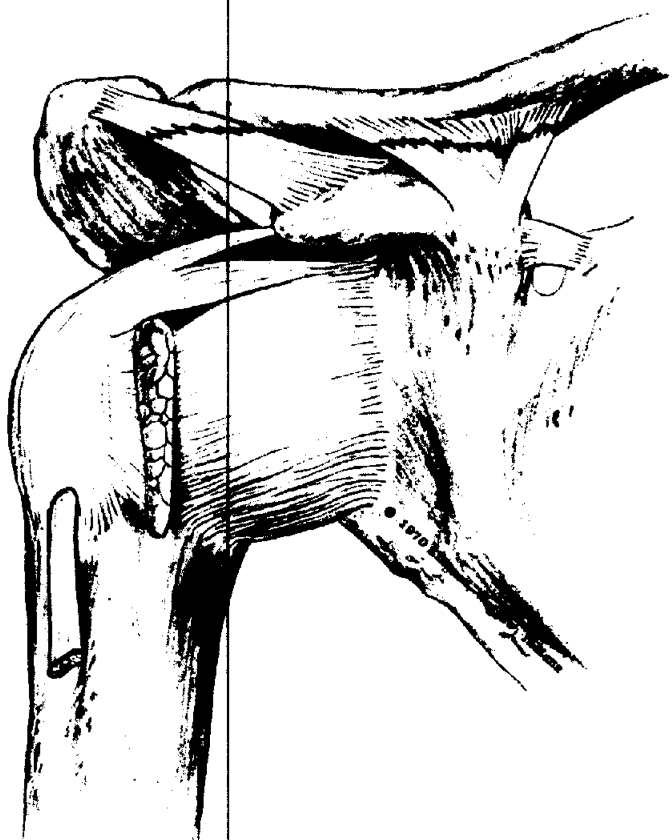


STEINMANN PIN



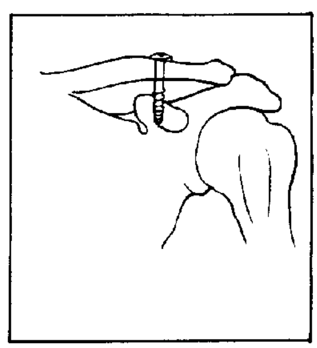
SCREW FIXATION

The position of the clavicle in the shoulder girdle, exposing it to force from many different angles, makes it particularly vulnerable to injury. Most clavicular fractures are treated by closed reduction. When open reduction is necessary, two fixation procedures frequently used are the Steinmann pin and screws. A threaded Steinmann pin is shown to secure a transverse fracture; the pin is inserted through the medullary canal of both fragments, angled to connect with the edge of the canal for stability. Threads prevent the pin from migrating. For an oblique fracture, screws are inserted to prevent the two fragments of bone from overriding one another. In some cases, small bone fragments may be grafted around the fracture to stimulate new bone formation. Postoperative immobilization is usually by a sling and swathe; some surgeons prefer plaster immobilization.



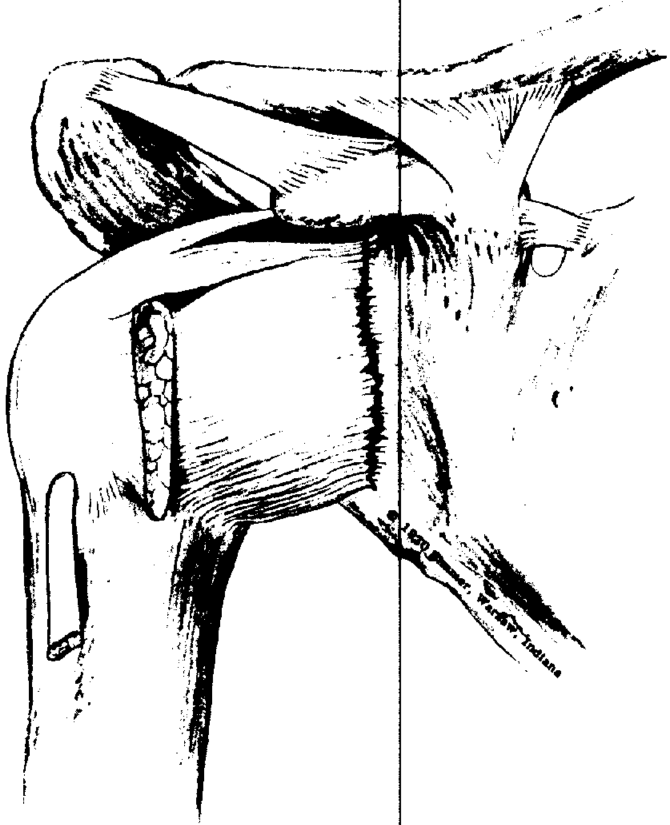
Dislocation of the acromioclavicular joint may be produced by a fall on the shoulder or elbow, rupturing the coracoclavicular and acromioclavicular ligaments and allowing upward displacement of the outer end of the clavicle. In many cases no dysfunction results. When there is interference with the complete elevation and abduction of the arm, however, the joint is surgically stabilized. One procedure utilizes a Bosworth coracoclavicular screw inserted through the clavicle and into the coracoid process to reduce the joint. This procedure causes synchronous rotation of the scapula and clavicle. The damaged ligaments are usually repaired also.

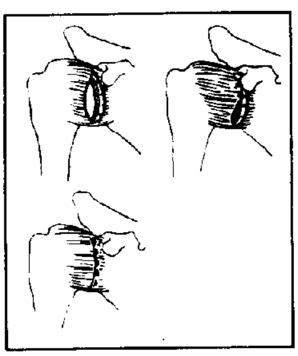
In cases of unreduced dislocations that are four to six weeks old or older, or for acute dislocations in middle-aged or elderly persons when movement is impaired, the outer end of the clavicle may be resected. Fixation of the clavicle to the coracoid process is not essential for normal, painless motion.



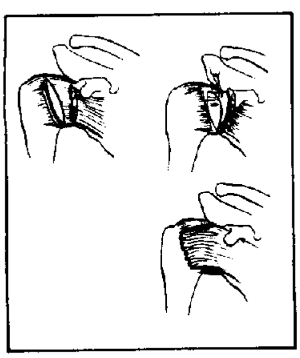
SCREW FIXATION

fractures and fracture management





BANKART PROCEDURE



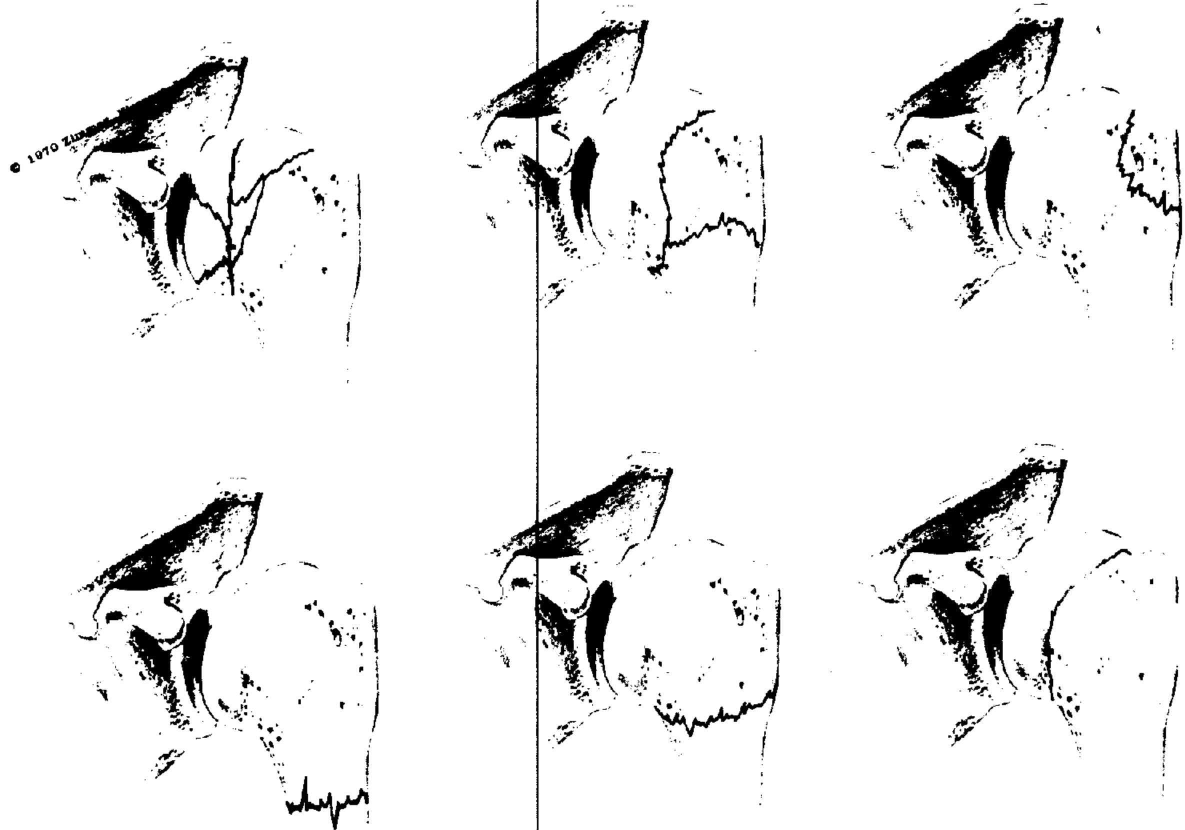
PUTTI-PLATT PROCEDURE

The shoulder joint is surrounded by a capsule incorporating ligaments, which contributes to the stability of the joint. Recurrent dislocation of the shoulder occurs when the ligaments and/or labrum are weakened or detached. More than 150 operations have been developed to strengthen the capsule; many also result in limiting abduction and external rotation to reduce the likelihood of future dislocations. Two of the more commonly used are the Bankart and Putti-Platt procedures.

