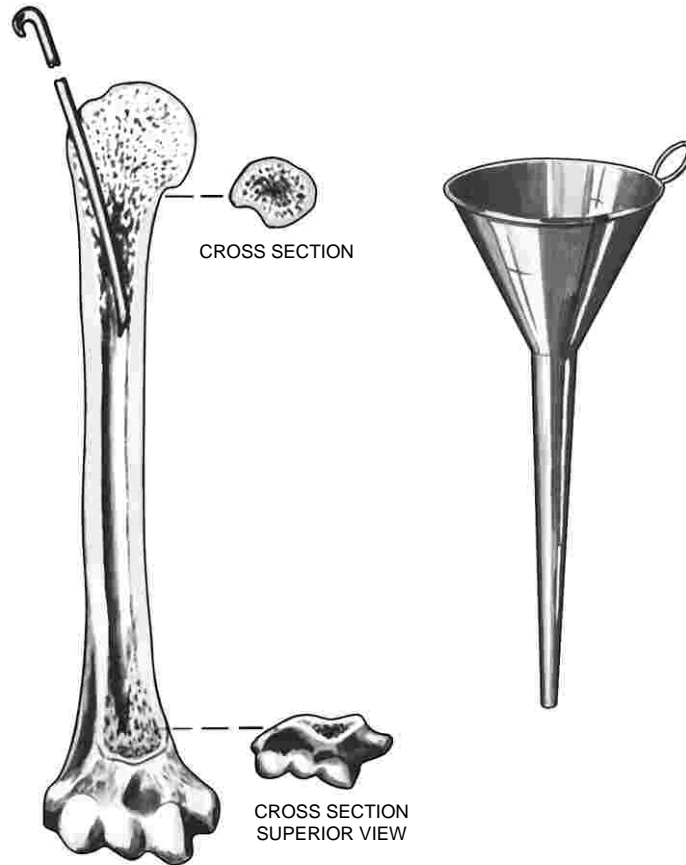


20 THE HUMERUS*



The marrow canal of the humerus is funnel-shaped. Its successful pinning is influenced by many factors.

With a few exceptions, the entire humerus is a beautiful field for medullary pinning. Semi-open reduction is the general rule. In recent cases, it is rarely necessary to endanger nerves or cripple the blood supply of the bone by wide dissection.

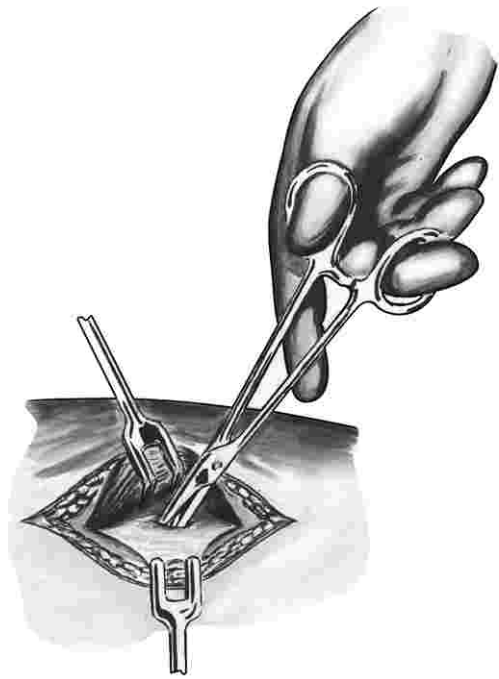
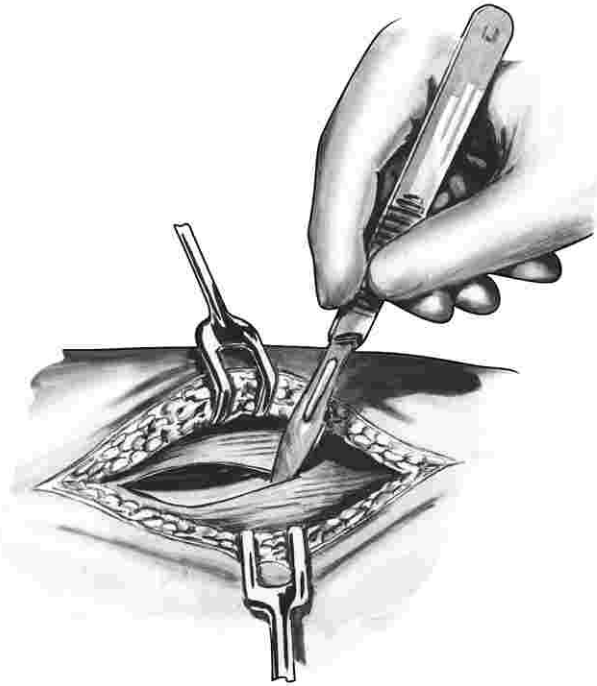
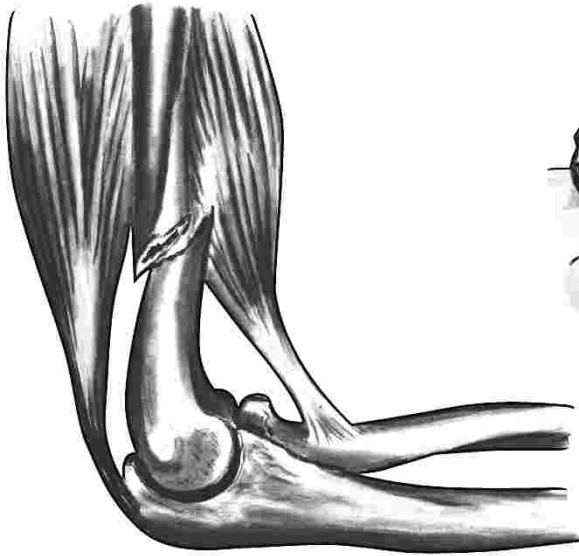
This region offers definite problems. Atrophy of the deltoid muscle and periarticular adhesions of the shoulder occur very rapidly if function of the shoulder is arrested.

