

61 Shoulder & upper arm injury

61.1 Introduction

Most shoulder injuries are caused by falling on the point of the shoulder, or on the outstretched hand. Dislocation can occur at either end of the clavicle, and at the shoulder; the humerus, clavicle or scapula can fracture. The brachial plexus may be damaged, and axillary vessels ruptured.

SHOULDER EXAMINATION

As in the elbow, first check the radial pulse, and the sensory territories of the median nerve (flexor surface of thumb, index & middle fingers), ulnar nerve (flexor side of little finger) & radial nerve (extensor side of thumb, index & middle fingers). Check the distal pulses, and especially in clavicular injuries, exclude a pneumothorax (43.1)

LOOK

Check that the ends of the clavicle are in similar position on both sides: (abnormal prominence suggests a dislocation). Check for signs of an anterior shoulder dislocation (or circumflex nerve injury causing wasting of the *deltoid*:

- (1) the shoulder outline is flattened,
- (2) the normal roundness of the *deltoid* is lost,
- (3) the anterior axillary fold is lowered,
- (4) the delto-pectoral groove is swollen,
- (5) the elbow is displaced away from the body, or
- (6) the humeral axis points towards the middle of the clavicle (61-4).

Check if the shoulder is grossly swollen, implying a humeral neck fracture, perhaps with dislocation of its head. You may then not see the flattening of the shoulder outline. Check for swelling of the subacromial bursa.

FEEL

Stand behind the patient and feel the spine of the scapula, and the entire subcutaneous surface of the clavicle, and the joints at either end. Feel for any swelling for tenderness. Palpate the axilla to feel a dislocated humeral head in its abnormal position, and feel for the presence of free fluid. Check if the tips of the acromion & coracoid, and the greater tuberosity of the humerus are in their normal places.

MOVE

Check for any abnormal movement between the clavicle and the acromion.

Flex the arm to 90° and rest it on your forearm. Gently move the whole arm up and down. Provided the clavicle is intact, abnormal mobility or crepitus in the shoulder suggests that there is a fracture of the scapular neck.

Now stand behind the patient. Put one hand round in front and hold the outer end of the clavicle firmly. With your other hand hold the tip of the scapula still, so you can be sure that any movements made are those of the shoulder, not of the scapula moving over the chest.

The shoulder should be able to abduct to 90° before the scapula starts to move.

Holding the scapula, with the forearm flexed, note how far will the elbow come across to the midline in front of the chest.

Check external rotation with the forearm flexed, so that it reaches the coronal plane. Rotate it internally to scratch the small of the back.

If placing the hand onto the opposite shoulder is possible, there is no serious shoulder injury.

UPPER ARM EXAMINATION

Palpate the lower half of the humerus for signs of a fracture. This is more difficult in its upper half, which is hidden by muscles.

Support the forearm and gently abduct the arm. Pain, tenderness, angulation, or crepitus, indicate a fracture of the shaft.

On both sides, measure the distance from the tip of the acromion to the lateral epicondyle. Shortening indicates a fracture. This test is particularly useful if you suspect it is impacted.

RADIOGRAPHS

N.B. The clavicle rarely itself needs imaging but without a radiograph, these fractures are difficult to distinguish from subluxation of the acromio-clavicular joint (61.6).

For an acromio-clavicular joint injury, ask for an AP distracted view in which the patient carries a weight.

For the shoulder & humeral shaft, get an AP & lateral view, but if you suspect a posterior dislocation, try to get for an axillary view, which may be difficult, if the arm is held close to the side.

ELBOW AND FINGER EXERCISES MUST START IMMEDIATELY

61.2 Brachial plexus injury

This severe injury can result from a high fall, or typically by avulsion in a motorcycle collision, or in prone ventilation of patients. Total avulsion of all 3 cords results in a completely paralysed insensitive arm, but the injury may be partial. Injury to the long thoracic nerve causes paralysis of *serratus anterior* and 'winging' of the scapula.

If the nerve roots are stretched rather than torn, the function of the rhomboids (which have a nerve supply straight from C5) will be preserved. So test these by seeing if the patient can pull the shoulder blades together.

If the rhomboids are intact, support the arm in a sling, protect it from injury, such as cuts, bruises, and burns, until its sensation returns. Make sure that passive exercises of the shoulder, elbow, and hand continue for 6-12 months or longer, because sensation & strength may take long to recover.

If the injury is extensive, recovery is unlikely unless the nerves can be repaired.

N.B. A serious brachial plexus avulsion may be associated with an axillary artery injury! (49.4c)

61.3 Casts & slings

SLINGS FOR AN INJURED ARM OR HAND

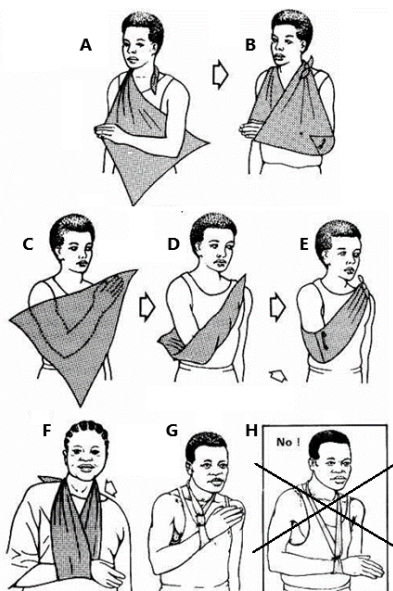


Fig. 61-1 SLINGS FOR AN INJURED ARM OR HAND. A, tie cloth as shown. B, fold it in a triangular shape to make a sling. C, make a St John sling. D, fold it around the forearm- E, raise the hand with it. F, in this sling, the elbow hangs free, allowing weight of the upper to distract humeral shaft fragments. G, a collar & cuff for a supracondylar fracture. H, a narrow bandage sling will cause a sore at the wrist.

Casts are seldom needed for elbow injuries and almost never for shoulder & upper arm injuries. The slings (61-1) are important for ambulant patients with injured arms. An injured or infected arm which hangs down is painful, and any sling makes it much more comfortable and allows it to be exercised when necessary.

Many hospitals supply plaster casts and sell or hire out crutches. They should do the same for slings. *An important principle in all shoulder injuries is for the patient to start exercising the elbow and fingers as soon as possible.* Even in a sling or with a brace, it is possible to move all the non-injured joints. Encourage regular isometric muscle strengthening symmetrically on the injured and the sound body side 6 times per day for 10sec. Also encourage pendulum exercises for the shoulder to prevent it stiffening (61-2).

INDICATIONS

- (1) All clavicular fractures
- (2) Most sterno-clavicular and acromio-clavicular dislocations.
- (3) Scapular fractures.
- (4) Reduced shoulder dislocation.
- (5) Axillary nerve injury.
- (6) Minimally displaced humeral head fractures

N.B. There is a fundamental difference between a sling and a collar & cuff, needed for a supracondylar fracture (62.4).

A loop of bandage (61-1E) is not suitable because it is uncomfortable and constricting on wrist, forearm and neck.

METHOD

A sling will relieve pain. Make it with a triangular bandage, and rest the arm in it for 2-3wks, or until the fracture site is no longer tender. Start elbow and finger exercises immediately. Begin shoulder exercises in 2-3days. If the clavicle is fractured, bracing the shoulders back will help to hold it to length. Encourage movements of the arm as soon as possible.