In the Bankart procedure, three or four holes are drilled in the rim of the glenoid cavity. The capsule is opened. The free lateral margin of the capsule is sutured through the holes in the glenoid rim. The medial margin of the capsule is then lapped over the lateral part and sutured in place.

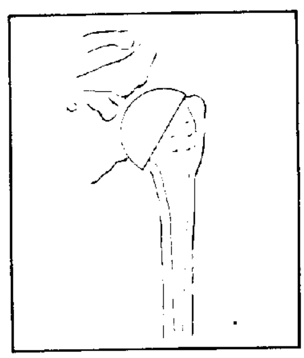
In the Putti-Platt procedure, both the subscapularis tendon and the capsule are overlapped and shortened. These are cut and the free edges are sutured to the soft structures along the anterior rim of the glenoid cavity, if these structures (including the labrum) are intact; if they are detached, the edges are sutured to the deep surface of the capsule and the subscapularis muscle. The final suturing, of the medial part of the subscapularis to the rotator cuff at the greater tuberosity or at the bicipital groove, provides overlapping of all previous layers.

fractures and fracture management

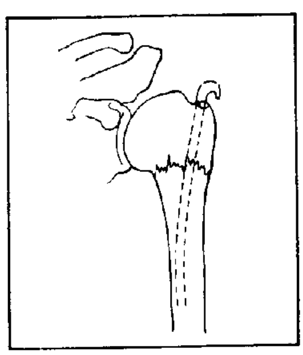


Open reduction of fractures of the head and neck of the humerus is indicated when manipulation has failed to achieve satisfactory reduction or when the head is severely rotated and contact between the head and shaft cannot be maintained. There are several means to achieve fixation; two shown here are the threaded Steinmann pin and the Rush pin. Each is inserted into the medullary canal lateral to the head so that the head of the pin does not protrude in the area of articulating surfaces. The hook on the Rush pin and threaded end of the Steinmann pin facilitate removal, which is done four to six weeks after surgery. Sling and swathe or plaster may be used for immobilization.

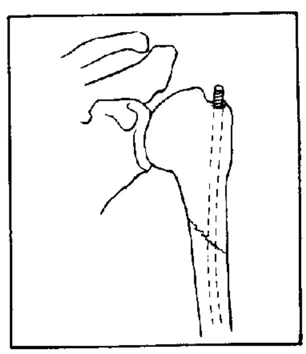
When the fracture is comminuted and when no soft tissue attachments remain, a humeral prosthesis may be required. In these cases, the head or fragments are excised, the medullary canal is prepared, and a prosthesis is inserted. A prosthesis may also be indicated occasionally when arthritis has destroyed the humeral head.



HUMERAL PROSTHESIS

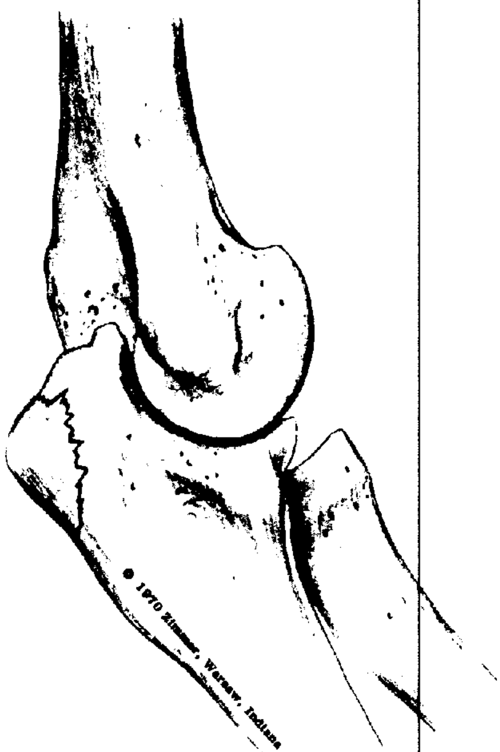


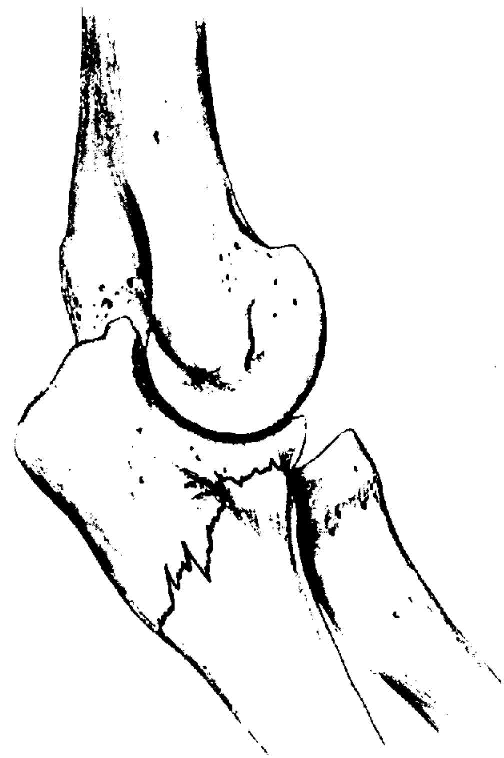
RUSH PIN

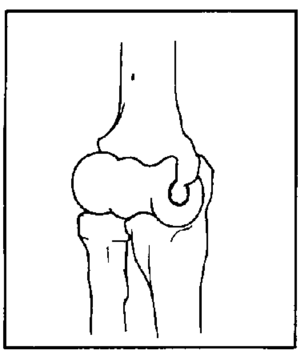


STEINMANN PIN

fractures and fracture management

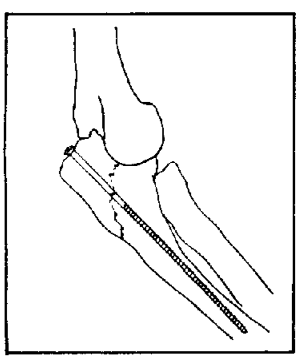




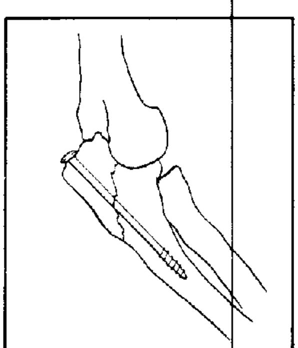


STEVENS-STREET
ELBOW PROSTHESIS

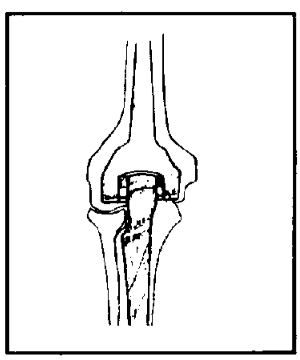
In a fracture of the olecranon, when the fragments are separated, open reduction and rigid internal fixation are frequently necessary to prevent recurring displacement. A screw is inserted through the olecranon and into the medullary cavity of the ulna. The threaded portion of the Leinbach screw is flexible to permit it to follow the medullary canal and must pass beyond the fracture line. The Aten screw is threaded only at the end and is not flexible. Plaster immobilization is usually required.