Proper utilization of dynamic forces at the different levels is essential if non-union is to be avoided. The important factors are distraction, tendency to angulation and rotary stress. They are most conspicuous at the level just below the deltoid insertion. Also, radial nerve palsy can be a

disagreeable complication.

For the shaft use a one-fourth inch pin whenever possible. Pins of smaller diameter do not give adequate stability and may fracture eventually from stress fatigue. It is best to shape the pin into a slight curve. The point of entrance is the supero-lateral surface of the greater tuberosity.

Most, but not all cases, do better without external fixation. Secure motion of the shoulder and elbow early. Late vigorous attempts to mobilize these joints can fracture the new callus and precipitate non-union. Yet, at times, a light hanging case or sling can be used to good advantage.



Lower Shaft

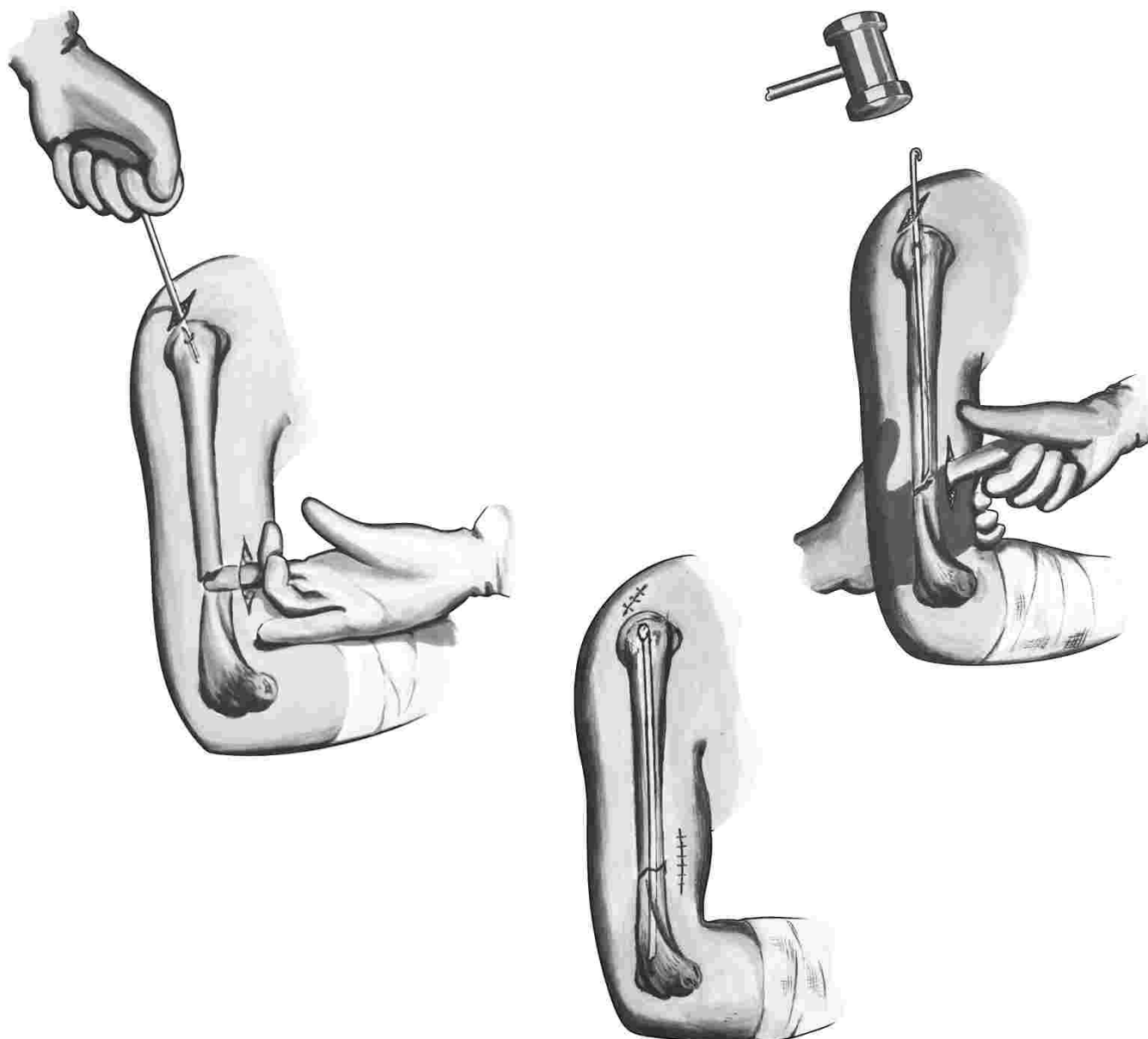
The operation is done as a semi-open procedure. The arm is draped so that it can be manipulated.