Shoulder exercises are in 2 groups; perform early passive exercises smoothly and rhythmically with gradually increasing amplitude. Give the instructions (61-2A-E). Perform late active exercises more vigorously with these instructions: (61-2F-I).

Don't leave a sling on too long. Remove it at a set time, as some patients develop a 'sling neurosis' and are unwilling to part with it.

SHOULDER EXERCISES

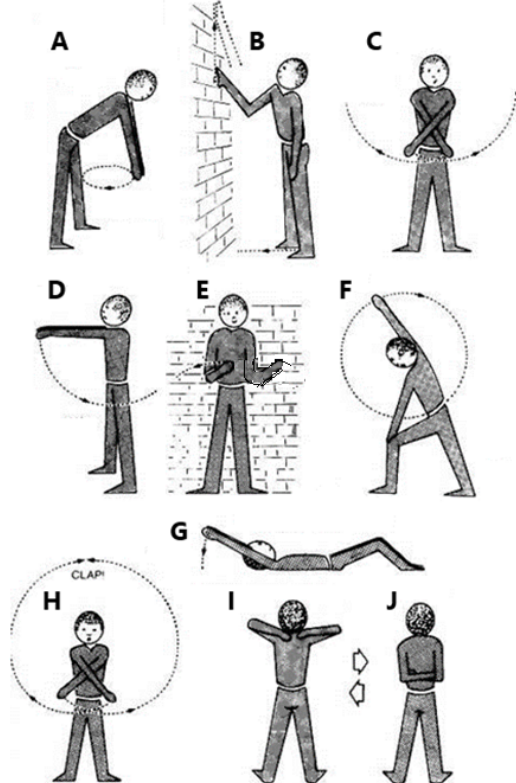


Fig. 61-2 SHOULDER EXERCISES in 2 groups. Early passive exercises: A, stoop forwards and dangle your arm in a circle (pendulum movements). B, put your arm against a wall. With the arm straight, move steadily closer to the wall. C, stand astride with your arms crossed and swing them sideways and upwards. D, stand astride and swing your arms forwards and upwards. E, lean against a wall with your arms bent, turn your arms to touch the backs of your hands against the wall (shown in left arm). Later active exercises: F, put one leg in front of the other, put your hand on your knee, and swing your arm. G, lie on your back with your arm stretched and press downwards to touch the floor. H, stand astride with your arms crossed, swing your arms sideways and upwards, and clap them above your head. I, J stand astride; alternately touch the back of your neck and fold your hands behind your back. Kindly contributed by Michael Wood.

61.4 Clavicular (collarbone) fracture

If an adult breaks the clavicular middle $\frac{1}{3}$, the *sternomastoid* muscle pulls the medial fragment up, while the weight of the arm pulls the lateral part down. Often there is a 3rd middle fragment. If the fracture is lateral to the coraco-clavicular ligament, the medial end of the clavicle is little displaced, because these ligaments hold it. If it breaks medial to the ligaments, its outer end may appear to be displaced backwards and upwards, so that it forms a lump under the skin.

CLAVICULAR MIDDLE $\frac{1}{3}$ FRACTURE



Fig. 61-3 FRACTURE OF THE MIDDLE $\frac{1}{3}$ OF THE CLAVICLE. If an adult breaks the middle $\frac{1}{3}$ of the clavicle, the *sternomastoid* muscle pulls the medial fragment upwards, while the weight of the arm pulls the lateral part down.

Treat all fractures of the clavicle with a sling and active movements (61.3). For very medial fractures, use a 'rucksack' brace. *N.B.* Some say this is of no benefit! Don't forget to wash under the armpits!

RUCKSACK BRACE

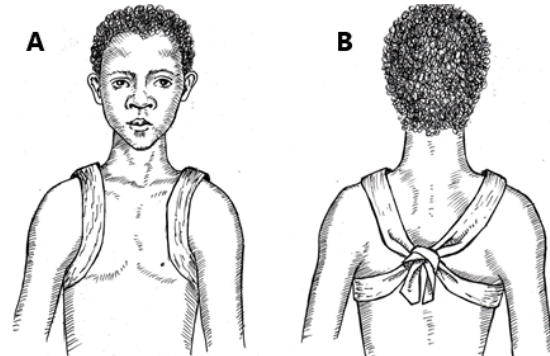


Fig. 61-4 THE RUCKSACK BRACE for a very lateral clavicle fracture. A, anterior view. B, posterior view. Tie the straps tightly, but not too tight!. *N.B.* This may cause skin ulceration, so beware!

The clavicle almost always unites with no loss of function, and if there is a lump, this will usually remould and disappear in an adult.

Rarely there may be a pneumothorax (43.1) associated; this may present with subcutaneous emphysema and is often asymptomatic. Take follow-up chest radiographs if you suspect this.

If the skin is severely tented, and at risk of perforation, administer a GA and press on the clavicle to reduce the fracture whilst an assistant distracts the shoulder.

If the skin is broken over the fracture, clean the skin & exposed bone with antiseptic, administer prophylactic antibiotics, and reduce the fracture as before. *Don't be tempted to fix the fracture internally.*

61.5 Sterno-clavicular dislocation

(a) **An anterior dislocation** makes the sternoclavicular joint swollen and tender. This distinguishes it from a fracture of the medial end of the clavicle, where tenderness is immediately lateral to the joint. Reduction is usually unnecessary, so encourage use of the arm (61.1).

(b) **A posterior dislocation** is rare and is usually associated with a severe chest injury, in which several ribs may be broken. The dislocated end of the clavicle obstructs superior mediastinal structures, causing severe pain, a tight feeling in the throat, difficulty in swallowing, and distended neck veins.

Place a sandbag between the scapulae, and press the shoulders back. If this fails to reduce the dislocation, clamp the proximal end of the clavicle with padded bone forceps, and, whilst an assistant abducts & pulls on the upper arm, twist the clavicle forwards and upwards. If this still fails to relieve pressure on the superior mediastinum, proceed to open reduction.

REDUCTION OF A POSTERIOR STERNO-CLAVICULAR DISLOCATION

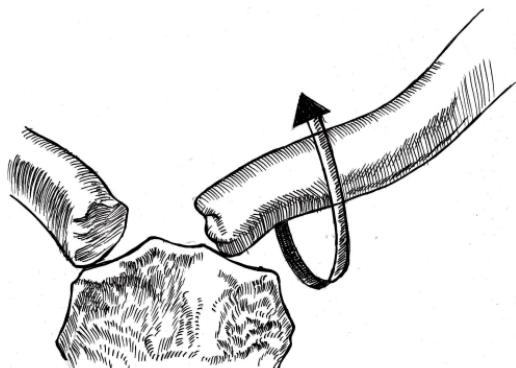


Fig. 61-5 REDUCING A POSTERIOR STERNO-CLAVICULAR DISLOCATION. While an assistant abducts the arm, grasp the medial end of the clavicle with bone forceps and twist it forwards & upwards. After Iwai T, Tanaka K, Okubo M. Closed reduction of a posterior sternoclavicular joint dislocation. *Trauma Case Rep* 2018; 17:1-4.