LEINBACH SCREW

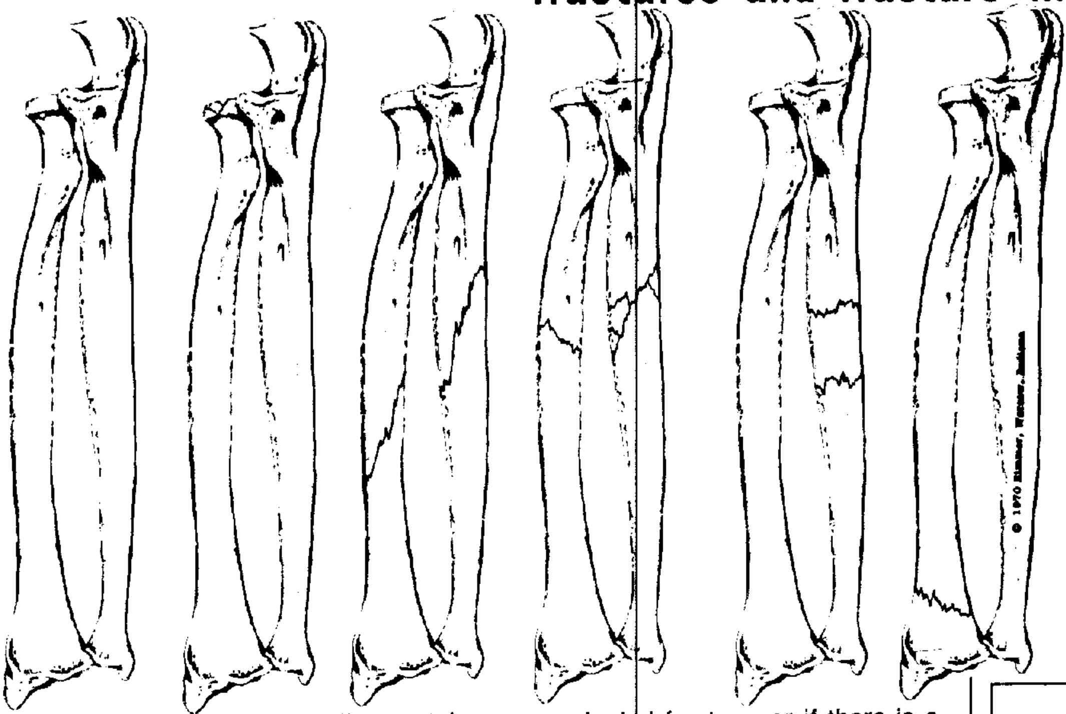


ATEN SCREW



COONRAD
ELBOW PROSTHESIS

fractures and fracture management



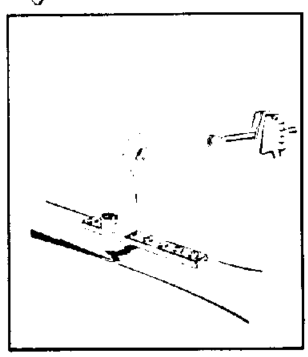
When the head of the radius sustains a comminuted fracture, or if there is a marginal fracture with substantial displacement, the total head may be excised. Excision may also be indicated when the radial neck is fractured, with tilting or impaction of the head, or when the head is severely damaged by arthritis. (This procedure is not performed in children, since the epiphysis would be lost and growth stopped.)

In dealing with fractures of the forearm it is most important to restore the rotational alignment of these bones, which is frequently difficult by closed reduction. Stabilization is maintained by use of intramedullary fixation, bone grafts, or plates and screws. Plaster immobilization is usually required.

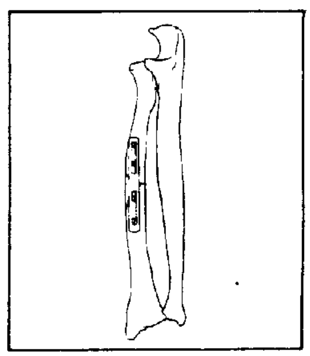
A nail must be large enough and strong enough to prevent side-to-side, angular, and rotary motion while the tracture is healing. A Rush pin, shown here in the radius, is inserted through the medullary canal and is hooked for removal. A Schneider nail, similarly inserted, is four-flanged for maximum strength.

When both the radius and ulna are fractured, sometimes a combination of methods is used: a Steinmann threaded pin secures the ulna while an onlay bone graft is used on the radius. A graft is taken from the tibia and split longitudinally. Endosteal fragments are placed into the medullary canal across the fracture and the stronger outer plate of the graft is placed on the flat surface of fragments across the fracture site. Screws are inserted through the graft and fragments.

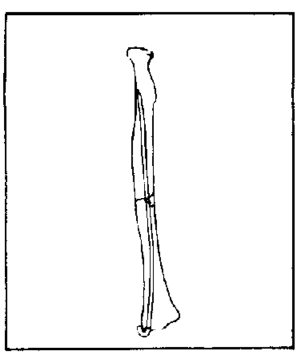
Eggers bone plates are slotted to permit telescoping of fragments. Screws are placed away from the inner ends of the slots to allow the longitudinal muscular pull to hold the fractured ends in contact. In a Bagby compression plate, the slots have a vertical wall so that the act of seating the screw pushes the fragments together.



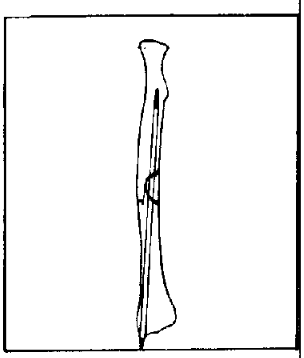
I/O COMPRESSION PLATE



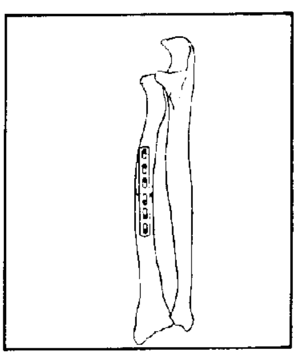
EGGERS PLATE



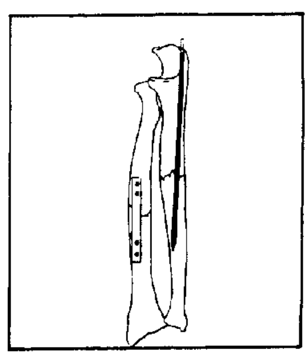
RUSH PIN



SCHNEIDER NAIL

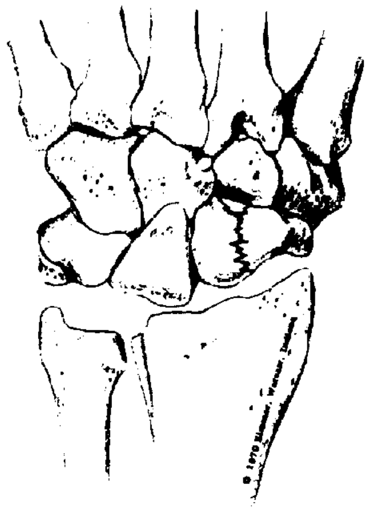


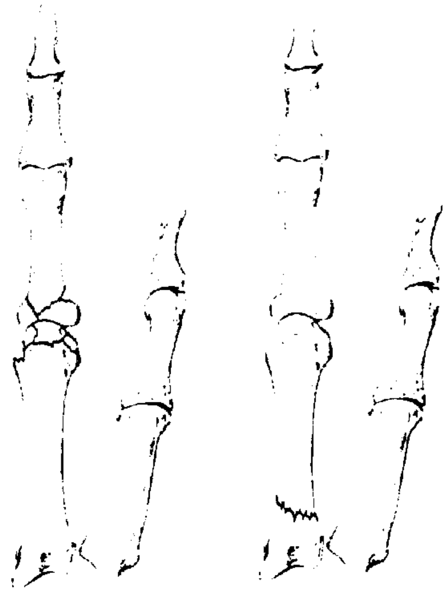
BAGBY PLATE

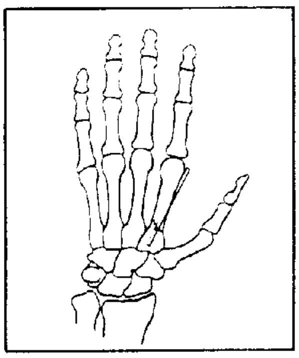


ONLAY GRAFT WITH STEINMANN PIN

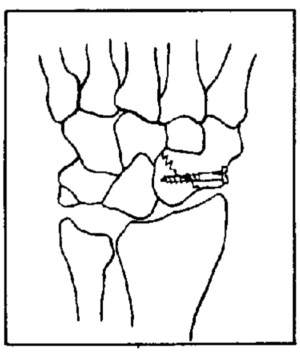
fractures and fracture management



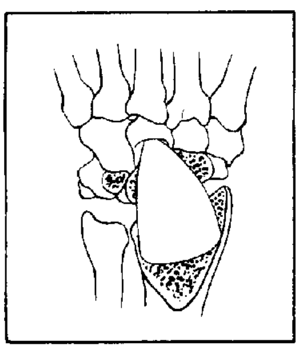




STEINMANN PIN



SCAPROID SCREW



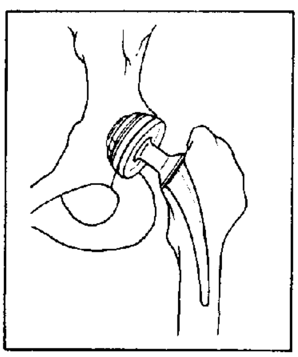
ARTHROTOMY
OR
ARTHRODESIS

Arthrodesis (fusing of a joint) may be indicated if there is a long-standing nonunion of the carpal navicular, or scaphoid, bone associated with arthritic changes in the wrist, and when these is severe and constant pain and marked dysfunction. A bone graft (taken from the tibia, ilium, or, as in this case, radius) is placed across the joint, with one end fitted into the medullary canal of the radius and the other end into a groove fashioned in either the base of the metacarpals or, as shown here, in the capitate bone. Plaster immobilization is usually required.

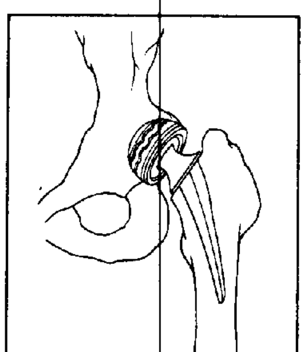
When the navicular bone fragments are viable, reduction may be accomplished by inserting a small scaphoid screw across the fracture line to stabilize both fragments. Plaster immobilization may be required.