Incision: A very slight incision, about one and one half inches, is necessary. This is made at the level of the fracture, on the antero-lateral surface of the arm, just lateral to the belly of the biceps muscle. It extends through the fascia only. The biceps is retracted medially and an artery forceps is pushed through the brachialis muscle

to enter the hematoma. The opening is stretched to admit one examining finger which will guide reduction of the fracture.

By this procedure, the musculo-spiral nerve is not endangered.

A small incision is made over the tuberosity which can be identified by palpation. This incision extends through the fascia.



Lower Shaft (CONTINUED)

The awl-reamer is pushed through the fibers of the deltoid to engage the cortex of the tuberosity, at first vertically. As the cortex is penetrated the direction of the instrument is changed to approximate more closely the long axis of the bone.

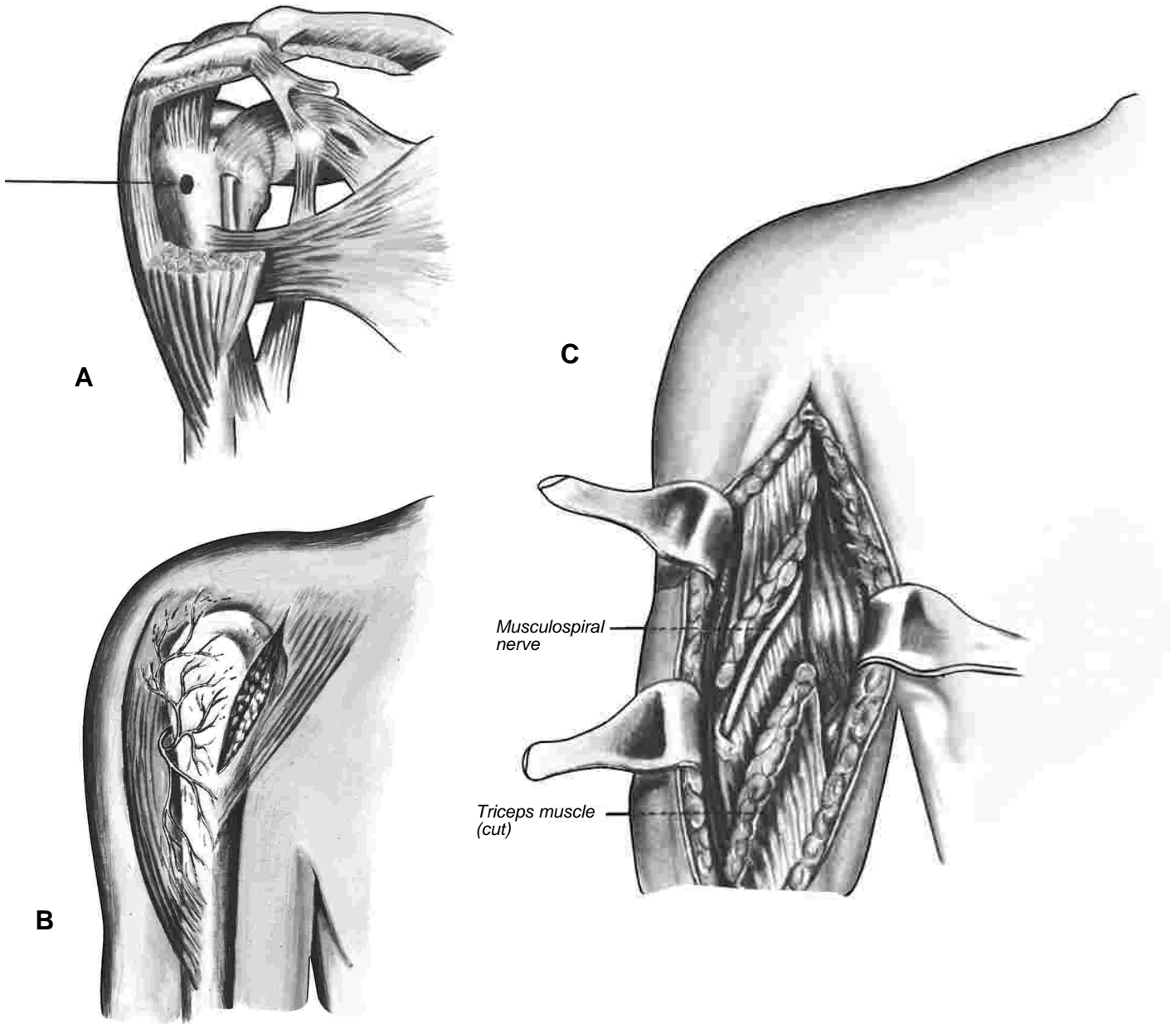
During this procedure, one index finger is kept in contact with the fracture surface of the proximal fragment for orientation.