FIXATION OF A POSTERIOR STERNO-CLAVICULAR DISLOCATION (GRADE 3.3)

Put a solid roll or sandbag between the scapulae so that the shoulders and the clavicles fall backwards.

Remember that the internal thoracic arteries & veins run along the lateral sternal rim posteriorly 2mm from the bone.

Make a 5cm horizontal incision over the sternoclavicular joint and dissect sharply to expose the antero-medial surface of the clavicle and lateral upper border of the sternum.

Dissect bluntly with your finger on the posterior of clavicle & sternum, protect the underlying structures behind with a blunt-edged solid flat instrument (such as a bone spreader). Drill a hole through the distal clavicle and pass the wire on a needle through the manubrium from posterior to anterior. Tie the wire in a figure of 8 to reduce and fix the dislocation (61-6).

FIXATION OF A POSTERIOR STERNO-CLAVICULAR DISLOCATION

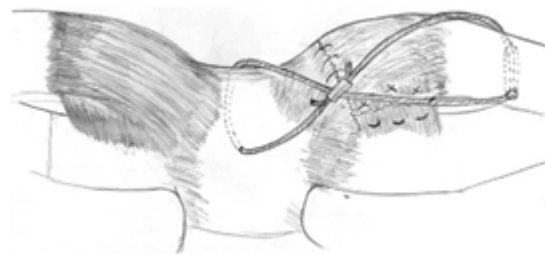


Fig. 61-6 FIXING A POSTERIOR STERNO-CLAVICULAR DISLOCATION. Pass a steel wire on a needle through the manubrium from behind to forward, and drill a hole in the medial $\frac{1}{3}$ of the clavicle. Pass the wire through this and tie a figure of 8 loop. *Beware of the vessels behind the sternum, which are likely to be and so be very careful when using sharp instruments!!* After Janson JT, Rossouw GJ. A New Technique for Repair of a Dislocated Sternoclavicular Joint Using a Sternal Tension Cable System. *Ann Thorac Surg* 2013;95 (2):e53-5.

61.6 Acromio-clavicular dislocation

There are 2 varieties of this injury, depending on whether the ligaments joining the clavicle to the scapula are partly or completely torn.

ACROMIO-CLAVICULAR DISLOCATION

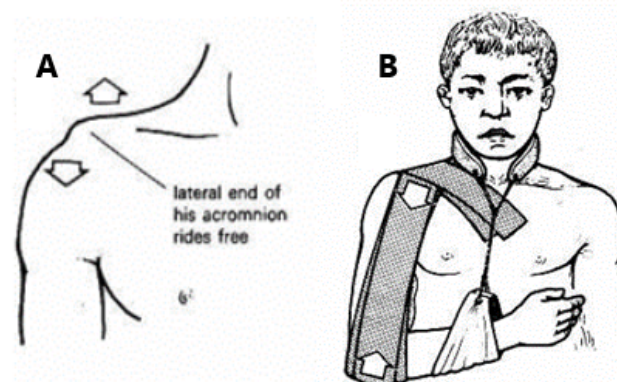


Fig. 61-7 ACROMIO-CLAVICULAR DISLOCATION. A, shows the characteristic deformity of the shoulder. B, shows the method of strapping it.

If only the ligaments between the clavicle & acromion are torn, those joining the clavicle to the coracoid can prevent severe displacement. The clavicle is stable and you cannot move it backwards or forwards.

If all the ligaments joining the clavicle to the scapula are torn, the weight of the arm pulls the shoulder downwards, while the *sternomastoid* muscle pulls the clavicle upwards (61-3A), as in a middle $\frac{1}{3}$ clavicular fracture (61.4).

The joint is so wildly unstable that the lateral end of the clavicle rides free, high above the acromion, and you can easily move it backwards and forwards. Get a radiograph standing. Holding a 2kg weight to distract the acromio-clavicular joint may reduce it spontaneously.

Treat a mild dislocation with a sling and active movements (61.3). For a major dislocation, stick pads to the acromion and the elbow, and reduce the dislocation by binding them together with adhesive strapping; then put the arm in a sling, (61-7B).

Don't refer these injuries for surgical repair.

61.7 Scapular fracture

The scapula can break in several ways. Direct blows occasionally break it into several pieces; its coracoid process can fracture, either with no displacement, or with downward displacement. Its neck can fracture, so that its glenoid articulation breaks off and is displaced. This is the most common scapular injury, and provided it does not involve the joint surface, it needs only symptomatic treatment. The acromion may fracture with only a crack, or with severe fragmentation and displacement. These fractures cause much pain and bleeding and are difficult to diagnose without sophisticated radiographs. The clavicle, the ribs, or the spine may be broken at the same time.

The scapula is splinted on both sides by muscle, so treatment is easy. Use a sling and encourage movements of the shoulder, elbow, and fingers actively and early.

61.8 Anterior shoulder dislocation

Dislocation is the most common shoulder injury. It is usually anterior and only occasionally posterior. In an anterior dislocation the humeral head passes forwards and downwards to lie in front of the scapula. In the common subcoracoid variety, the normal smooth curved outline of the shoulder is made angular (61-8). There is usually great pain, unless the dislocation is recurrent.

ANTERIOR SHOULDER DISLOCATION

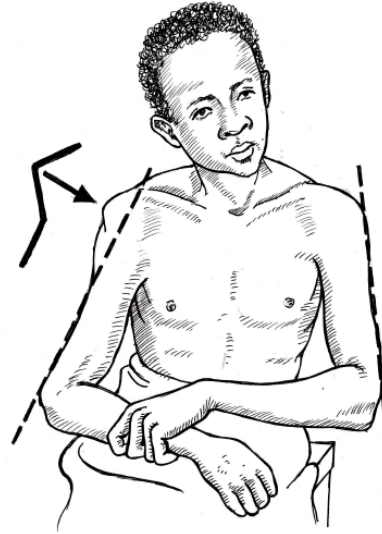


Fig. 61-8 ANTERIOR SHOULDER DISLOCATION SIGNS. Note the characteristic double angle profile of the shoulder, and the interrupted line of the upper arm..

RADIOGRAPHS OF AN ANTERIOR SHOULDER DISLOCATION

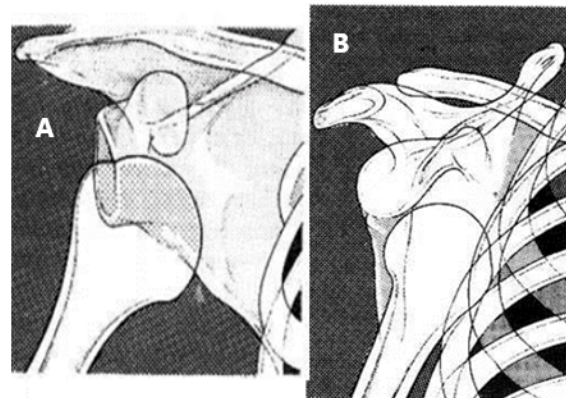


Fig. 61-9 RADIOGRAPHS OF AN ANTERIOR SHOULDER DISLOCATION. A. *always take an AP and B, an oblique view before you try to reduce what might seem to be an ordinary dislocation.* If you do this routinely, you will not miss a rare posterior dislocation. *N.B.* 25% of all acute dislocations are associated with a fracture, most commonly a fracture of the greater tuberosity.