Fractures of the metacarpals seldom need open reduction. If there is gross displacement, however, open reduction may be indicated. Sometimes it is sufficient to merely pry, or elevate, the bone ends into anatomic position and no internal fixation is necessary. If, however, the bone ends are not well engaged and stable, intramedullary fixation may be accomplished by inserting a small Steinmann pin through the medullary canal of both fragments. Plaster immobilization is usually required. The Zimmer Riordan fixation pin is also used.

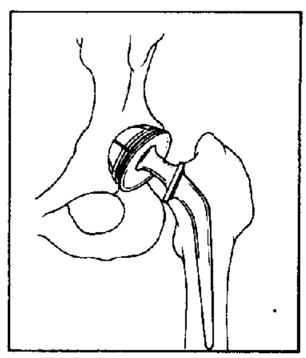
fractures and fracture management



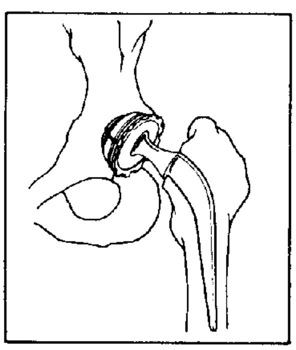
MULLER TOTAL HIP



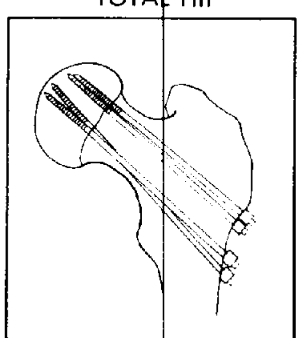
AUFRANC–TURNER
TOTAL HIP



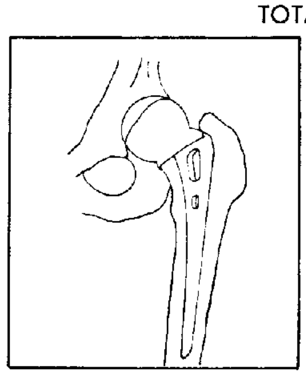
TRAPEZOIDAL–28
TOTAL HIP



CHARNLEY TOTAL HIP



KNOWLES PINS



AUSTIN MOORE PROSTHESIS

fractures and fracture management

Cup arthroplasty, which consists of fitting a cup in the acetabulum, is intended to restore or improve joint function. It may be indicated in cases of rheumatoid arthritis, degenerative joint disease, ankylosis, fresh or old fractures of the acetabulum, and complications of fractures of the femoral neck, specifically nonunion or avascular necrosis of the femoral head. The operation consists of disarticulating the hip, molding the femoral head to a spherical shape, reaming the acetabulum to a perfect hemisphere, and implanting the cup. Smooth fibrous cartilage develops between the cup and acetabulum and between the cup and femoral head, thus forming smooth congruous joint surfaces.

Note: Reamers must be correlated to the size of the cup to be used. Both hand reamers and brace type reamers are available.

In severe fractures of the head or neck of the femur, or after old fractures followed by nonunion and absorption of the neck, avascular necrosis of the head with or without union, or arthritic degeneration of the hip after union, a prosthesis may be used to replace the head and neck of the femur. It is not a routine procedure and is usually reserved for older people. The regular stem Austin Moore prosthesis approximates the anatomical configuration of the femur; the straight stem Austin Moore prosthesis may be indicated if there is also a fracture of the femoral shaft. Moore prosthesis have openings in the stem intended for the bone to grow in to form a bridge for additional stability. The Thompson prosthesis has a large collar for weight distribution on the calcar femorale. The femoral head is excised, and fashioning of the femoral neck is performed to achieve an accurate fit. If necessary, the acetabulum is reshaped to receive the head of the prosthesis. The medullary canal of the femur is reamed and the prosthesis is inserted.

Note: Rasps which are specific to the type of prosthesis to be used are available and should always be used.

If both the acetabulum and femoral head are involved in a degenerative process, due to injury or disease, total hip replacement arthroplasty may be indicated.

A displaced upper femoral epiphysis may be held with pins after a satisfactory position is obtained. These pins are inserted through the femoral neck, across the epiphyseal plate, and into the epiphysis. They should not penetrate the articular cartilage. The Knowles pin is threaded only at the medial end.

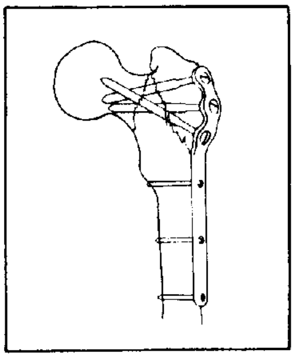
There are many procedures for obtaining arthrodesis of the hip. One of these uses the Fox internal fixation appliance. A nail is driven (through a drill hole) from the greater trochanter through the femoral head and into the pelvis. A "pelvic button" or yoke is attached to the medial end of the nail. A femoral plate is then applied, compression of the femoral head into the acetabulum is achieved, and the plate is fixed to the femoral shaft with three screws. The plate is held firmly to the nail by a lock washer and nut.

fractures and fracture management

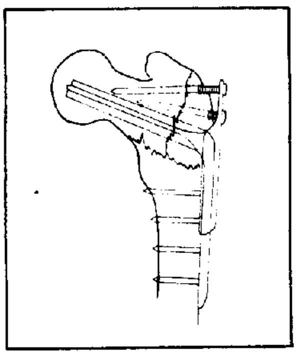
Reduction and internal fixation is the treatment of choice for trochanteric fractures. The aim is to restore the correct angle between the femoral neck and femoral shaft. The fixation may be achieved through the use of nails, which are flanged in various configurations for stability inside the bone, and plates which provide additional stability and fixation. Most nails are cannulated and are inserted over guide pins. These procedures are not recommended for subtrochanteric fractures.

The Smith-Petersen nail is a straight, tri-flanged nail; it is shown here in combination with a McLaughlin plate although it may also be used alone. The Ken sliding nail has a variable frictional resistance feature. The Jewett angled nail is shown with an overlay plate, used to prevent medial migration of the distal fragment due to muscle pull, particularly in comminuted fractures. The Neufeld nail has a "V" design blade which tends to restrict movement of the fracture fragments. The Massie sliding nail and tube assembly, particularly useful for neck fractures, prevents maintenance of distraction by the fixation appliance. The Moe intertrochanteric plate is used especially with comminuted fractures. The Zimmer compression hip screw permits compression of the fragments.

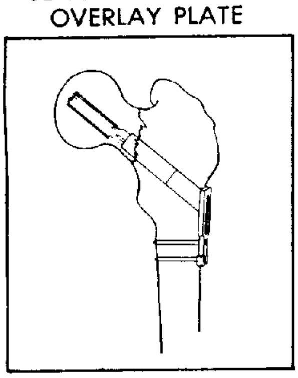
The operation is a major one. The patient is usually immobilized on a fracture table for the procedure. First the correct angle of the neck and shaft is restored. Then guide pins are inserted with a drill, hand chuck, or mallet. The guide wires are used because it is easier and less destructive to the bone to reinsert a wire if the position is incorrect than to reinsert the nail. A hole is drilled in the lateral cortex of the femur to preclude splitting of the cortex when the nail is inserted. Then the nail is inserted across the fracture site, into the femoral neck and head. The plate must be flush and in complete contact with the shaft of the femur. It is usually affixed with three or more bicortical screws.