The pin, preferably one-fourth inch and slightly curved, is driven to the fracture line. The arm is then manipulated with one palpating finger within

the wound to guide the reduction and the pin driven home. The pin should be of sufficient length to extend well into the distal fragment.

The head of the pin should be stress relieved and left slightly prominent to simplify later removal. Too long a pin will cause distraction or extend high enough at the shoulder to interfere with motion.

If a curved pin is used, the point must be carefully driven into the external condyle in such fashion as to avoid angulation.



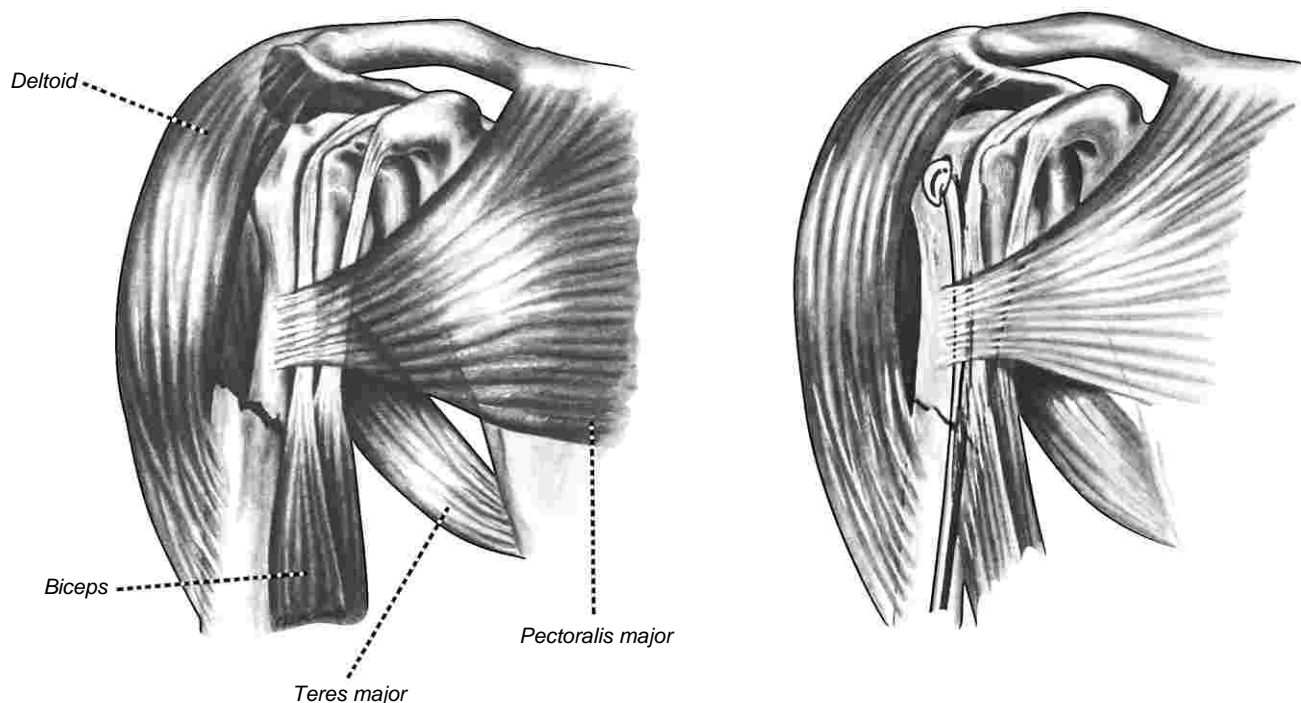
Anatomy

A. The rotator cuff need not be injured or compromised by the insertion of the pin. The supero-lateral surface of the great tuberosity is the proper area for insertion. This point is below the insertion of the supraspinatus and lies between the insertions of the internal and external rotators.

B. Nerve supply of deltoid muscle must be safeguarded. Approach to the humerus in this