This dislocation is often missed if loss of movement is not checked. Look for typical (61.1) signs. Although you can make the scapula move over the chest, you cannot make the humerus move on the scapula.

If the shoulder is not too swollen, you may be able to feel the displaced head of the humerus below the coracoid process.

You must differentiate a simple dislocation from a humeral neck fracture or a combination of the two. Both are less common (seen in 25%) but their treatment differs, and if you miss a fracture (61.12), the results may be disastrous.

So always get AP and oblique radiographs before trying to reduce what might seem to be an ordinary dislocation.

REDUCING A DISLOCATED SHOULDER

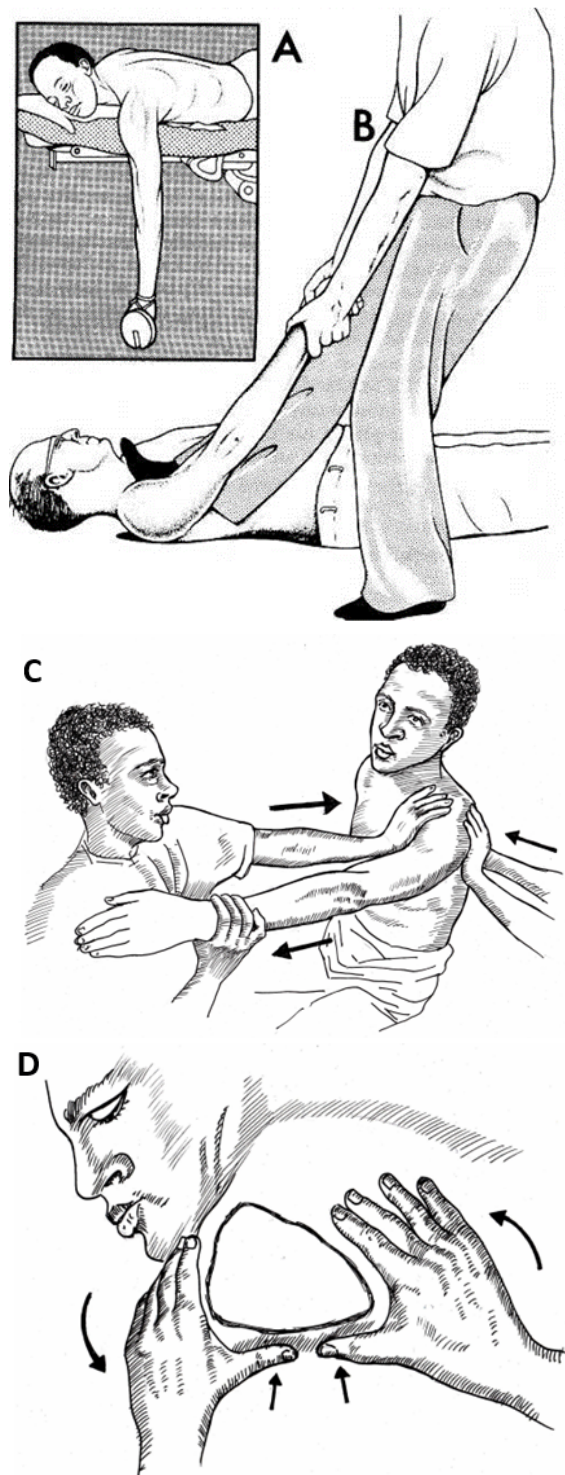


Fig. 61-10 SOME METHODS FOR REDUCING A DISLOCATED SHOULDER. A, Stimson method. B, Hippocratic method. C, scapular manipulation: pushing against the clavicle whilst. D, the scapula is rotated.

N.B. A, kindly contributed by Gerald Hankins. B, The editor of the first edition is depicted lying on the floor; the foot belonged to co-author Peter Bewes!

N.B. If you take an oblique view routinely, you will not miss a rare posterior dislocation (61.9). Although an oblique view is more difficult to take, it is easier to interpret than a lateral view.

Danger signs suggesting a humeral head fracture are:

- (1) The elbow can touch the side.
- (2) The humerus moves on the scapula.
- (3) There is much swelling.

LACK OF SHOULDER MOVEMENT & AN ABNORMAL CONTOUR ARE CRITICAL SIGNS OF A DISLOCATED SHOULDER

Reduce the dislocation immediately if there is a neurological deficit. If the injury is recent, reduction is usually easy, and may only need mild sedation or analgesia.

Make sure you have seen the radiograph yourself and have excluded a fracture. Check for nerve injury (48.1), and feel for the radial pulse.

ANAESTHESIA

If the injury is recent, no anaesthetic may be necessary. Good relaxation is required later, or if the patient is anxious, very tense or muscular. Try simple methods first, especially if the dislocation is very recent, with analgesia.

METHODS FOR A RECENT ANTERIOR DISLOCATION (GRADE 1.3)

(a) Stimson method

With the patient prone and the arm hanging over the edge of the bed, tie a 2kg weight to the wrist (61-10B). Leave him like this for 20-30mins whereupon you may find the dislocation has reduced spontaneously. If it has not, flex the elbow and externally rotate the arm, whilst pulling on it.

(b) Scapular manipulation

Face the seated patient, hold the wrist with the arm extended forwards and push against the clavicle, whilst an assistant grasps the scapula with 2 hands (61-10C) and rotates it anticlockwise (on the left) or clockwise (on the right). Some external rotation (holding the elbow at 90°) may help.

(c) Spaso technique

With the patient supine, hold the wrist & distal forearm and lift it vertically. Apply gentle traction and external rotation.

(d) Milch technique

With the patient supine, gently abduct the arm straight, holding the elbow, till you reach above the head.

Then gently add external rotation whilst pressing on the humeral head with your thumb or fingers.

(e) Hippocratic method

Lie the patient on the floor. Place stockinged foot in the axilla, lean backwards, and pull on the abducted arm (61-10D). Pull gently and steadily for 5mins.

CAUTION ! Don't exert excessive force: you may injure the brachial plexus.

N.B. We don't recommend Kocher's method for reducing a dislocated shoulder because if you use it and are inexperienced, you may fracture the humeral neck.

If these don't reduce the dislocation, try again using GA.

POSTOPERATIVE CARE (both methods)

As soon as the patient is awake ask if abducting the arm gently is possible. Check that you have not injured the axillary or musculocutaneous nerves during reduction. Examine to make sure that you have reduced the dislocation, and take a check radiograph.

Put the arm in a sling for 3wks, and start pendulum exercises in the sling immediately. Then start most of the other early exercises. *Avoid abduction and external rotation exercises,* because they may re-dislocate the shoulder.

DIFFICULTIES WITH DISLOCATED SHOULDERS

If you suspect that there is a dislocation but you have no radiographs, under GA, move the shoulder *very gently:* a dislocation may reduce spontaneously, and you are unlikely to cause harm.

If part of the greater tuberosity has broken off, it will probably return to its bed as you reduce the dislocation. If it fails to do so, and prevents abduction of the arm, see 61.10. You can easily see this on a shoulder radiograph: the external rotator muscles of the shoulder pull a fragment of bone away from the head of the humerus as the shoulder dislocates.

