SUMMARY OF PRINCIPLES OF FRACTURE MANAGEMENT

FRACTURE MANNAGEMENT

1. In accident and Emergency Department

a) Make a clinical and radiological diagnosis. Mechanism of injury is part of history. If a patient is unconscious and has nobody to give such history a quick clinical examination will guide as to which part of the skeletal system will require special attention. Imaging must include Ap and Lat views and further imaging can be considered. This is important in such injuries as unstable pelvic injuries and trauma to the sprine.

b) Resuscitation may be necessary in multiple system trauma and multiple fractures of long bones. Use ATLS protocol. If primary survey reveals need for resuscitation.

b) Damage control orthopedics is a concept used to describe minimal methods that may be used to stabilize bone injuries while the more serious injuries are being addressed. A good example is use of External fixators.

BONE HEALING

<u>There are two types of bone healing:</u>

a) **Direct bone healing (Primary Bone Healing)**

b) **Healing by callus (Secondary bone healing)**

<u>Five stages of Healing:</u>

1) **Haematoma** : there is tissue damage and bleeding at fractures site;
2) **Inflammation** : Inflammatory cells (cytokines) appear in the haematoma;
3) **Soft callus formation**: the cell population changes to osteoblasts; over time, the callus calcifies and woven bone appears in the Fracture callus.
4) **Hard callus formation**: the fracture is solidly united.
5) **Remodeling**: the newly formed bone is remodeled to resemble the normal structure. Woven bone is replaced by laminar bone. Bone formation is a function of osteoblasts while remodeling is a function of osteoclasts

- ***Primary bone healing*** may be seen in impacted fractures and theoretically after rigid fixation.
- **Secondary bone healing** will occur where relative movement is occurring in a comminuted fracture or in skeletal fraction.

c) Definitive management of the fractures will involve

i. Outpatient manipulation under suitable sedation or general anesthesia.

ii. Children's fractures should almost always be manipulated under GA

What is being corrected?

I. Unacceptable angulation'

II. Unacceptable shortening

III. Unacceptable rotation – consider fractures of the shaft of the tibia as a guide to the importance of corrections of rotation. Use the patella and the web space between the big toe and second toe.

Use of image intensifier reduces the need for repeat manipulation

iii. Use of image intensifier has improved results of manipulation . Commonly the corrected limb will be splinted by pop or fibre glass which can be fashioned into a slab support where swelling is anticipated.

iv. Patient goes home after confirmation that the reduction is acceptable and this can be done in theatre etc and reviewed the next day or in the earliest fracture clinic where circulation is checked. Patient goes home with pop instruction on swelling etc

2. The decision in A+E may lead to a patient being admitted because outpatient treatment is not feasible.
3. For open injuries of bone, remember to grade and record the approximate time of injury, besides the severity of injury
4. In the Clinic circulation is checked and any tight pop can be dealt with to reduce the possibility of compartment syndrome which is one of the early complication of fracture treatment.

- Admission will depend on type of fracture with a strong indication that the patient may require ORIF. Patients in A and E may also require initial icu care particularly if they require respitory support. The limb will be splinted to be fixed later when the condition of the patient allows. Indeed the patient may also go to theater if actively bleeding into the abdominal cavity from raptured spleen, lacerated liver or blunt abdominal trauma.

a) Admission for treatment of compound fractures is a good example of need for inpatient treatment where attention to the soft tissues and stabilization of the fracture is important.

- In A and E Protection of the fracture from further contamination by use of sterile dressing
- Tetanus toxoid is given
- Prophylactic antibiotic
- Surgical toilet and stabilization of the fracture by EF or IM where applicable
- Remember to grade the severity of injury using suitable classification e.g. Gustillo –Anderson.

b) Ward admission for management of fractures

i. Conservative treatments e.g. Skeletal traction in adults or skin tractions in children. Conservative treatment can lead to long hospital stay and this is especially true for the average 12 weeks required to treat a fracture femur in adults with all possible associated complications.

ii. Possible indications for open reduction and internal (or external) fixation. Consider fractures of the femur as considered above.

a) Short hospital stay in adults in both adult and children

b) Intra-articular fractures

c) Transverse fractures of patella , fracture olecranon

d) Fracture neck of femur in both children and adults unless otherwise indicated e.g. hemi or total joint arthroplasty in a displaced fracture 3 and 4 (Garden)

e) Multiple fractures of long bones

f) Multiple system injury - damage control orthopaedics concept may be applied by use of EF wherever feasible