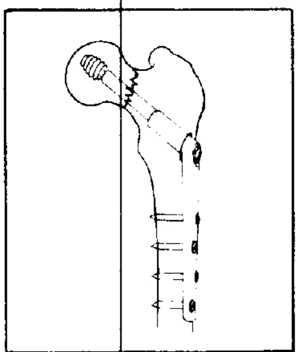
MOE INTERTROCHANTERIC PLATE



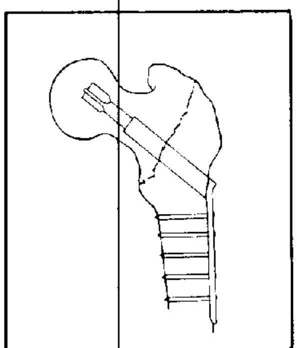
JEWETT NAIL WITH OVERLAY PLATE



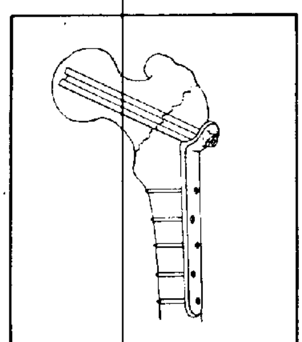
MASSIE NAIL



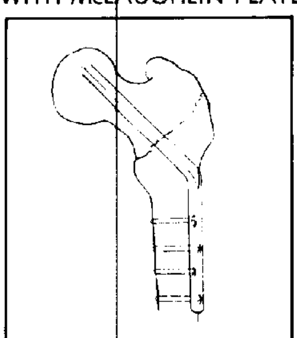
COMPRESSION HIP SCREW



KEN SLIDING NAIL

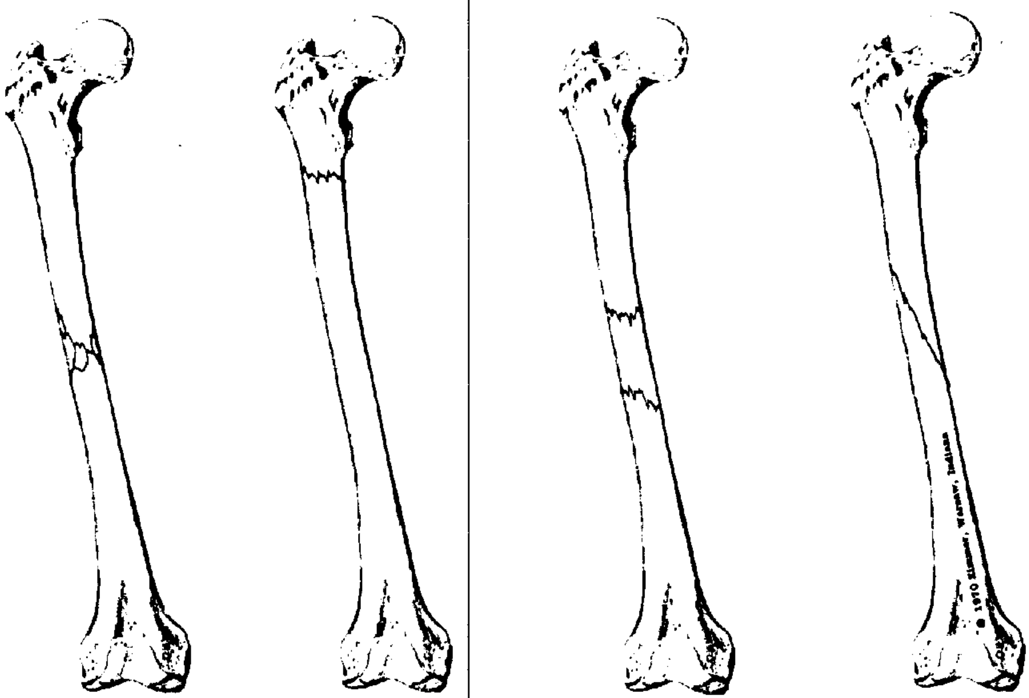


SMITH-PETERSON NAIL WITH McLAUGHLIN PLATE



NEUFELD NAIL

fractures and fracture management



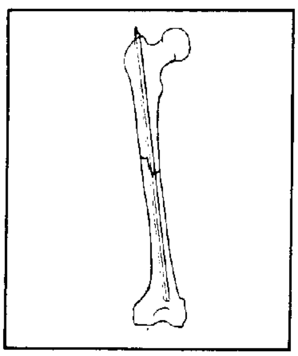
Intramedullary nailing may be indicated for fractures, nonunion, or malunion of the femoral shaft. It is infrequently used in children, adolescents, and severely comminuted fractures. Plaster immobilization is usually required.

The medullary canal is usually reamed prior to nail insertion.

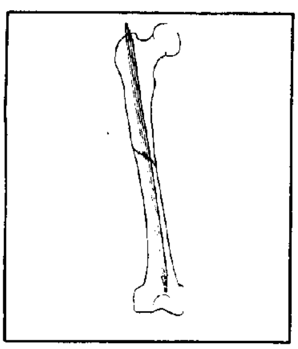
Note: An air-powered drill or the Luck power drill may be used for reaming.

The nail is driven through the proximal fragment, then into the distal fragment while the fracture is held reduced. The Kuntscher nail has a cloverleaf configuration in cross section designed to render the shaft of the nail compressible. Thus it occupies the entire width of the canal throughout most of its length, since it can be compressed at narrow points and still fill the larger diameter. Hansen-Street pins have a diamond-shaped cross section with two different sized diameters to fit the medullary canal, which is oval in cross section. The Schneider intramedullary nail is four-flanged and self-broaching and may be driven or extracted from either end.

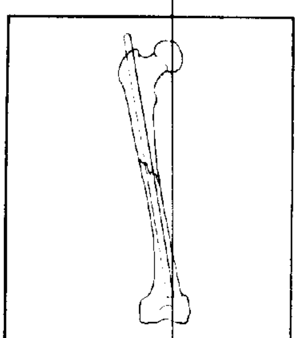
If the fracture is oblique, a heavy-duty femur plate may be used for fixation.



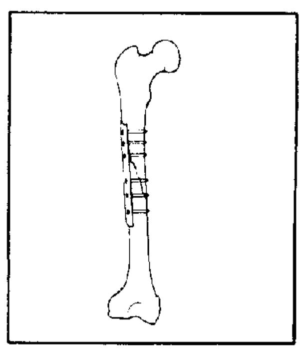
HANSEN—STREET PIN



SCHNEIDER NAIL

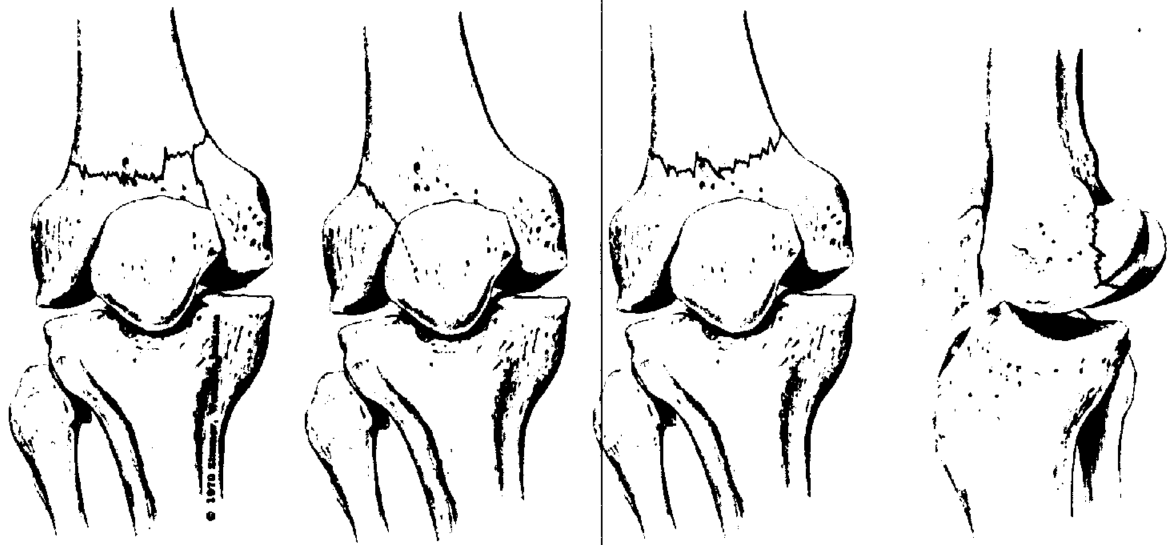


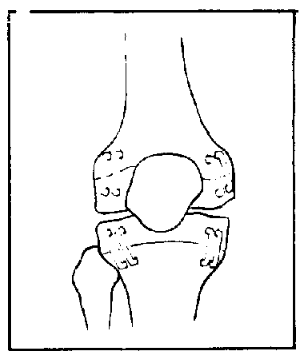
KUNTSCHNER NAIL



HEAVY DUTY PLATE

fractures and fracture management

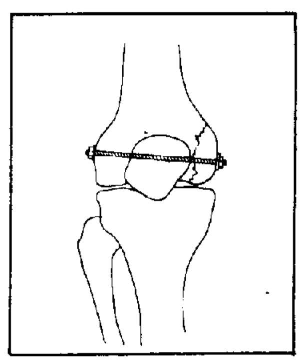




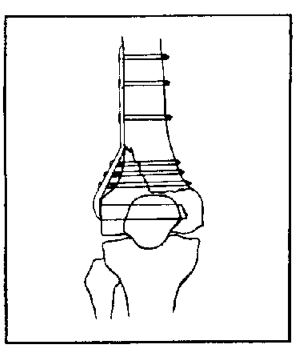
EPIPHYSEAL STAPLING

Fractures of the femoral condyles are reduced by fitting the fragments together, lining up the condyles with the shaft, and then securing the fragments. The Elliott femoral condyle blade plate is preshaped to fit the lateral condylar and shaft surfaces of the femur. The blade has an inverted "V" shape for contact with cancellous bone of the condyles, and the plate is slotted to allow continuing apposition of the fragments. It has three additional holes at the condylar bend portion for additional fixation of the distal condylar fragments, especially useful in comminuted fractures. The Zimmer femoral condyle blade plate is particularly useful for "T" fractures or supracondylar fractures. For a vertical fracture line of the medial condyle, Webb bolts are sometimes used to secure the fragment. Rush pins may also be used in a criss-cross configuration for a transverse fracture.

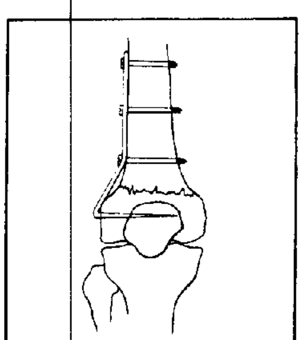
Epiphyseal arrests, either by stapling or bone grafting, may be used to purposefully arrest bone growth, as in cases of limbs of unequal length. Three staples are usually used on each side of the bone, shown here on the femoral condyle. Staples are inserted with the cross-bar perpendicular to the epiphyseal plate, pointing toward the center of the bone. Specialized instruments are used to place and remove staples. When a limb length discrepancy or angular deformity has been corrected, staples may be removed, if further growth from the epiphysis plate is possible and is desired.