region should be anterior, at the deltopectoral groove. Lateral stab wound for insertion of the pin should be made high upon the muscle.

C. The radial nerve spirals around the shaft of the bone and must be carefully protected in open reduction. Semi-open reduction is indicated in most recent fractures and eliminates the danger to this nerve.



Above Deltoid Insertion

Healing is usually good at this level. The strong muscular envelope gives good contact compression to stimulate healing.

The deltoid muscle is attached to the lower fragment which it pulls laterally. The proximal fragment displaces medially from the pectoralis major pull.

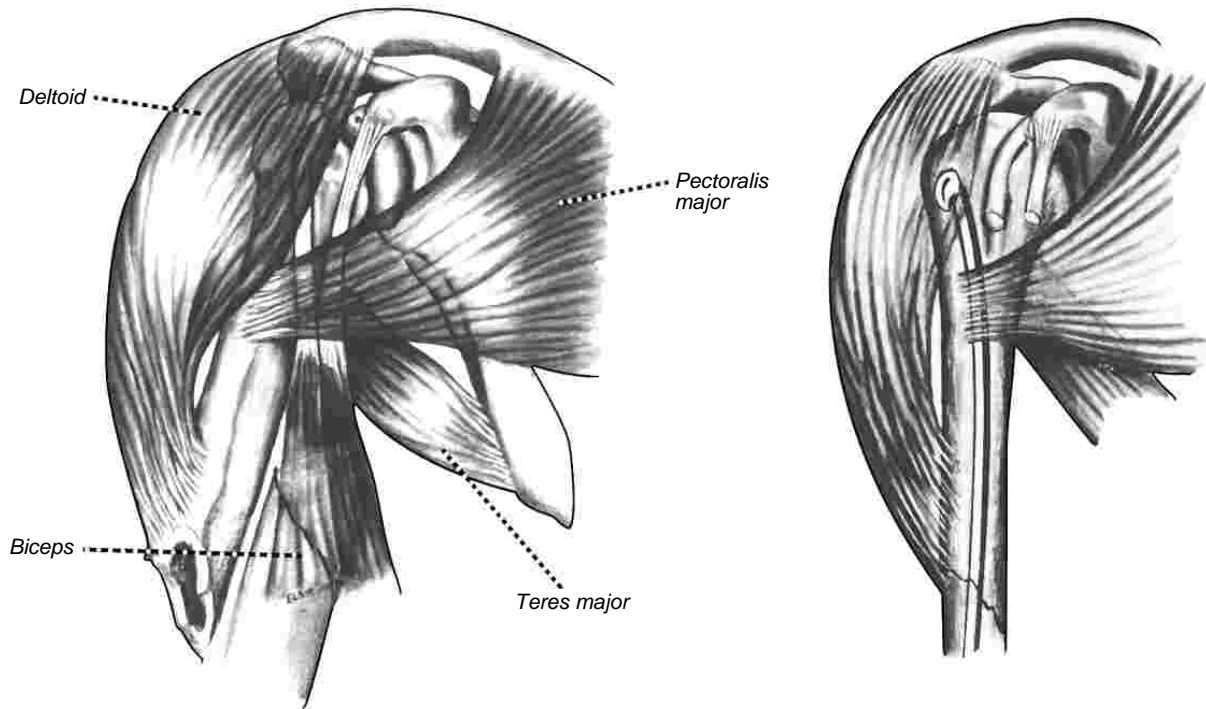
This is usually pinned as a semi-open procedure. This incision is made over the fracture at the anterior border of the deltoid.

The pin is inserted as just described for fractures of the lower third. One must be cautious not to pass the pin too obliquely in the short proximal fragment. This can cause angulation.