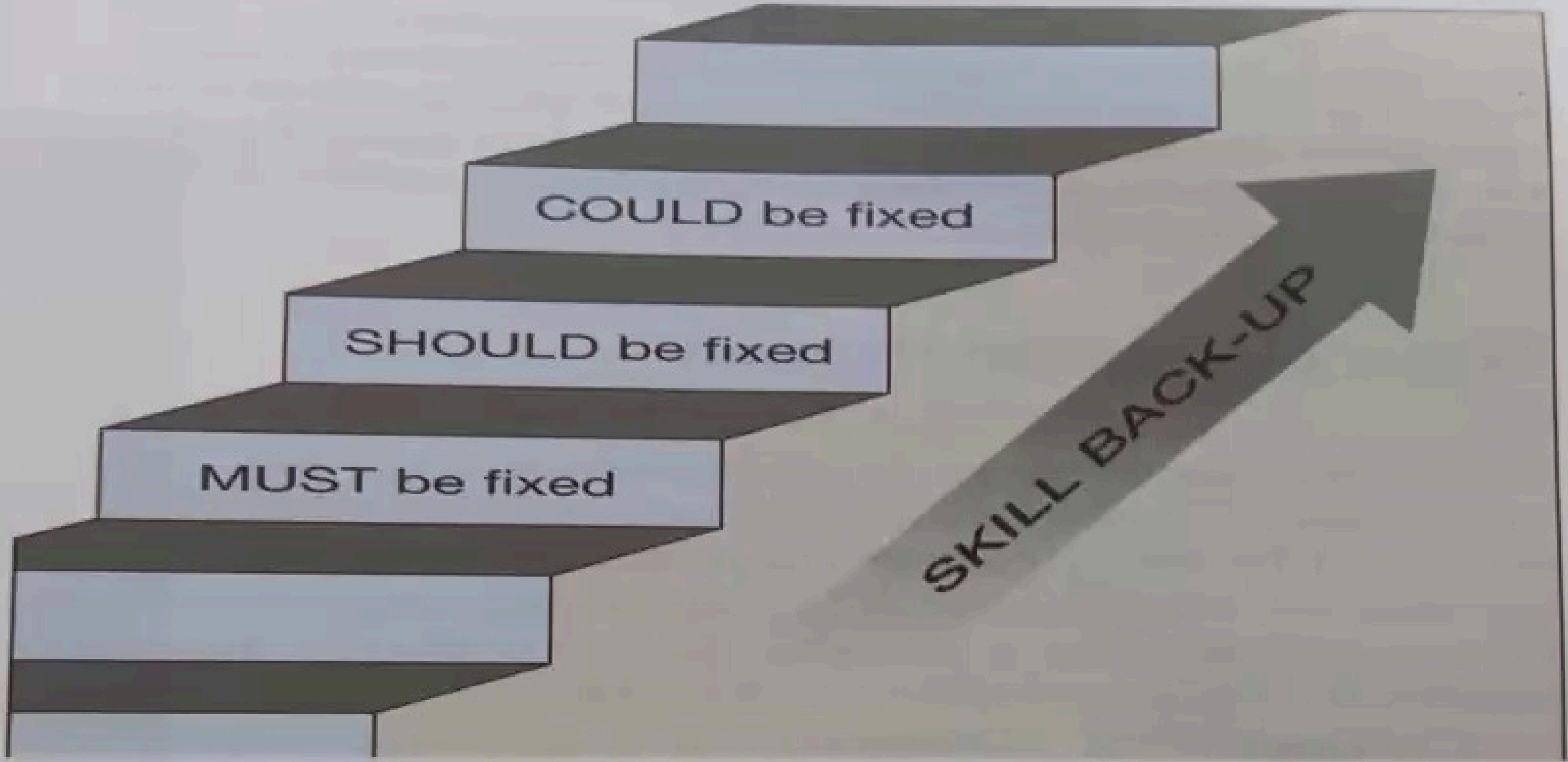


Figure 23.15 Indications staircase The indications for internal fixation are not immutable; thus, if the surgical skill or back-up facilities (staff, sterility and equipment) are of a low order, internal fixation is indicated only when the alternative is unacceptable (e.g. with femoral neck fractures). With average skill and facilities, fixation is indicated when alternative methods are possible but very difficult or unwise (e.g. multiple injuries). With the highest levels of skill and facilities, internal fixation is reasonable if it saves time, money or beds.

3. Complications of fractures: Consider early and late complications

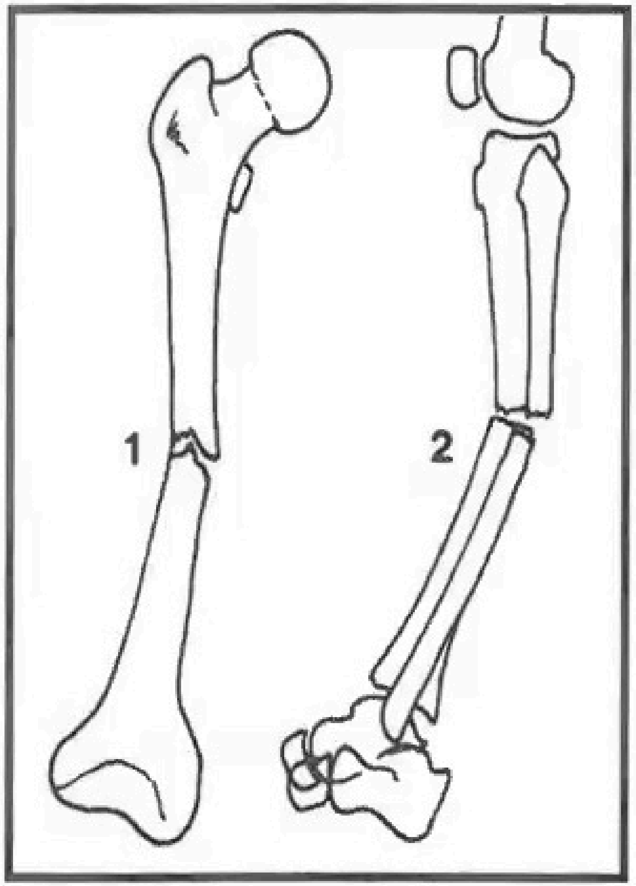
- Complications associated to the characteristics or nature of fracture itself.
- Possible complications during treatment.

a) Early complications - how to prevent them

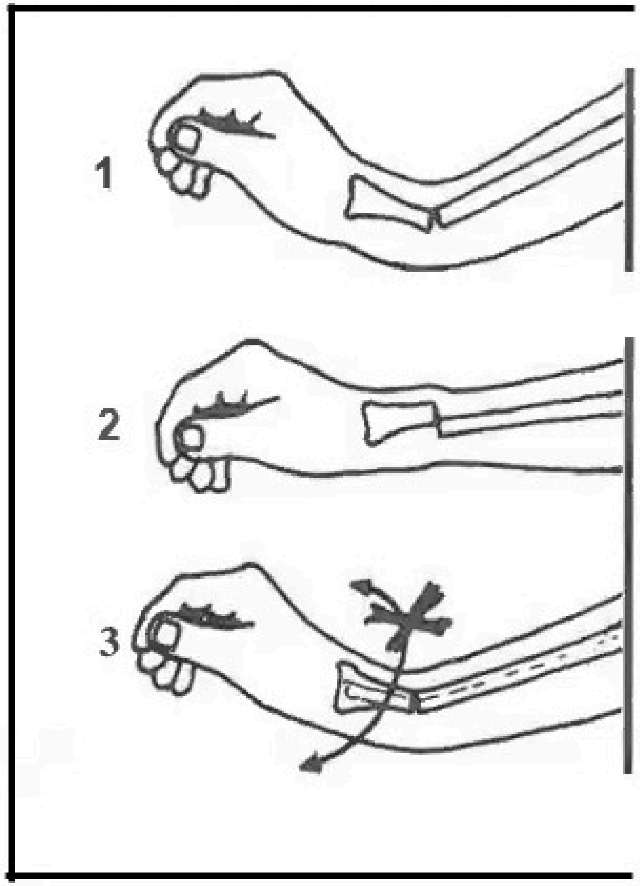
b) Late complications – correction by surgery electively