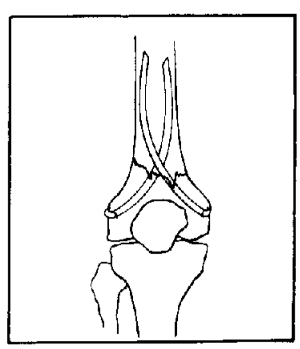
WEBB BOLT



ELLIOT FEMORAL CONDYLE BLADE PLATE

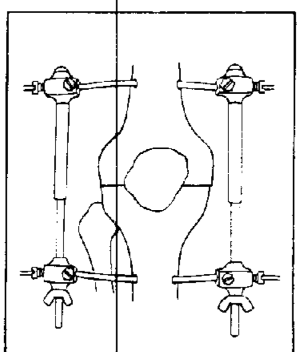


ZIMMER FEMORAL CONDYLE BLADE PLATE

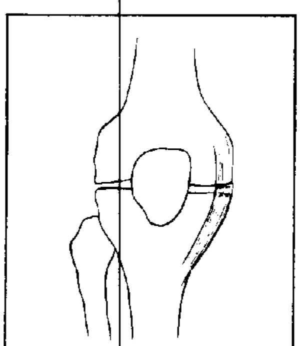


RUSH PIN

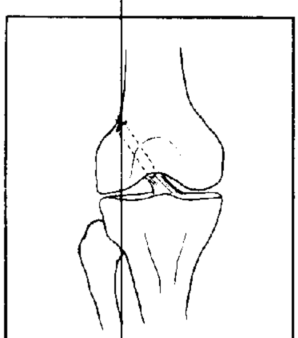
fractures and fracture management



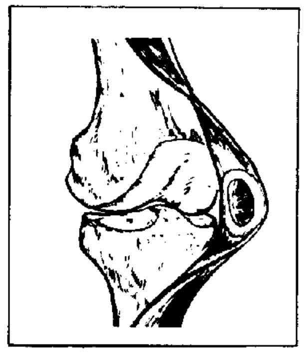
CHARNLEY
COMPRESSION ARTHRODESIS



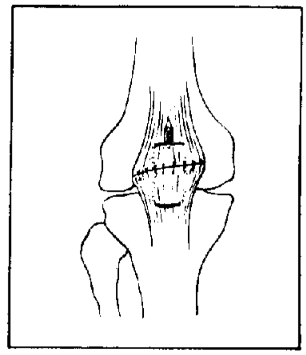
COLLATERAL
LIGAMENT REPAIR



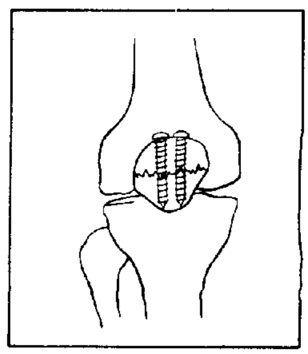
CRUCIATE
LIGAMENT REPAIR



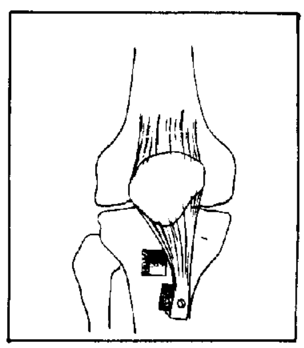
EWALD-SLEDGE
PATELLAR REPLACEMENT



REPAIR OF PATELLA

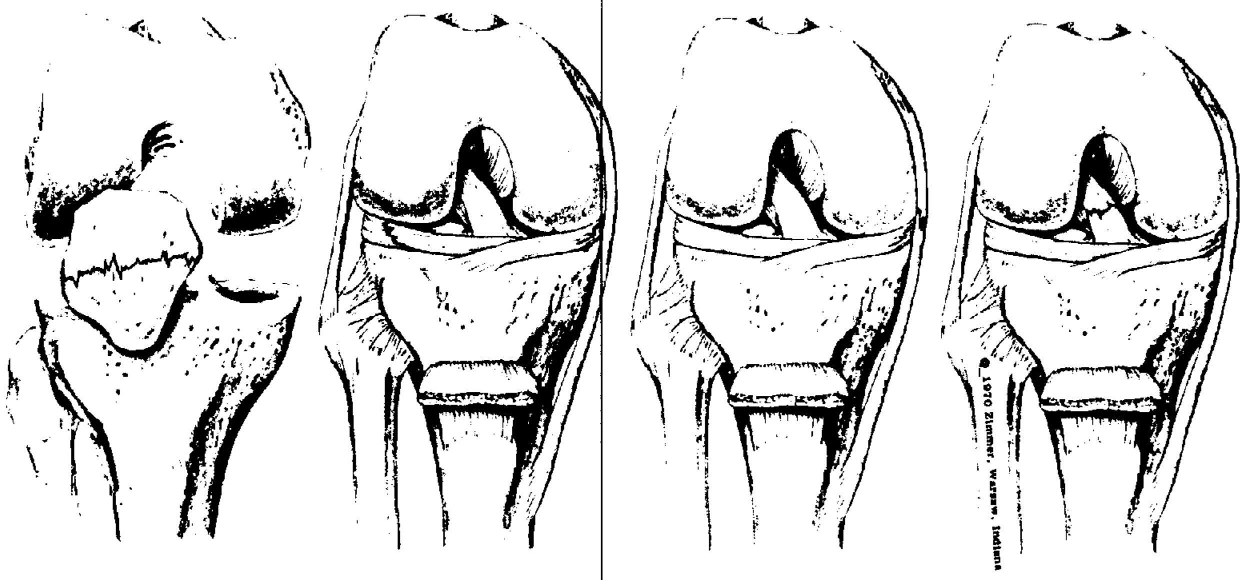


REPAIR OF PATELLA



PATELLA TENDON
TRANSFER

fractures and fracture management



Arthrodesis of the knee joint is a means of stabilizing the joint. Bone ends, menisci, synovial membrane, etc., are exercised to form broad contact of contiguous bony surfaces. A Charnley arthrodesis clamp may be used to compress the joint and provide for approximation of bone ends with rigid locking in the desired position of rotation. Plaster is usually required.

If the meniscus is torn, with or without the existence of a locked knee joint, one practical treatment is meniscectomy. Cartilage should be removed without damaging other structures. Attachments are severed and the meniscus is removed by sharp dissection, avoiding pulling or tearing.

Note: It is best to avoid using a knife with detachable blade deep in the joint, because the blade may become detached from the handle.

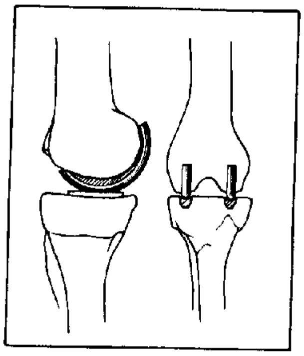
For treatment of rheumatoid arthritis with persistent swelling, synovectomy may be done to ease pain, help prevent further joint destruction, and to restore some function to the joint, although motion will be permanently impaired. The menisci are usually excised if no longer serviceable and pathologic tissue in the joint is removed.

Arthroplasty, to help relieve pain and increase the range of motion, is a resection of joint surfaces. The femoral surface is fashioned to a convex shape. Tibial surface is made concave. Frequently, soft tissue procedures are also required.

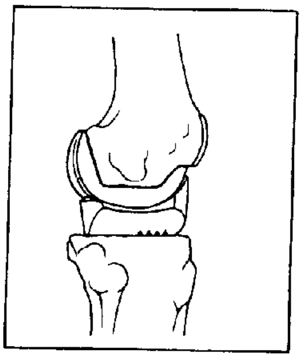
Most acute ruptures of ligaments of the knee usually involve both the collateral and cruciate ligaments (common is the anterior cruciate and medial collateral). They are repaired by suturing the deep and superficial layers separately, overlapping if possible. If separated from the bone at one or both ends, the ligament should be reattached to the bone through drill channels. Edges of the ligaments may be sutured to the periosteum to strengthen the repair. Plaster is usually required.

Fractures of the patella are treated in various ways. In a transverse fracture with fragments of nearly equal size and without comminution, reduction and fixation with a screw, wire, or heavy suture is often done. For marginal fractures, or for transverse fractures in which the fragments are of unequal size, the smaller fragment is excised. In comminuted fractures or in polar fractures which are comminuted or widely separated, smaller fragments are often excised. The margin of the remaining fragment is trimmed to a flat surface, two or more channel holes are drilled in the fragment, and the tendon is sutured to the fragment. For severely comminuted fractures, all fragments are excised and the edges of the tendons are overlapped, plicated, and sutured together and the medial and lateral retinacular structures repaired. Plaster will usually be required.

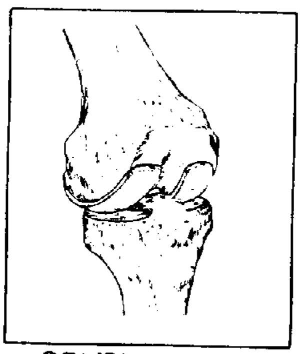
For recurrent lateral dislocation of the patella, a tendon transfer may be done. A block of cortical bone from the tibial tubercle with patellar tendon attached is removed. A second block of bone is removed distal and medial to the original site of the tendon attachment. The first block with the tendon attached is countersunk into this site and secured with a screw through the block and the tibia; the patella now lies in a more nearly normal position and the line of pull of the quadriceps mechanism is more anatomic. The block of bone removed from the second site is implanted into the space created by removing the first block. Plaster will usually be required.