As the pin traverses the fracture, it resists the pull of the pectoralis major muscle by pulling the upper fragment outward. Similarly, it resists the pull of the deltoid by forcing the distal fragment medially.

If the fracture is irregular rotation is not to be feared and no external immobilization is necessary. If in doubt, use a sling or light hanging cast.

The use of a curved pin, offsetting the point toward the lateral condyle, can be an excellent safeguard against rotation. This should be used only if the proximal fragment is long enough to afford good three-point pressure.



Below Deltoid Insertion

This is the danger level for non-union. The deltoid muscle pulls the upper fragment outward. These fractures are nearly always oblique and the direction of the obliquity is extremely important.

When the direction of the fracture line is as shown above, the problem is simple. The pin is applied just as shown on the preceding page, for fractures above the deltoid insertion.

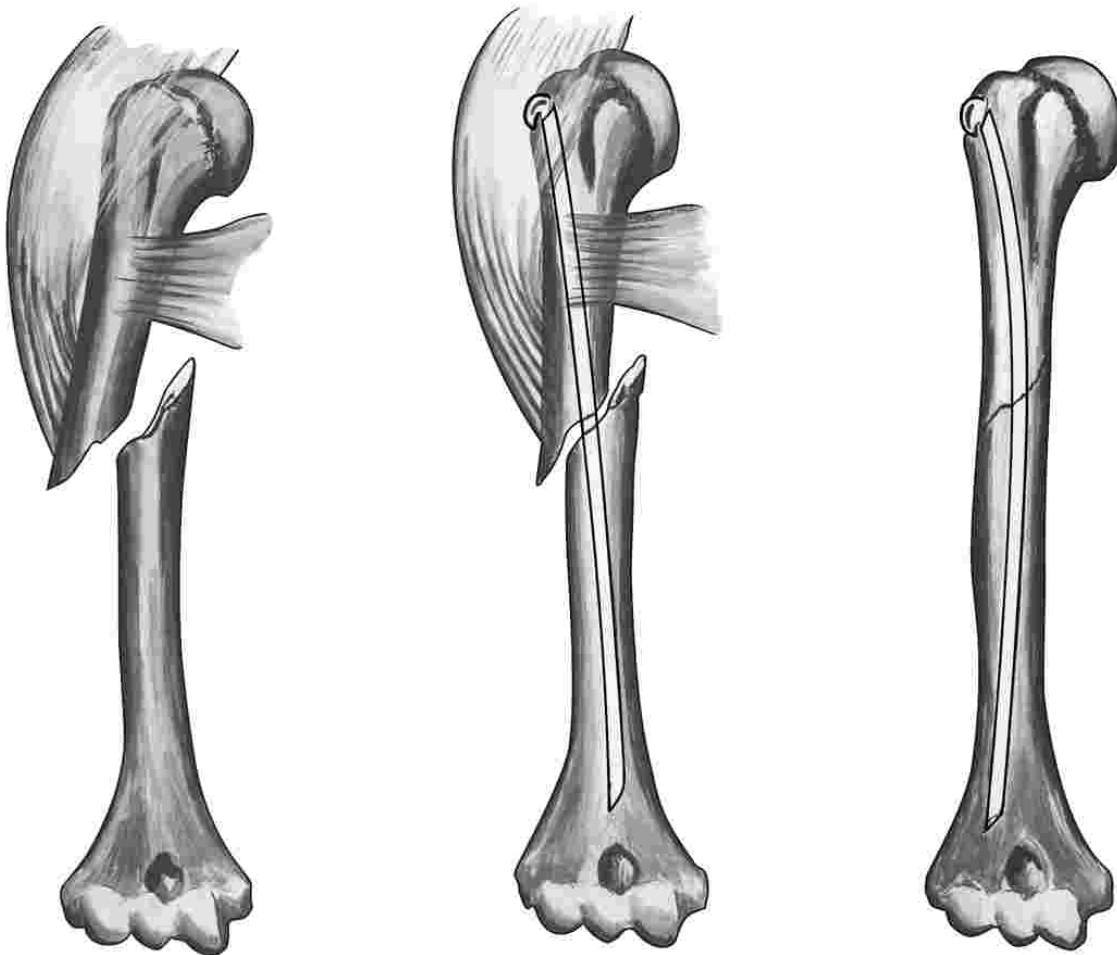
After the pin has been placed, the continuous pull of the deltoid compresses the fracture surfaces to give excellent fixation and stimulate healing.

Unfortunately, this is not the usual direction of the fracture line. It generally runs in the opposite direction to complicate our problem.

At this level it is important to pay meticulous attention to the stability of fixation. When the fracture is well reduced and stably transfixed rapid healing usually occurs.