4.Special considerations when dealing with children's fracture - presentation

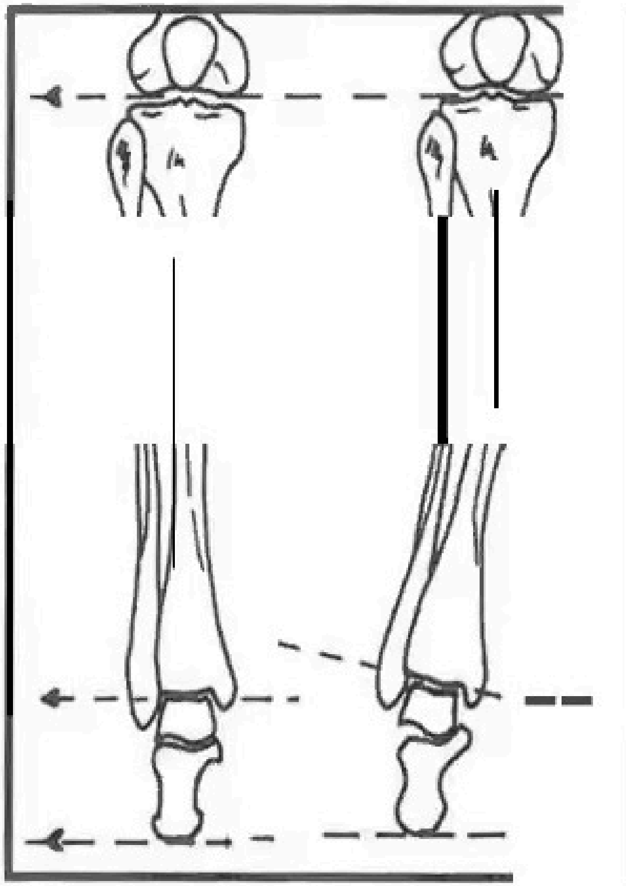
- Trans epiphyseal fracture (salter Harris injuries
- Traumatic bowing / plastic deformations
- Greenstick fractures
- Complete fractures
- Often fractures of femur in the younger child may adequately treated by hips pica with care to correct for rotations.



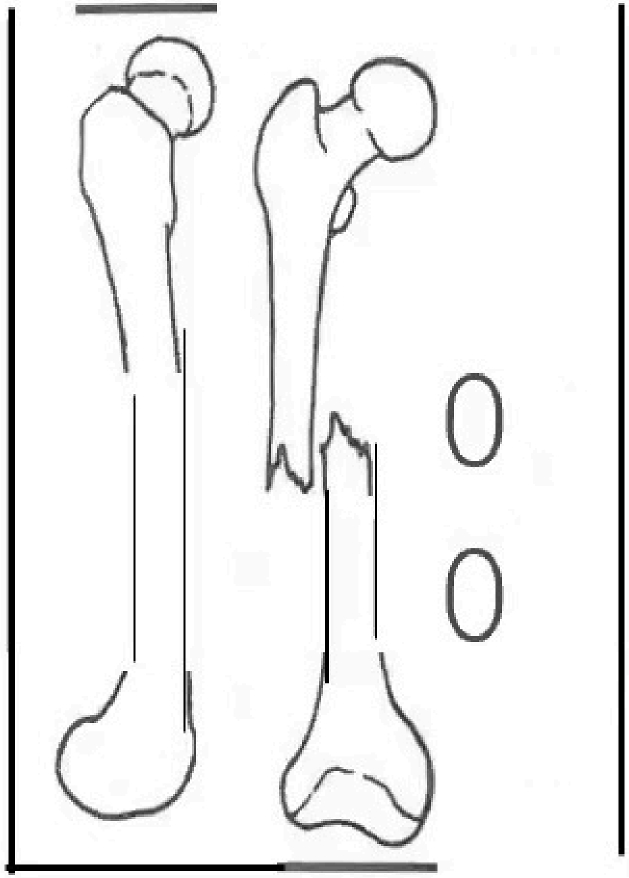
46. **Angulation !iii:** Equally acceptable, and perhaps less liable to error, would be to describe these fractures in the following way:
(I) a fracture of the middle third of the femur with the distal fragment tilted laterally, (2) a fracture of the tibia and fibula in the middle thirds, with the distal fragment tilted anteriorly.



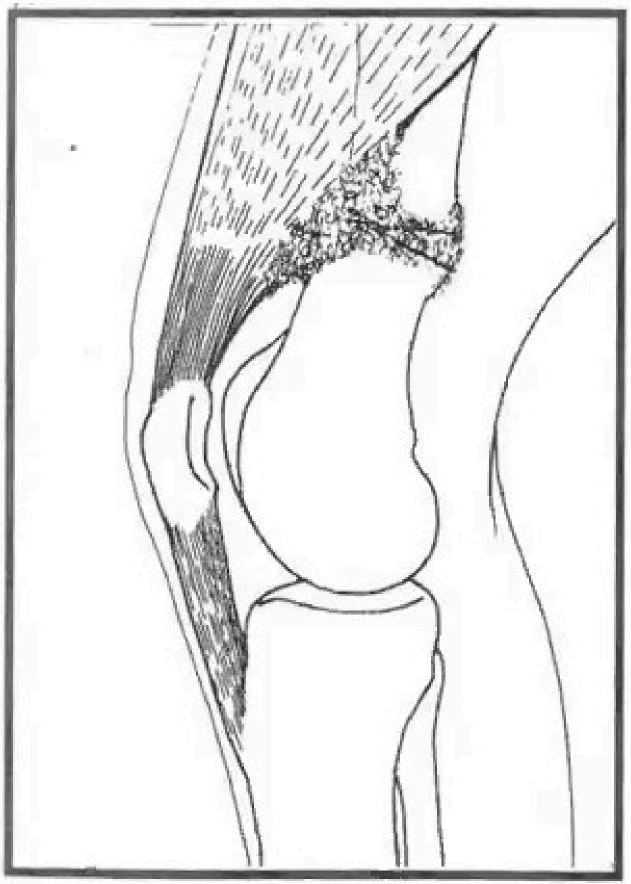
47. **Angulation (iii):** Significant angulation must always be corrected for several reasons. Deformity of the limb will be conspicuous (1) and regarded (often correctly) by the patient as a sign of poor treatment. Deformity from displacement (2) is seldom very obvious. In the upper limb, function may be seriously impaired, especially in forearm fractures where pronation/supination may be badly affected (3).



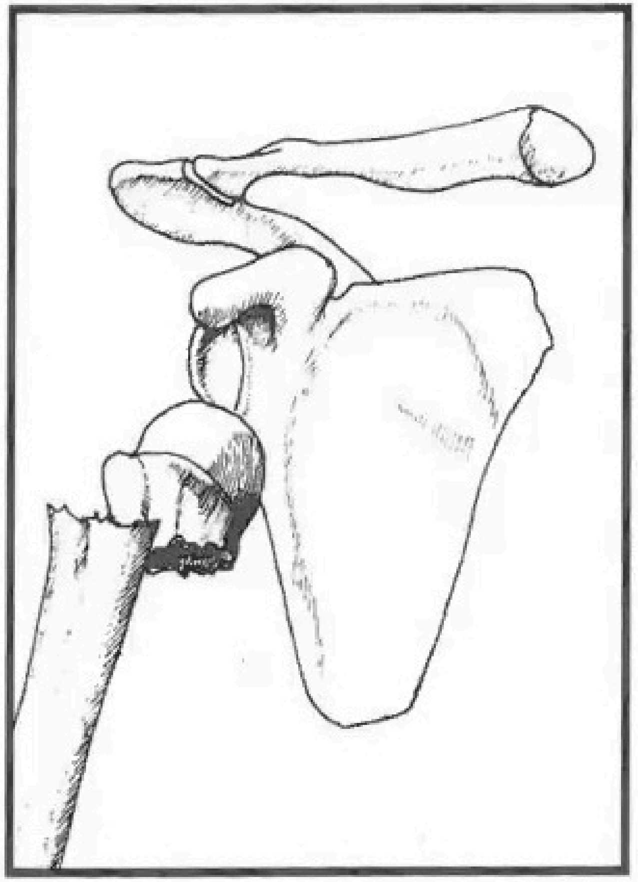
48. **Angulation (iv):** In the lower limb, alteration of the plane of movements of the hip, knee or ankle may lead to abnormal joint stresses, leading to the rapid onset of secondary osteo-arthritis.