If the dislocation recurs >6wks, especially in a young person, it will probably continue to recur subsequently; an operative repair is necessary, because the *labrum* has separated from the glenoid ring. Repeated dislocation makes the shoulder ever more unstable, so it may even dislocate on sneezing or turning over in bed.

If the humeral head drops out of the glenoid because the axillary nerve is damaged, support the arm in a sling for several months until the nerve recovers.

Tighten the sling regularly so as to keep the contour of the shoulder normal, and show a companion how to do the same. *This is not the same as recurrent dislocation of the shoulder.* Suspect it if there is no sensation over the *deltoid*, and is abduction of the arm is totally impossible.

If the shoulder remains stiff after a dislocation, explain that movements will eventually return. Active exercises are safer and more effective than passive ones. Avoid excessive force, because this will only make the stiffness worse. The shoulder is more likely to become stiff if early movements are missed out.

If the brachial plexus is injured, it may take a year to recover. Meanwhile, put the shoulder through a safe range of movements to prevent contractures. Some nerve injury is common after a dislocation, and may involve any of the three cords of the brachial plexus. The axillary and musculocutaneous nerves are most commonly involved.

If the axilla rapidly swells after a shoulder injury, the axillary artery has been torn. This rare event may follow a fracture dislocation, and can occur when you are reducing a fracture dislocation, particularly an old one in an aged patient with calcified arteries, or if you use greater force than the original injury.

The torn artery bleeds and forms a large haematoma round the shoulder, which can cause exsanguination. Apply firm axillary pressure and prepare to ligate (or repair) the torn artery (49-8) or the subclavian (49-7).

If the circulation in the arm is occluded after a reduction, the blood supply was probably impaired beforehand. Check the distal blood supply with a Doppler ultrasound. This may need surgery or anticoagulation.

If a patient with a dislocated shoulder presents late, reduction becomes increasingly difficult and dangerous as time passes. Initially, every hour is important, but after 6wks, reduction may be impossible. *Using force may break the humeral neck, or tear the axillary vessels or nerves.* Especially if pressure on the structures in the axilla causes symptoms, an open procedure is indicated. Try to find an expert, as otherwise the result may not be good.

**REDUCE ALL DISLOCATIONS
IMMEDIATELY**

NO MOVEMENT OF THE SHOULDER AFTER AN INJURY MEANS A DISLOCATION

61.9 Posterior shoulder dislocation

If a patient has pain, swelling, and reduced movement after a shoulder injury, together with an apparently normal AP radiograph, suspect that there is a posterior dislocation, not just a contusion. Typically, the arm cannot move, and is locked in adduction and internal rotation.

POSTERIOR SHOULDER DISLOCATION

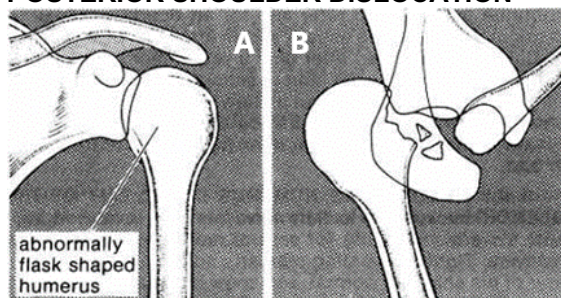


Fig. 61-11 POSTERIOR SHOULDER DISLOCATION
This is often missed because the AP view looks almost normal. A, the closeness of the head to the film does however make it look abnormally small and flask shaped. You will not miss a posterior dislocation if you always get an oblique or a lateral view of the shoulder. B, an axillary view, however, (if you can abduct the arm far enough from the side to get the tube into the axilla) shows the dislocation best.

On an AP radiograph, the humeral head appears smaller and flask-shaped (61-11A).

METHODS FOR A RECENT POSTERIOR DISLOCATION (GRADE 1.4)

- (1) Use GA. Try to put the shoulder through a normal range of movements, while pulling upwards on the humerus, with the arm above the head, and the elbow flexed to relax the biceps tendon. The dislocation will usually reduce promptly.
- (2) Alternatively, flex the elbow, and exert traction in the long axis of the arm (61-12A). Ask an assistant to press downwards on the humeral head with the thumb (61-12B). Adduct the arm while still maintaining traction (61-2C). When the head reaches the glenoid cavity, rotate the arm externally (61-2D), and then gently rotate it internally (61-2E). If this also fails, try to refer the patient. If reduction is successful, put the arm in a sling for 3wks and encourage exercises as before.

DIFFICULTIES WITH A POSTERIOR SHOULDER DISLOCATION

If the dislocation is not painful, leave it as a partial arthrodesis. *Forceful reduction might well fracture the humerus!* Anterior open reduction is difficult, and needs an expert.

AN ALTERNATIVE METHOD FOR REDUCING A POSTERIOR DISLOCATION

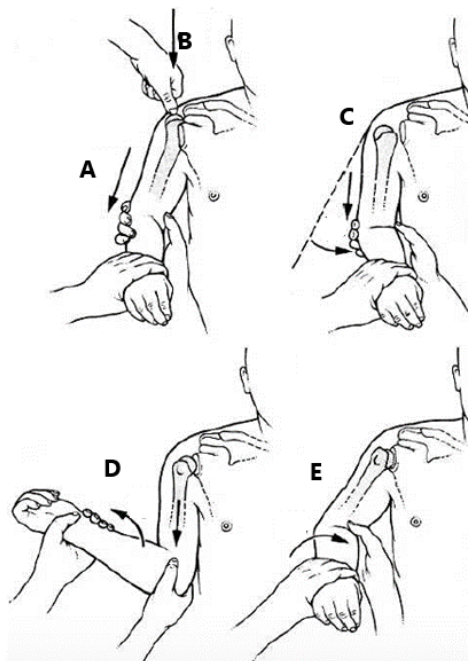


Fig- 61-12 AN ALTERNATIVE METHOD FOR REDUCING A POSTERIOR DISLOCATION. A-E follow instructions in the text. The axillary nerve may be injured, so support the arm in a sling to prevent the humerus dropping out of the glenoid. After de Palma AF, *Management of Fractures and Dislocations, An Atlas*, WB Saunders, 2nd ed 1970 with kind permission.

POSTERIOR SHOULDER DISLOCATIONS ARE OFTEN MISSED

61.10 Greater tuberosity fracture

The greater tuberosity of the humerus may be fractured by a direct blow, or it can be torn off at dislocation. Treatment depends on how far displaced the fragment is.

MINIMAL DISPLACEMENT Begin active shoulder, elbow, and finger movements immediately.

SIGNIFICANT DISPLACEMENT REDUCTION (GRADE 1.4)

First try abducting the arm. This will cause the fragment to press against the underside of the acromion and may push it into place. Alternatively, press on it firmly whilst you lower the arm (61-13). If this fails, repeat it again after 2wks, when the fragments will have become 'sticky'.

GREATER TUBEROSITY FRACTURE.