In the type fracture shown on the opposite page, motion at the fracture site frequently develops insidiously. First, there is loss of compression of the fracture surfaces by the shear force of the deltoid pull; then follows distraction. Add to this, possibilities of the pin loosening somewhat in the bone, plus rotary stress and a non-union can be precipitated.

Barrel stave grafts are indicated if healing is delayed.



Below Deltoid Insertion (CONTINUED)

Observe that here the fracture line runs in the opposite direction. The pull of the deltoid produces wide distraction.

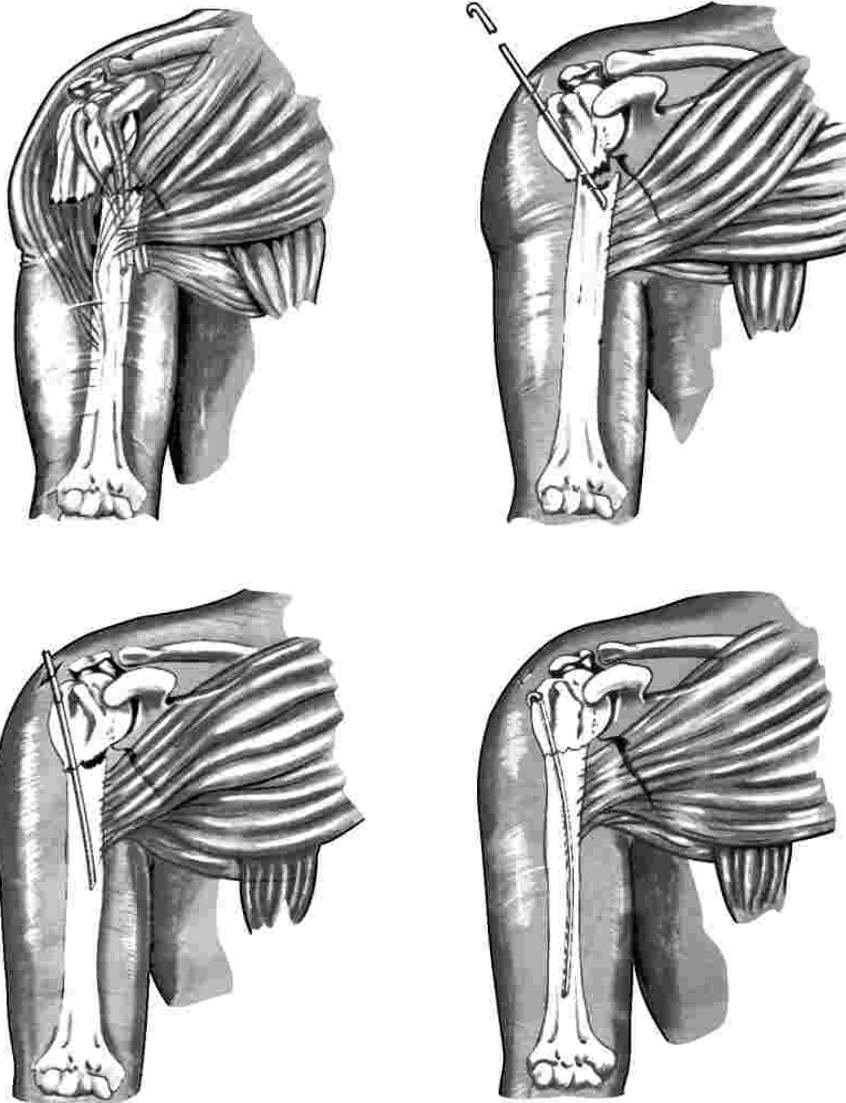
After the application of a straight pin, distraction still occurs. Fixation is not stable and rotation of the fragment can occur.

The proper application of a curved one-fourth inch pin takes care of the situation very well.

The pin enters the proximal fragment through the side of the tuberosity at a slightly oblique

angle. A straight pin would angulate the fragment, but this is counteracted by the curve of the pin. As the curved pin is driven firmly into the distal fragment, the fracture line closes to give good fixation and compression.

Tendency to rotation is prevented. The proximal fragment is stably transfixed by the three-point pressure of the pin having entered from the side. The curved pin with the point offset laterally against the cortex, or into the external condyle, stabilizes the distal fragment.



Neck: Closed Pinning

Closed Pinning: Often indicated in the elderly, can be very simple or very difficult.