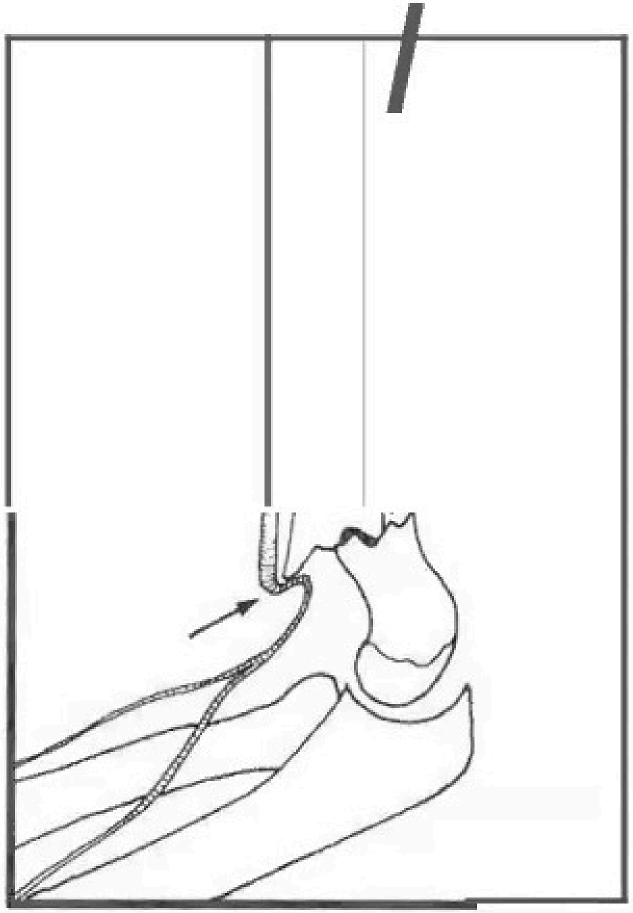
43. **Displacement (iii):** Where none of lhe fracture surfaces is in contact, the fracture is described as having 'no bony apposition' or being 'completely off-ended'. Off-ended fractures are (I) potentially unstable, (2) liable to progressive shonening, (3) liable to delay or difficulty in union, (4) often hard to reduce, sometimes due lo trapping of soft tissue between the bone ends.



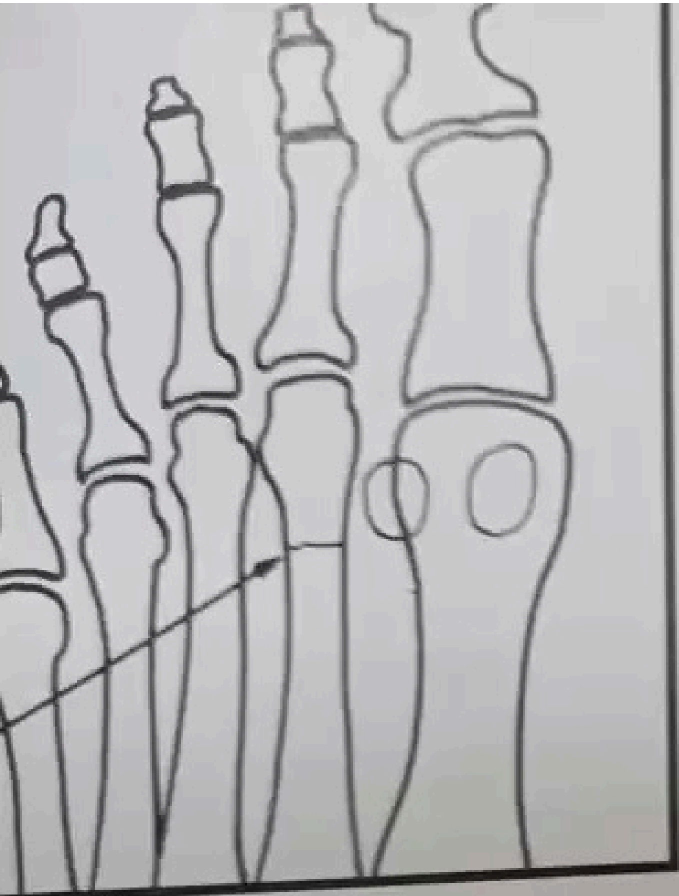
34. **Fracture close to a joint:** When a fracture lies close to a joint, stiffness may also be a problem due to tethering of neighbouring muscles and tendons by spread of callus from the healing fracture; e.g. in fractures of the femur close to the knee, the quadriceps may become bound down by the callus, resulting in difficulty with knee fleidon.