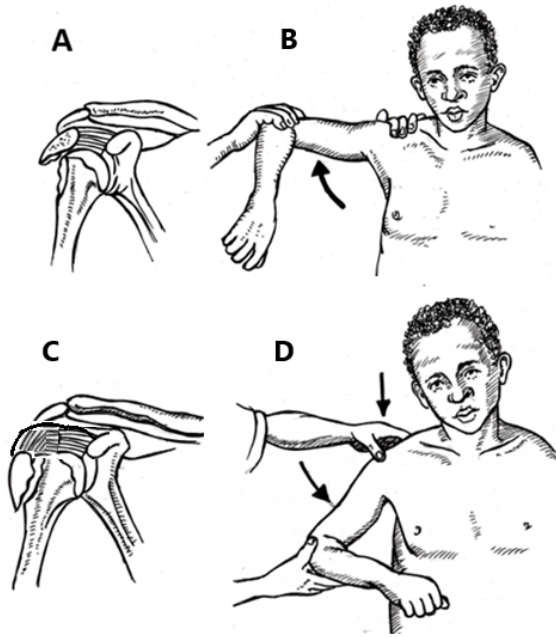


Fig. 61-13 GREATER TUBEROSITY FRACTURE. Infiltrate the fracture site with LA. A, the tuberosity detached. B, abducting the arm. C the tuberosity repositioned by D, pressing firmly on the fragment with your thumb while lowering the arm. After de Palma AF, *Management of Fractures and Dislocations, An Atlas*, WB Saunders, 2nd ed 1970 with kind permission.

If reduction fails, especially if there is >5mm dislocation, this is indication for an internal fixation.

FIXATION OF THE GREATER TUBEROSITY (GRADE 3.2)

Make a 5cm incision from the edge of the acromion down over the *deltoid* on the lateral aspect of the shoulder. Separate the muscle fibres by sharp and blunt dissection.

N.B. The axillary nerve lies >5cm distal to the acromion and is not at risk.

Dissect down directly onto the fracture site near the anatomical neck of the humerus. Palpate the dislocated fragment of the tuberosity and reduce manually or by means of a hook or forceps. Reduction may be easier if you move the arm into a half-abducted position. Press the fragment into its proper position and fix the *supraspinatus* insertion with a K-wire which you drive into the head 4cm deep and which you lead through the open wound. Bring a 2nd K-wire parallel to the 1st through the *infraspinatus*. Then close the wound.

Keep the arm in a sling and the K-wires *in situ* c.3wks. Continue pendulum exercises with the shoulder, & active exercises with forearm and hand

61.11 Humeral neck fracture

The surgical humeral neck is the region between the tuberosities, and is the site of the insertions of *pectoralis* & *teres major*. When it breaks the soft tissues hold the fragments together very satisfactorily, and provided there is some contact between them, they always unite. There is such a wide range of movement in the shoulder joint that the exact position of the fragments is unimportant. Even if the joint surfaces don't fit together perfectly, good function is still possible, *but only if the patient starts to move the shoulder early*. Most of these fractures need not be reduced. The only ones which you should reduce are those in which there is no contact between the broken surface of the neck & shaft.

The patient, who is typically an older woman, falls on her outstretched arm and injures her shoulder. Her osteoporotic humerus breaks across its neck. Sometimes, its head is comminuted.

HUMERAL NECK FRACTURE



Fig. 61-14 HUMERAL NECK FRACTURE. There is considerable displacement of the shaft. There is such a wide range of movement in the shoulder joint that the exact position of the fragments is unimportant.

In spite of her pain, she may be able to use her swollen, tender shoulder, so the diagnosis is often missed. Soon, she has severe bruising extending to her elbow. If the humeral head is impacted on the shaft, the fracture is more likely to heal with reasonable function. These fractures are less common in young adults, but when they do occur, they usually heal well.

Check the radial pulse and the axillary nerve function.

REDUCING A HUMERAL NECK FRACTURE

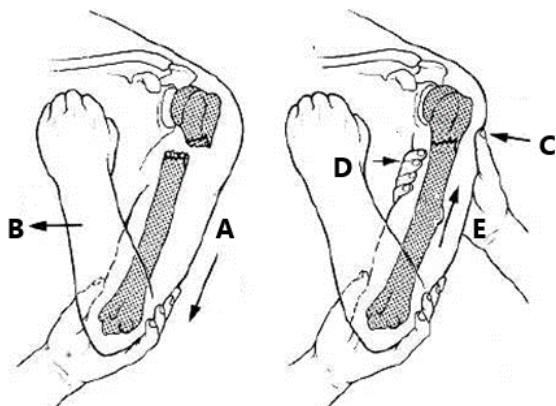


Fig. 61-15 REDUCING A HUMERAL NECK FRACTURE with wide separation or severe angulation. A, while still pulling, adduct the elbow across the chest and flex it in the frontal plane of the body. B, the combination of these movements will restore the humeral length. C, place your other hand in the axilla and press on the head with your thumb. D, pull the shaft outwards. E, after the fragments are aligned, release traction gradually, so that the fragments engaged. After de Palma AF, *Management of Fractures and Dislocations, An Atlas*, WB Saunders, 2nd ed 1970 with kind permission.

RADIOGRAPHS

Take 2 views at right angles. The fragments may be widely separated, but overlie one another in a single view.

IMPACTED FRACTURES

If you can move the arm through a reasonable range without causing severe pain, it is impacted. Begin active and assisted shoulder movements immediately.

Between these exercises, put the patient's arm in a sling for 4-6wks. Make sure that it supports the elbow, and so prevents disimpaction. Avoid lifting heavy objects for 3months.

UNIMPACTED FRACTURES

If there is no separation and angulation $<90^\circ$, put the arm in a sling and use strong analgesia. Wait for 3wks before starting active shoulder exercises.

REDUCTION OF DISPLACED HUMERAL NECK FRACTURE (GRADE 1.5)

If there is wide separation or angulation $>90^\circ$, under GA flex the elbow and manipulate the humerus so that fragments are in close contact, but *not necessarily in perfect position* (61-15A-E).

If the fracture is stable after reduction, put the arm in a collar and cuff. Keep it to the side for 3wks, then gradually begin progressive movements as pain lessens, starting with pendulum exercises and continuing with wall crawling exercises.

If the fracture is unstable after reduction, use forearm traction (62-4) for 2wks, then use a sling and arm dangling exercises.

If there is gross separation with the humeral shaft in the axilla, the axillary artery is in danger, so check the distal pulse first. Reduction of the fracture may pull a spicule of bone out of the axillary artery and cause massive bleeding! So, it is wise to reduce this fracture by an open method, which includes exposing the axillary artery (49.4c).

REDUCING A FRACTURE DISLOCATION OF THE HUMERAL NECK

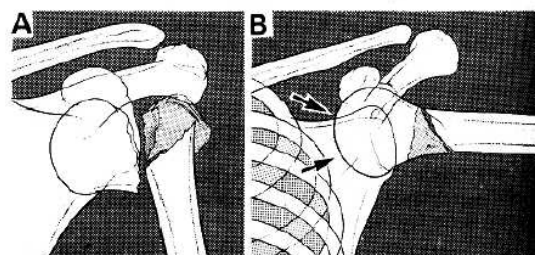


Fig. 61-16 REDUCING A FRACTURE DISLOCATION OF THE HUMERAL NECK. A, before reduction. B, during reduction. The arrows show where to push with your thumbs to return the humeral head back into the glenoid.