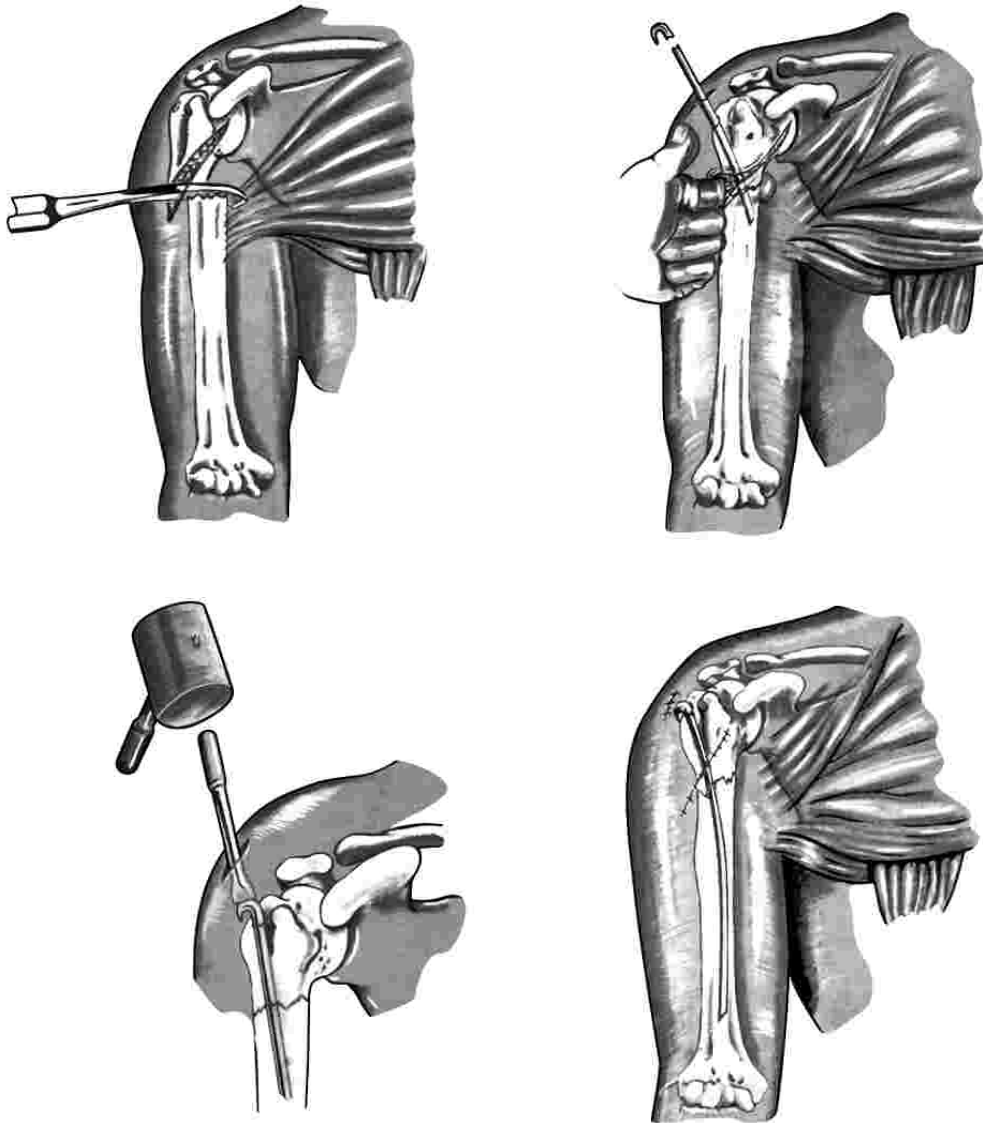
Displacement: Upper fragment pulled outward by supraspinatus. Pectoralis major pulls shaft medially. This is continuous and can cause delayed deformity if fracture is not pinned.

Technic: Reduce fracture. Choose pin three-sixteenths inch in diameter. If the bone is osteoporotic the loop head condyle pin might be

better. Introduce as before but be sure direction of pin is in axial line of the upper fragment to avoid angulation.

Keep sled runner of point directed toward far cortex to guide it down shaft. Set head, close stab wound. No external immobilization is applied.

Pin exerts three-point pressure in bone to resist muscle pull.



Neck: Semi-Open Pinning

When closed pinning is not practical make a small anterior incision. Wide dissection is seldom necessary. In comminuted fractures, it can do infinite harm by breaking up the fascial envelope about the fragments.

The incision need admit only a manipulating finger or small bone skid to maneuver the fragments into position.

It is simpler to delay introducing the pin until the

surgeon is well oriented by palpation. This can prevent angulating the proximal fragment.

When the tuberosity is comminuted, it may be necessary to pass the pin through the head of the bone. This is often also true in certain fractures of children. In such cases, leave the head high so that it can be palpated beneath the skin after swelling subsides, and remove the pin as soon as healing permits.