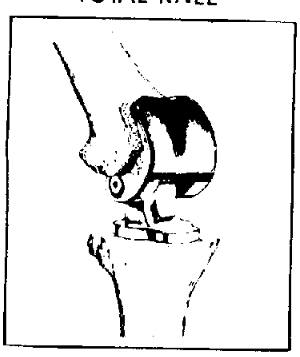
POLYCENTRIC
TOTAL KNEE



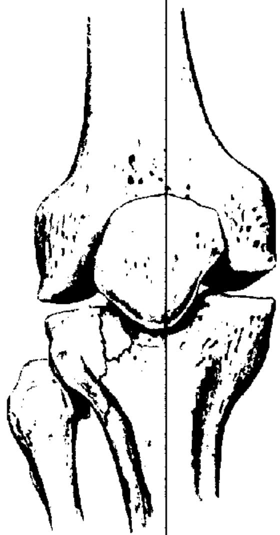
GEOMETRIC
TOTAL KNEE

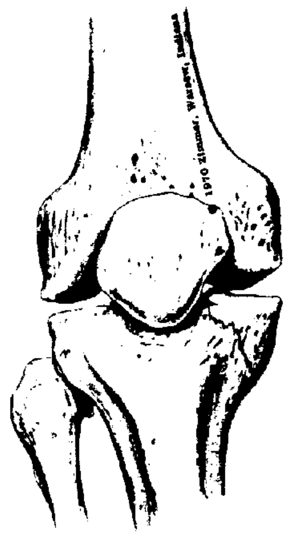


COMPARTMENTAL
TOTAL KNEE



OFFSET HINGE
TOTAL KNEE

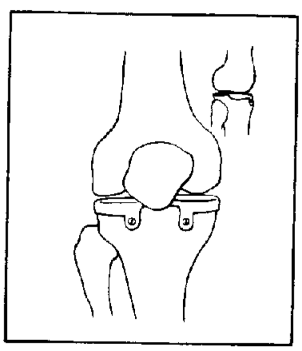




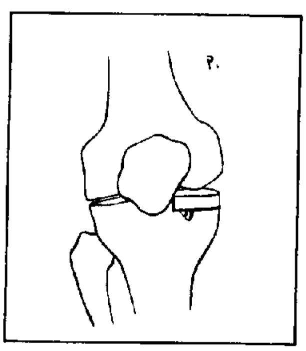
When the tibial plateau is badly eroded or destroyed by disease (arthritis) or trauma, a tibial plateau prosthesis may be implanted to restore the smooth articular surfaces of the knee joint. The prosthesis is an anatomically contoured plate, surfaced to fit the upper end of the tibia and to reestablish the anatomical outline of its articular surface. The operation consists of excising the menisci, synovial membrane, and other material from the knee joint and reshaping the end of the tibia. The patella may be removed.

For a Sbarbaro plateau prosthesis, the surface of the tibial plate is flattened, a trough gouged in the surface, and the prosthesis seated in the trough. The Townley articular plate prosthesis has a cupped rim to fit over the reshaped tibial plateau and is seated with screws through the anterior rim of the prosthesis.

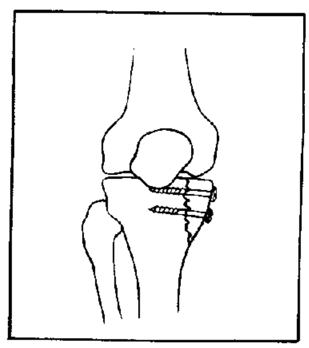
Fractures of the upper end of the tibia, particularly "T" or "Y" fractures, may be reduced and compressed with two screws inserted through the condyles parallel to the articular surface, or with Zimmer tibia bolts, which are secured with a nut and washers. Plaster will usually be required.



TOWNLEY PROSTHESIS

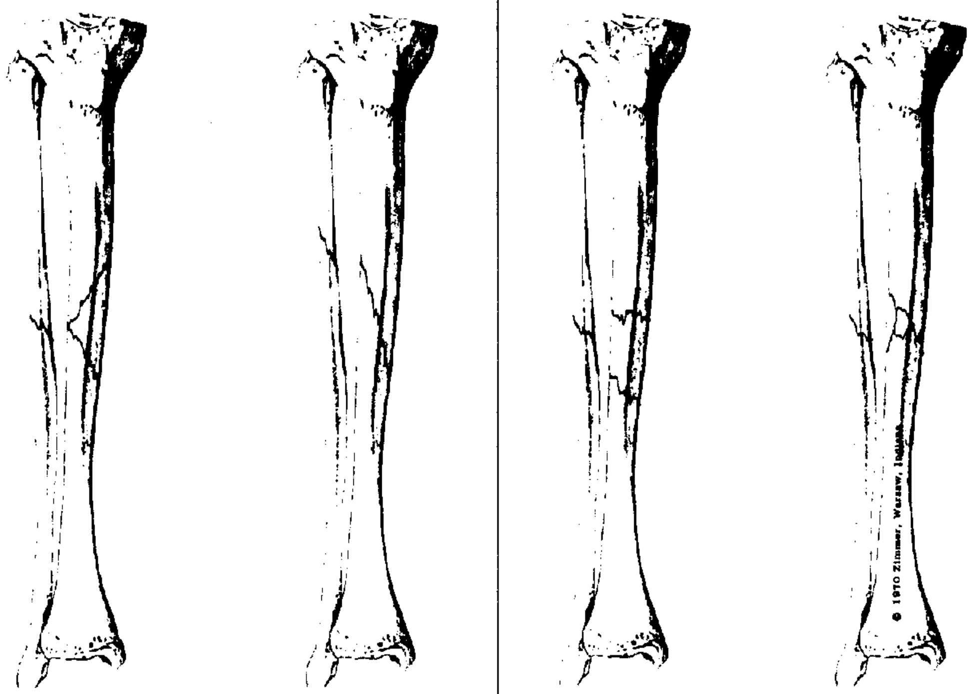


SBARBARO TIBIA PLATEAU



SCREW FIXATION

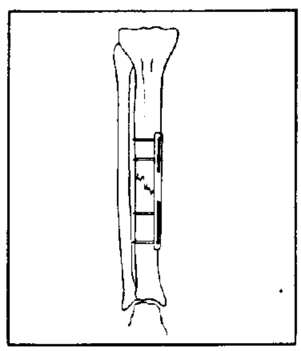
fractures and fracture management

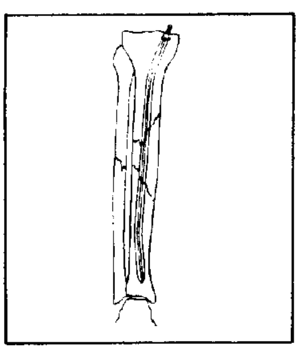


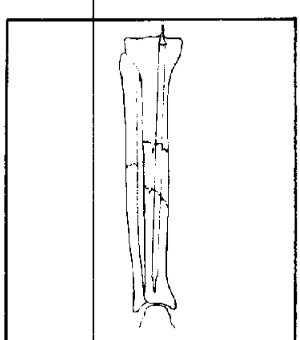
Many fractures of these bones can be treated by closed reduction. When both bones are fractured, fibular fractures are usually disregarded, with all the attention directed to the tibia. Longitudinal and rotational alignment of the fragments is essential to maintain the proper plane of motion in the knee and ankle. Fractures which require open reduction may be fixed by intramedullary devices or plates. Plaster is usually required.

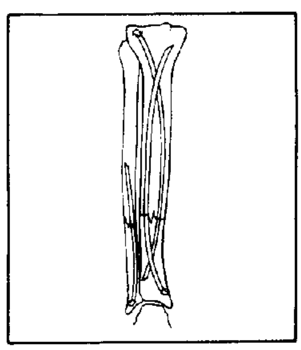
Schneider and Lottes nails are flanged for maximum stability within the medullary canal. Cancellous bone grafts are often applied across the fracture site following nailing. Rush pins are used in pairs to breach the canal completely.

Delayed union and nonunion are common in tibial fractures; for those situations, bone plates may be used to increase immobilization and close approximation of fragments. With an Eggers plate, screws are seated away from the inner ends of the slots to allow the longitudinal muscle pull to hold the fragments in contact.