CONSCIENTIOUS EXERCISES WILL OFTEN RESTORE MOVEMENTS TO A STIFF SHOULDER

61.12 Shoulder dislocation with humeral neck fracture

In 25% of cases, a shoulder dislocation is associated with a humeral neck fracture. If you try to reduce the dislocation (especially without GA), you may worsen the fracture and endanger the brachial plexus & axillary vessels.

Unless the dislocation reduces without the least force under GA, internal fixation is indicated. Sometimes the fractured and dislocated fragment will resist any attempt at closed reduction.

OPEN REDUCTION OF A SHOULDER DISLOCATION (GRADE 3.3)

Obtain anterior access through the deltopectoral sulcus, keeping the cephalic vein medially or laterally and thus reaching the upper end of the humeral shaft where the fracture is situated. The humeral head is somewhere under the *subscapularis* muscle.

To approach it, it may be necessary to dissect the conjoint tendon in a Z-shaped manner 1cm below the top of the coracoid process, leaving a tendon seam for later suture.

Occasionally it is necessary to dissect the *subscapularis* tendon in its upper $\frac{1}{2}$ to find and get hold of the head. Try to keep some soft tissue attached to the head, and reduce it into the glenoid fossa with the shaft fragments reduced into satisfactory position distally.

If this reduction as well as the manipulation of fragments remains unstable, proceed to intramedullary wiring by means of one, or better, two 2mm diameter K-wires, whose tip must be blunt (or filed blunt)

Make an incision 8-10cm above the olecranon on the back of the upper arm. Split the *triceps* tendon and muscle fibres and reach the distal humeral shaft above the olecranon fossa.

Retracting the soft tissue, using a 4.5cm drill, make an oval-shaped hole in the cortex (by slanting the drill bit side to side). Bend the K-wire 2cm from its end by c.10°, and its other end by 90° in the opposite sense.

Introduce the K-wire by rotating it to avoid it becoming stuck in the medullary canal. Once it reaches the fracture site, push it into the femoral head, and hammer it softly in place.

Check, if the head is now fixed to the shaft. If possible, insert a 2nd K-Wire of the same length alongside the 1st.

Repair the *subscapularis* tendon as well as the conjoint tendon and close the wound in layers. Place the arm in a sling, encourage exercises as below.

61.13 Humeral shaft fracture

Adult humeral shaft fractures are not common until adult life. They are many kinds, but their treatment is the same. Union is the first priority, then elbow movement. Moderate angulation is no disability.

Put the arm in a narrow sling (61-18B), so that $\frac{1}{2}$ the weight of the forearm acts on the lower fragment to reduce overlap and angulation. Put the arm across the chest to correct rotation. The muscles attached to the humerus will hold the fragments in place. Overlap and shortening are unimportant.

Tell the patient that he may hear and feel crepitus for the 1st 2wks, but that this is a good sign.

RADIOGRAPHS are not essential, unless there are signs which suggest that the shoulder may be dislocated also, or unless the fracture is so low in the shaft as to be supracondylar (62.6).

HUMERAL SHAFT FRACTURES

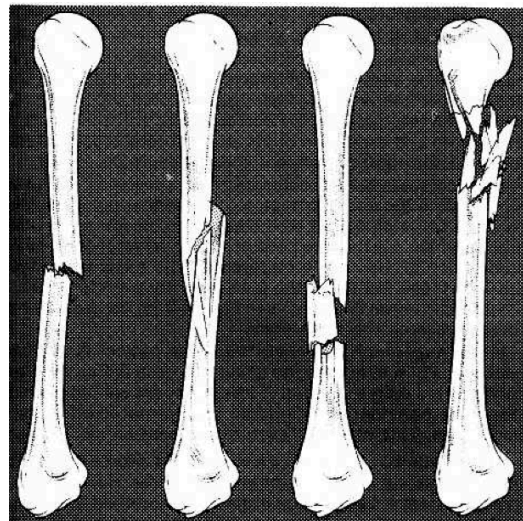


Fig. 61-17 FRACTURES OF THE SHAFT OF THE HUMERUS. A, transverse. B, oblique, C, segmented. D, comminuted. All these can be treated the same way.

TREATMENT

Check the peripheral pulses, and the function of the radial nerve and record these (65-3).

TREATING A HUMERAL SHAFT FRACTURE

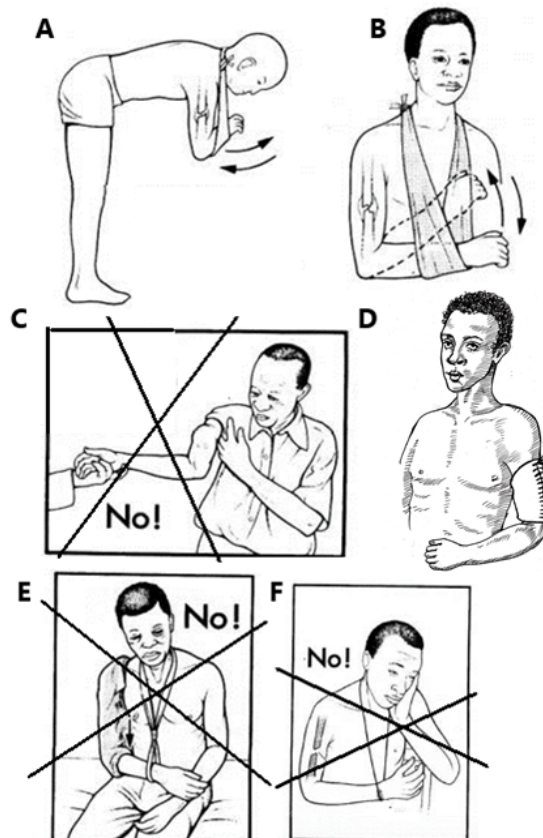


Fig. 61-18 TREATING A HUMERAL SHAFT FRACTURE A, a properly treated patient exercising the shoulder. B, the same patient exercising the elbow. C, mal-union after a fracture 30yrs. However, this patient had surprisingly little disability. D, a perfectly satisfactory traditional splint. E, this heavy cast caused non-union. F, a sore at the wrist. Kindly contributed by Peter Bewes

REDUCTION OF AN ANGULATED HUMERAL SHAFT FRACTURE (GRADE 1.4)

If the fracture is grossly angulated, reduce it under GA, or LA into the fracture haematoma. Manipulate it carefully, as the radial nerve is close to the fracture site.

If the fracture is very mobile & painful, putting a light splint is more comfortable and will protect the fracture in case of another fall; otherwise a wide sling will suffice.

Make the patient a sling 10cm wide which supports only the distal part of the forearm; *it must not include the elbow*, which must be at 90°. Make it by folding a triangular bandage several times (61-18B).

CAUTION! The width of the sling is critical. Use a narrow wrist sling which supports only the distal half of the patient's forearm.