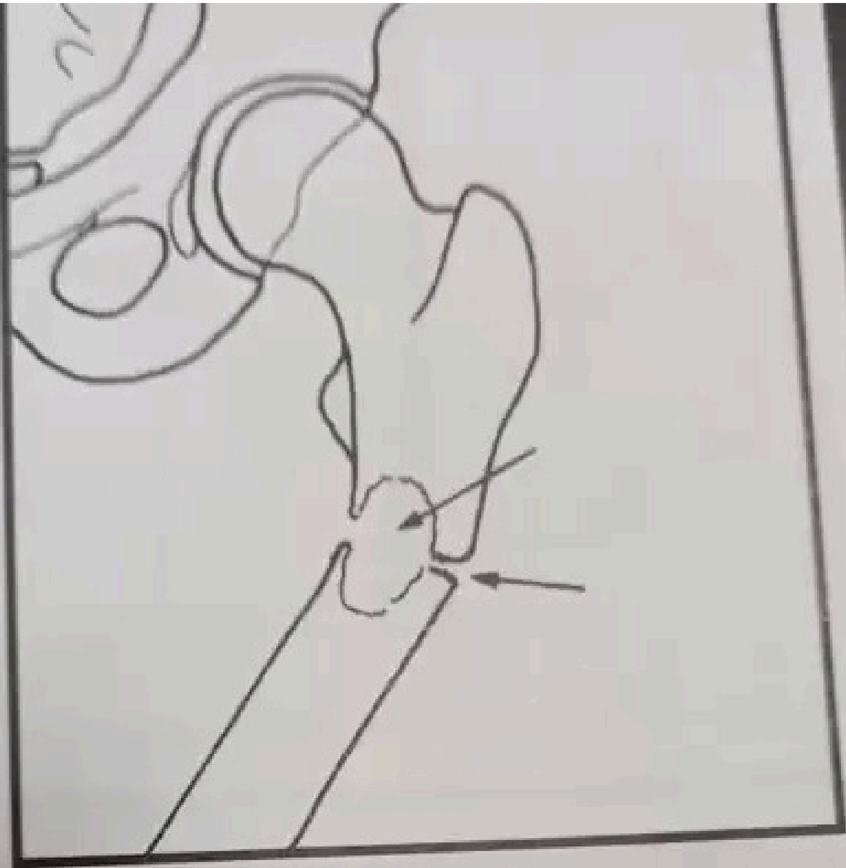
35. **Fracture-dislocation:** A fractur dislocation is present when a joint has dislocated and there is in addition a fracture of one of the bony components of the joint. Illustrated is a fracture-<lislocation of the shoulder, where there is an anterior dislocation with a fracture of the neck of the humeru s. Injuries of this kind may be difficult to reduce and may be unstable. Stiffness and avascular necrosis are two common complications.



36. **Complicated fractures:** A fracture is described as complicated if there is accompanying damage to major neighbouring structures. The diagram is of a complicated supracondylar fracture of the humerus. (Such an injury might also be described as a supracondylar fracture complicated by damage to the brachia! artery.)



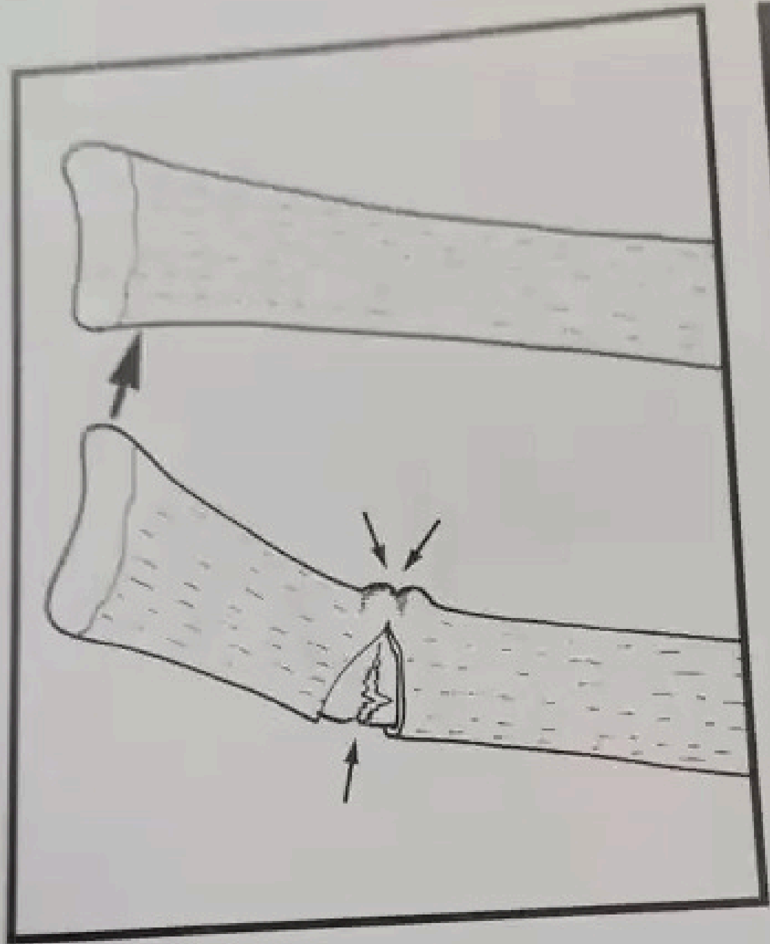
gue fractures: Stresses, repeated
ssive frequency to a bone, may result
. This mechanism is often compared
ue in metals which break after
ending beyond their elastic limit.
nonest of these fractures involves the
tatarsal—the march fracture (so
ause of its frequency in army



11. **Pathological fractures (a):** A pathological fracture is one which occurs in an abnormal or diseased bone. If the osseous abnormality reduces the strength of the bone then the force required to produce fracture is reduced, and may even become trivial. For example a secondary tumour deposit may lead to a pathological fracture of the subtrochanteric region of the femur—a common site.

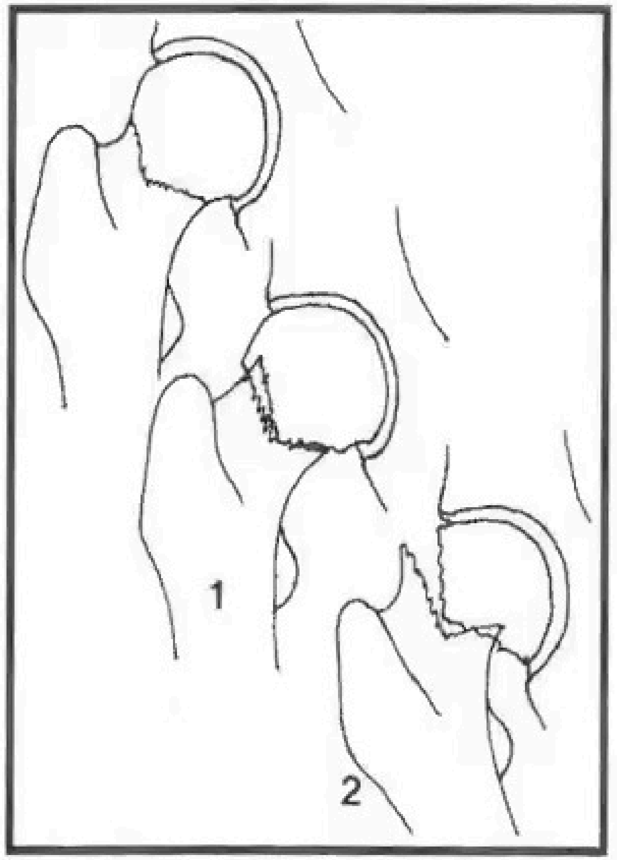
12. **Pathological fractures (b)**
Pathological fractures may also oc
site of simple tumours—e.g. a fra
humerus in a child with a simple
The commonest causes of pathol
fracture are osteoporosis and os

e fractures (d): Radiograph of
an athletic adolescent with a 7-
of persistent leg pain. Previous
vere reported as normal. Note the
obtain optimal detail and the
ir-line fracture revealed by bone
ubperiosteal callus. A crepe
rt only was prescribed, and the
ed in a further 6 weeks.