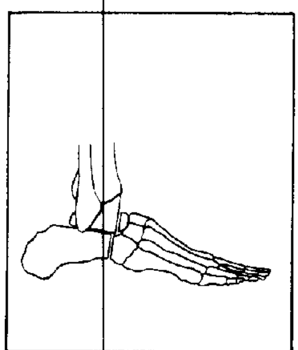

EGGERS BONE PLATE


LOTTES TIBIAL NAIL

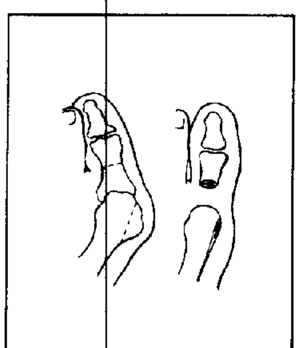

SCHNEIDER NAIL


RUSH PIN

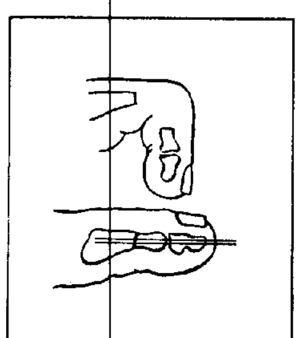
fractures and fracture management



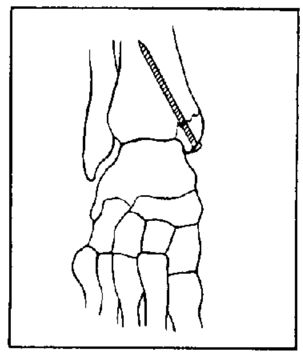
TRIPLE ARTHRODESIS



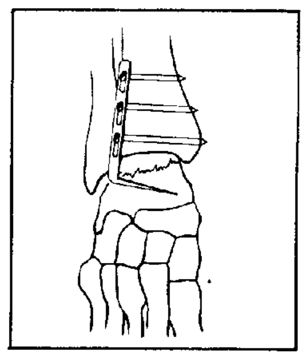
BUNIONECTOMY



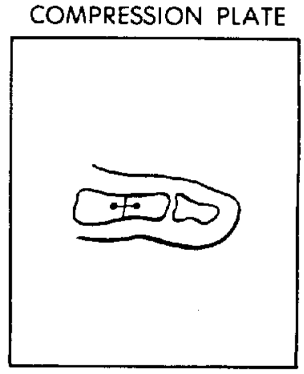
HAMMERTOE RESECTION



SCREW FIXATION
OF MALLEOLI



BAGBY ANGLED
COMPRESSION PLATE



METATARSAL SHORTENING

6. **Medullary Nailing...** This technique employs a long Intramedullary Nail which is hammered into the marrow of long bones and engages both fragments. This is used to treat fractures of the shaft of the long bones: thigh, leg, arm, and forearm.

UNION, OR HEALING OF FRACTURES

Union is defined as the healing of a fracture and bones are said to heal with normal union, delayed union, or if they fail to heal at all, it is termed non-union.

If set properly and if no infection has occurred, most fractured bones will heal by normal union within a few weeks time. However, there are breaks in certain bones that are accompanied by interference with the blood supply and these fractures are subject to delayed healing. As an example, fractures of the lower third of the leg involving the tibia (shin bone) are notorious for their slow healing for this reason. In other instances, despite the best of orthopedic management, union fails to take place. This circumstance is found in about 30% of all fractures involving the neck of the femur in the hip region, and in some cases where the long bones such as the tibia (leg bone) or ulna (forearm bone) are broken.

The commonest causes of delayed and non-union are:

1. Improper immobilization.
2. Interference with blood supply to the bone as a result of the fracture.
3. Loss of bone substance so that the broken ends do not meet.
4. Extensive injury to the soft parts — muscles, ligaments, blood vessels, lymph channels — surrounding the fracture.
5. Infection at the fracture site.
6. Excessive traction.
7. Soft tissue (such as muscle or fibrous tissue) which gets in between the ends of the broken bones and prevents them from knitting together.
8. Improper introduction and/or fixation of pin or wire, which migrates before bone has knit.

In the great majority of cases, the orthopedist can overcome non-union. He can reset a poorly reduced fracture; he can help to overcome infection by draining off pus and by administering large doses of the antibiotic drugs; he can build up the general health of his patient by giving proper medications. On the other hand, when extensive soft part injury has accompanied the fracture, he can only wait for nature to take its course in bringing about repair.

Surgery can be most helpful in cases where x-ray examination shows no tendency toward healing or where there is evidence of loss of bone between the ends of the fractured bones.

fractures and fracture management

Fractures of the hip are divided into two major types: those of the trochanteric region and those involving the intracapsular part of the femoral neck. About 80% of both types occur in people over 60 years old. Both are more common in women than in men (80 - 85%); this is probably due to several factors. Women have a slightly wider pelvis with a tendency to coxa vara, they are usually less active and more prone to senile osteoporosis, and the life expectancy of a woman aged 60 years is five years longer than that of the average man.

TROCHANTERIC FRACTURES

The term trochanteric fracture is used to include any fracture from the extracapsular part of the neck to a point 2 inches distal to the lesser trochanter. In general, the type of internal fixation and other treatment are the same for this entire group.

Closed methods of treatment are satisfactory as far as union of the fracture is concerned. The mortality rate, however, is relatively high. Also after prolonged immobilization, function of the extremity, particularly motion in the knee, is regained slowly; in fact, permanent limitation of the knee motion is common.

The four types of trochanteric fractures are as follows:

Type 1

Fractures extending along the intertrochanteric line from the greater to the lesser trochanter. Reduction of this type of fracture is usually simple and is maintained with little difficulty. Results are generally satisfactory.

Type 2

Comminuted fractures, the main fracture line being along the intertrochanteric line but with multiple fractures in the cortex. Reduction of these fractures is more difficult since the comminution may vary from slight to extreme. A particularly deceptive form is the fracture in which an anteroposterior linear intertrochanteric fracture line occurs, as in type 1, but with an additional fracture in the coronal plane, seen on the lateral roentgenogram.

Type 3

Fractures which are basically subtrochanteric, with at least one fracture line passing across the proximal end of the shaft just distal to or at the lesser trochanter. Varying degrees of comminution are associated. These fractures are usually much more difficult to reduce and result in more complications, both at operation and during convalescence.

Type 4

Fractures of the trochanteric region and the proximal shaft, with fracture lines in at least two planes. If open reduction and internal fixation are used, two-plane fixation is required because of the spiral, oblique, or butterfly fracture of the shaft.

Fortunately, the most difficult fractures to manage, type 3 and type 4, comprise only about one third of all trochanteric fractures.

Internal fixation of trochanteric fractures has reduced the mortality and morbidity rates. Medical complications after internal fixation are fewer and less serious than those during rest in bed in a body cast. Unquestionably, the disadvantages of internal fixation of trochanteric fractures are outweighed by its advantages.

fractures and fracture management

Various nails and pins have been devised to fix trochanteric fractures. One of the early types was devised by Lawson Thornton in 1937. This consisted of a plate, one end of which fitted over the head of a Smith-Petersen nail and was fixed to it with a screw. Jewett varied this by welding the plate to a Smith-Petersen nail. Moore suggested a blade-type plate. Neufeld devised a V-shaped nail, bent at 135° to conform to the angle of the neck to the shaft. Regardless of the location of the fracture, the proximal part of the nail must be long enough to be well embedded in the neck and head fragments; the distal end of the plate must extend down the shaft well distal to the level of the fracture to provide sufficient stability and fixation and to eliminate the need for external support.

FRACTURES OF NECK AND FEMUR

Internal fixation of this fracture by nails, screws, or pegs is not a new procedure. The first report of this method of treatment was by von Langenbeck in 1850. Successful results were reported by Nicolaysen and others before the development of the roentgenogram. Thomas in 1921 and Martin and King in 1922 reported excellent results after using wood screws for internal fixation. At that time, non-electrolytic metals were not available, and thus absorption of bone and loss of fixation sometimes occurred. Lack of good roentgenographic control, inaccurate reduction, or lack of dexterity on the part of the surgeon in introducing the appliance rapidly brought the method into disrepute. Smith-Petersen is responsible for reviving and popularizing the procedure. The present treatment of fractures of the neck of the femur was made practical by the following: (1) the development of efficient apparatus for internal fixation, particularly the Smith-Petersen and Thornton nails, with compatible plates, (2) the development of relatively non-electrolytic metals such as **ZIMALOY** after the experimental work of Venable, Stuck, and Beach, and (3) the perfection of efficient roentgenographic control.

Early in the development of the method the fracture of the femoral neck was exposed and reduction and internal fixation were done under direct vision. Now with good roentgenographic control, exposure of the femoral neck in fresh fractures is not indicated unless the reduction is poor. Internal fixation using roentgenographic control may be done with minimal surgery and with minimal injury to the blood supply of the femoral head and neck.

PROSTHETIC REPLACEMENT FOR RECENT FRACTURES OF FEMORAL NECK

The medullary hip prosthesis as a replacement for the head and neck of the femur has been satisfactory as a salvage procedure to justify its addition to the methods of treatment of fresh fractures.

Some of the advantages of using a prosthesis in a fresh femoral neck fracture are as follows:

1. Instead of 14 - 16 weeks of existence in a bed and wheel chair and total dependence on others, the patient is allowed ambulation and weight bearing at 3 or 4 weeks and has a relatively rapid return to ordinary social activities.
2. As a primary procedure this operation eliminates some of the possible complications of femoral neck fractures treated by internal fixation, namely, avascular necrosis, arthritis, and nonunion. If it could be determined in advance who will be among the one third of the patients with these undesirable sequelae, the operation would of course be desirable for them.

NOTE:

Many indications for the use of a prosthesis are relative and controversial. Probably no two orthopaedic surgeons would agree on them.