Don't use: (1) an elbow sling which raises and supports the elbow, or (2) a collar and cuff, or (3) a bootlace or piece of bandage

N.B. If the elbow is supported in a full sling, the *weight of the forearm cannot reduce the overlap*. A collar and cuff will draw the lower fragment forwards and angulate the fracture. A bootlace or a single turn of bandage will be acutely uncomfortable and may well lead to a chronic wound (61-18F)

Once the fracture is 'sticky', after 1wk, apply a Sarmiento brace. Around a tube of cotton wool from above the acromion to below the olecranon and from 3cm below the axillary crest to 3cm above the elbow fold, apply a light plaster. While the plaster is hardening, model the brace to correct any axial displacement. Cut out a 2cm wide section anteriorly from the plaster cylinder, and wrap an elastic bandage (or better, velcro fastenings) round it, to fit it nicely to the arm.

Repeatedly readjust the binding to maintain circular compression on the arm, thus stabilizing the fracture site as the swelling, reduces.

The ideal splint is a stiff, *light* cuff with 'velcro' fastenings, which will allow active shoulder and elbow movement. A *light* bamboo or plaster. U-slab is an admirable alternative (61-18D).

Encourage isometric muscle strengthening, pendulum exercises of the shoulder (61-2A, 61-18A), active movements of forearm and hand and assisted flexion-extension of the elbow (61-18B). Keep the arm in a sling for 4wks more. Then remove the sling but keep the brace and encourage active movements in the shoulder and arm till 10wks after the injury, by which time the fracture has usually united.

Slight shortening or moderate axial bowing, usually *varus*, is acceptable in the upper, non-weight bearing limb.

N.B. Alternatives to cotton is crepe paper, stripes of cotton cloth, or even toilet paper in layers of 10.

Consolidation usually takes 2months in spiral & 3months in transverse fractures; it normally takes twice as long as clinical union.

DIFFICULTIES WITH HUMERAL SHAFT FRACTURES

If the arm is pulseless and cold, apply gentle traction. If this does not restore the circulation, explore the axillary artery (49.4c). If its circulation is not restored, the arm may need amputating (35.4).

If the shoulder or elbow is stiff, a stiff shoulder is a serious disability, but loss of movement is less serious in the elbow. Encourage increasing movements of the shoulder but no forced activity at the elbow.

If delayed union results, the causes are likely to be:

- (1) Removing the brace too early, so causing posterior angulation of the fracture.
- (2) Using a hanging cast (61-18E).
- (3) Inadequate traction or fixation when the patient is confined to bed because of other injuries,
- (4) Applying a heavy cast which distracts the fragments.
- (5) Unskilled internal fixation (58-4)
- (6) Excessive traction.
- (7) Soft tissue between the bone ends.

If there is non-union, if there is no pain, it is probably best to accept the disability and continue daily activities; bone grafting is the alternative, but this may fail, even in the best hands.

If there is a wrist drop, the radial nerve is injured. It may have been present before the injury, because of the injury or because of the treatment. *So documentation on presentation is important!*

When new & noticed early, and relieved by reduction of an angulated fracture, or removal of a tight splint, passive extension exercises of the fingers several times a day, using the other hand, is usually sufficient to recover function, though this may take 3months.

Exploration of the radial nerve is indicated if paralysis develops some weeks after the injury, or if there is no recovery after 6months.

Meanwhile, use a cock-up splint to support the wrist in dorsiflexion and prevent a contracture, (69-2).

If the humeral head is fractured & dislocated, it will be almost impossible to reduce, because traction on the arm will not shift the humeral head. This requires internal fixation.

If there are other injuries which prevent sitting or standing, apply skeletal traction with a K-wire through the thick part of the olecranon, hold the arm in a Gissane stirrup (59.4). Pass a cord from the stirrup over the foot of the bed. Suspend the forearm with the elbow flexed at 90° and the humerus slightly abducted.

CAUTION! Start with 2kg in an adult, and check reduction with radiographs once or twice during the 1st wk.

Adjust the weight so as not to distract the fragments. Once sitting, the patient should use a sling.

DON'T LET THE PATIENT TAKE THE ARM OUT OF THE SLING TOO SOON! HEAVY CASTS ENCOURAGE NON-UNION

61.14 Rotator cuff injury

Injury or degeneration with age (probably from repeated minor insults) sometimes with calcification is common. Typically there is pain between 60° and 120° of abduction. Steroid & LA injection into the *supraspinatus* tendon may help.

The 'frozen' shoulder, occurring after relatively trivial injury, is an adhesive capsulitis, which responds to NSAIDs.

61.15 Multiple fractures in the arm

When there are simultaneous fractures of humerus, radius & ulna, concentrate on the forearm; the humerus will probably heal itself. This is a classic indication for an X-fix. Management depends on the type of humeral fracture.

If the humeral fracture is spiral, distraction is less of a problem and it will probably unite, so reduce the forearm fracture and apply a thin long arm cast with the elbow at 90° and the forearm in mid-pronation, so that if rotation is reduced subsequently, the hand will be in the best position.

Support the cast in a sling so that its weight does not distract the humeral fracture.

HUMERAL SHAFT EXTERNAL FIXATION (GRADE 3.2).

If the humeral fracture is transverse, a long arm cast will probably cause serious distraction. This is an indication for an X-fix

The X-fix is also useful where a sling or brace is impractical, e.g. in chest injury, and for open fractures.

For the X-fix you need two solid insertion points above and below the fracture site, so this is not possible for head and subcapital fractures. Make sure you avoid the radial nerve (61-19).

EXTERNAL FIXATION OF THE HUMERUS

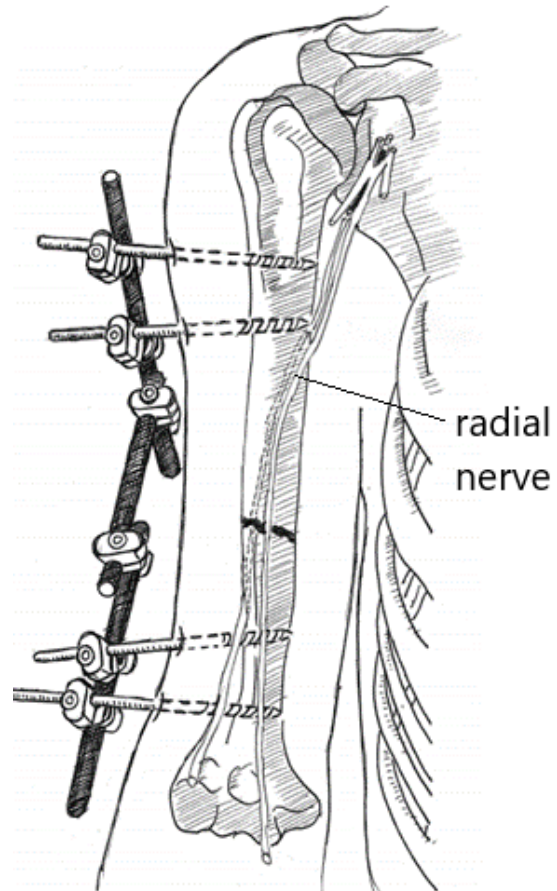


Fig.61-19 EXTERNAL FIXATION FOR A TRANSVERSE HUMERAL FRACTURE. Avoid the radial nerve which runs from the axilla, crosses the upper humerus posteriorly, and then the lower humerus anteriorly towards the radial head. See how close it comes!