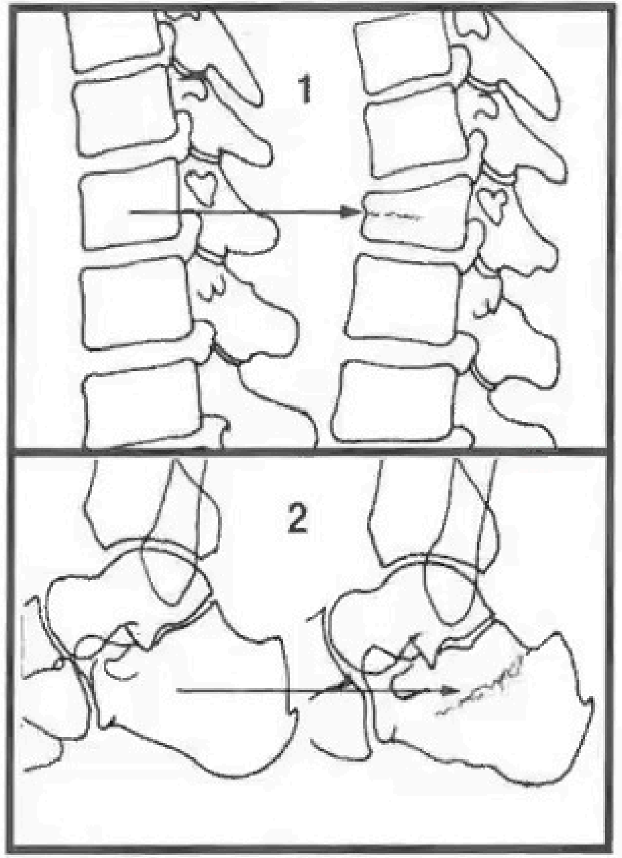


17. **Greenstick fractures (a):** Greenstick fractures occur in children, but not all children's fractures are of this type. The less brittle bone of the child tends to buckle on the side opposite the causal force. Tearing of the periosteum and of the surrounding soft tissues is often minimal.

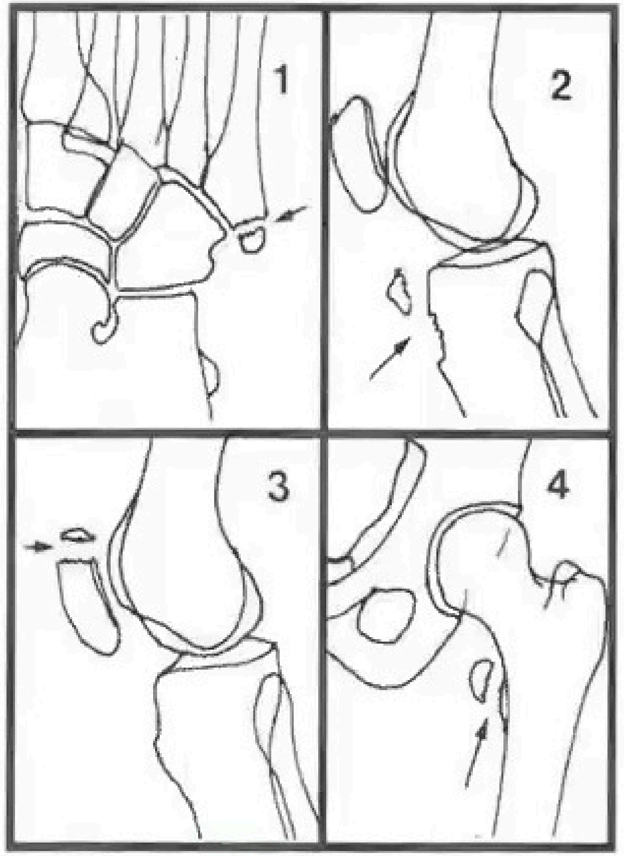
18. **Greenstick fractures (b):** This radiograph illustrates a more severe greenstick fracture of the distal radius and ulna. Note that although there is about 45° of angulation at the fracture site, there is no loss of bony contact in either fracture. The clinical deformity is clearly suggested by the soft-tissue shadow.



28. **Impacted fractures:** A fracture is impacted when one fragment is driven into the other (1). Cancellous bone is usually involved and union is often rapid. The *stability* of these fracrures varies and is more implied than real. Displacement will occur if the fracture is subjected to deforming forces; e.g. without fixation, impacted femoral neck fractures frequently come adrift (2).



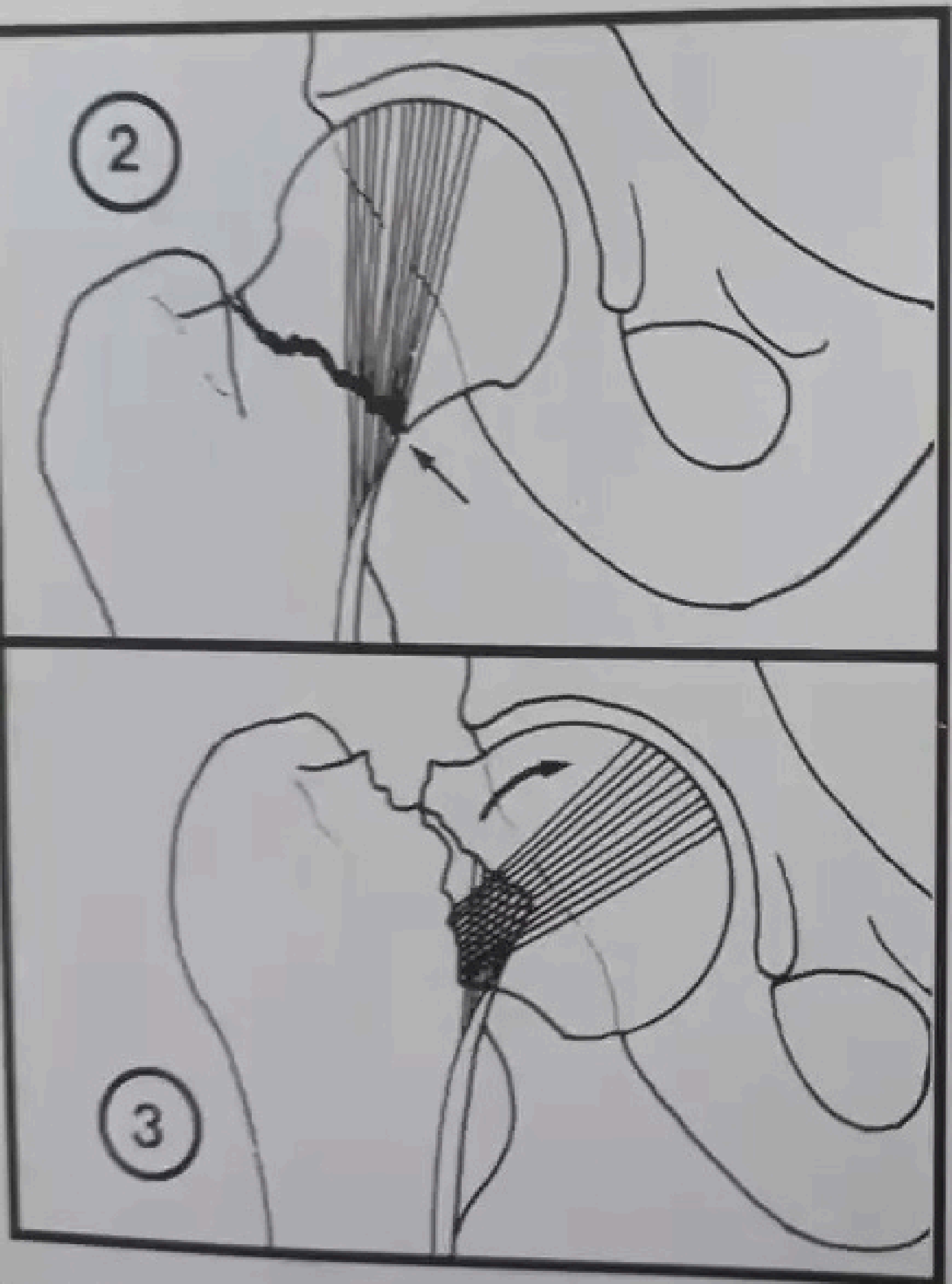
29. **Compression (or crush) fractures:** Crush fractures occur in cancellous bone which is compressed beyond the limits of tolerance. Common sites are(!) the vertebral bodies (as a result of flcxion injuries) and (2) the heels (following falls from a height). If the deformity is accepted, union is invariably rapid. In the spine, if correction is attempted, recurrence is almost invariable.



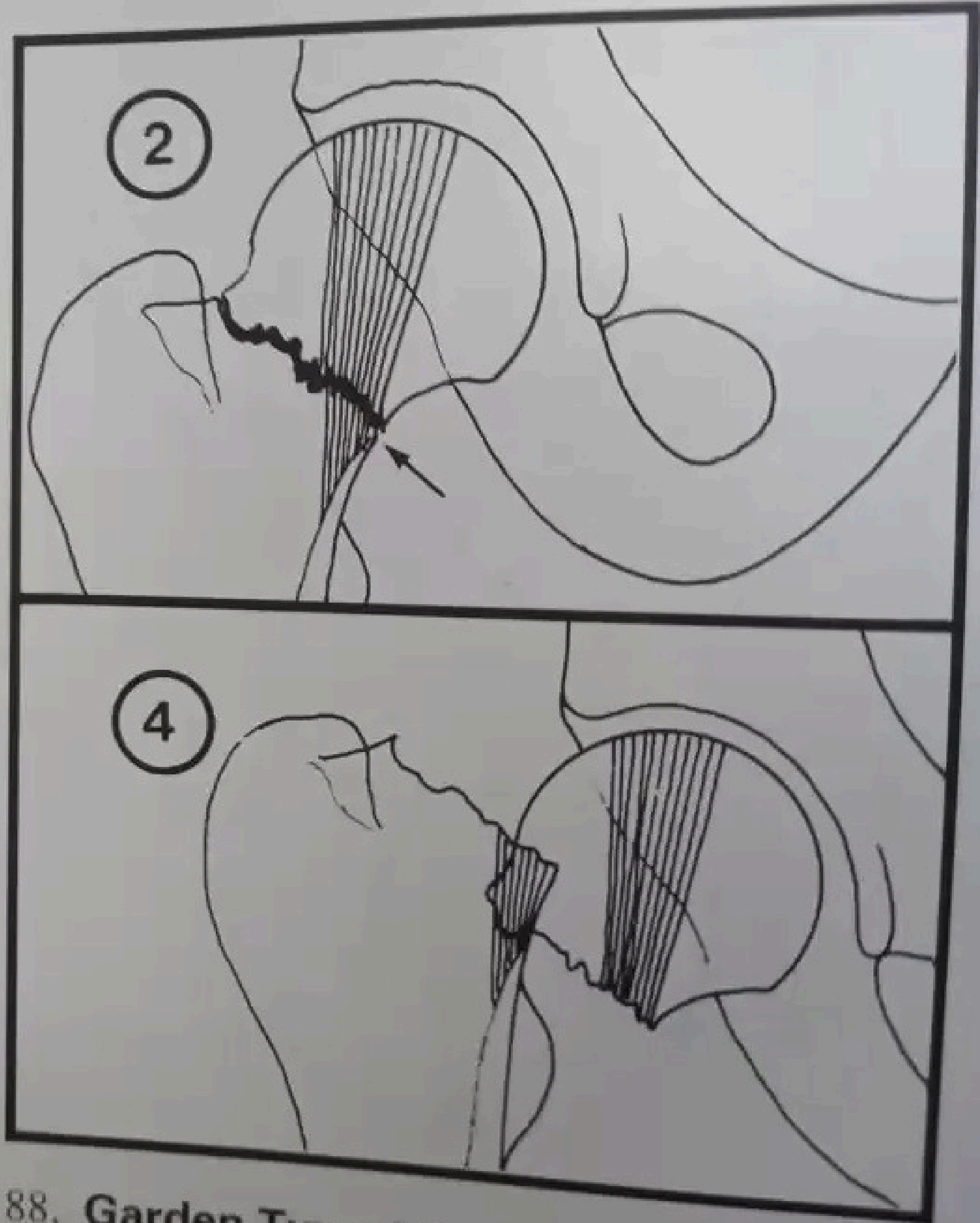
30. **Avulsion fractures (a):** An avulsion fracture may be produced by a sudden muscle contraction-the muscle pulling off the portion of bone to which it is attached. Common examples include:

1. Base of fifth metatarsal (peroneus brevis).
2. Tibial tuberosity (quadriceps).
3. Upper pole of patella (quadriceps).
4. Lesser trochanter (iliopsoas).

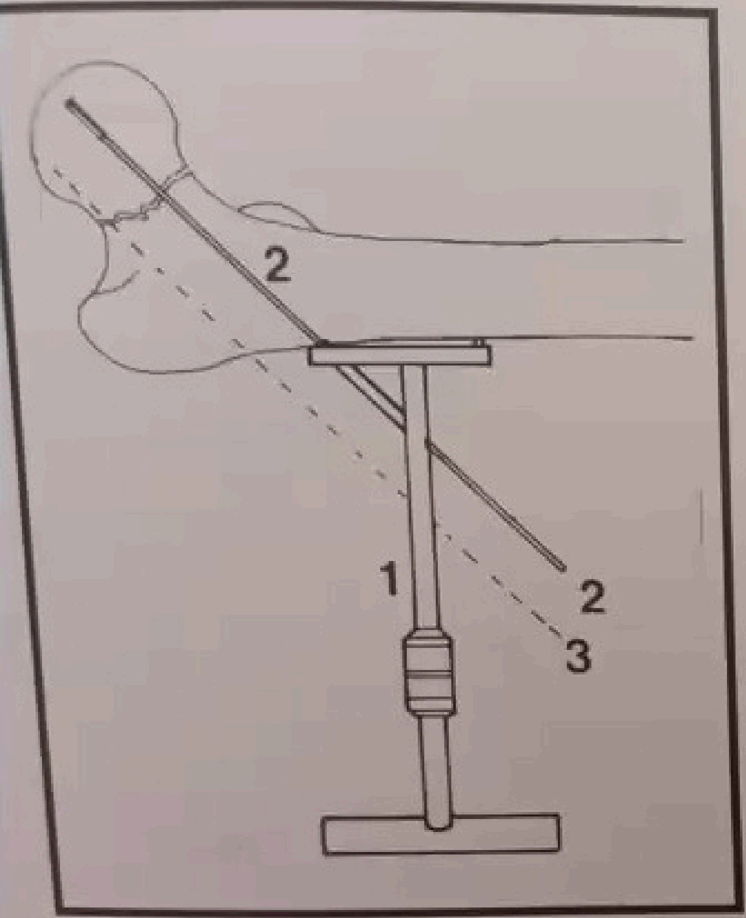
(These are all AO Type A fractures.)



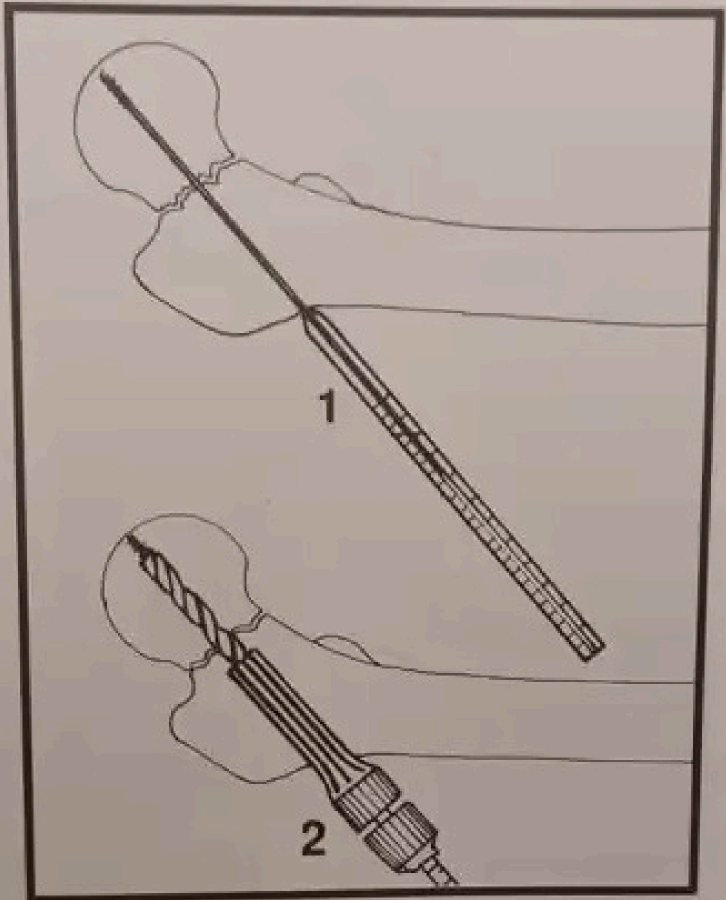
87. **Garden Type 3 fractures:** Here the fracture line is obviously complete. There is



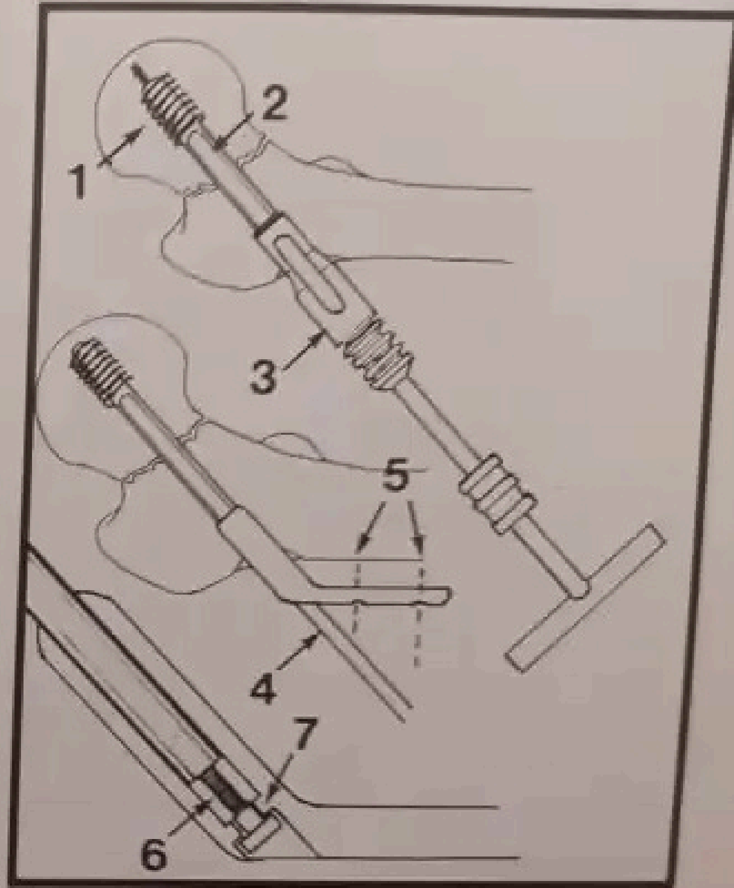
88. **Garden Type 4 fract**



91. **Insertion of AO dynamic hip screw (1):** An angle guide (1) is used to position the guide wire at an angle to the femoral shaft which corresponds with the geometry of the device. The outer bone cortex is drilled and the guide wire (2) is inserted; its position is checked in two planes with the intensifier. A second guide wire (3) may be inserted well out of the way above the first, in order to steady the head and avoid losing the reduction during the insertion of the device.



92. **DHS insertion (2):** A device (1) which measures the protrusion of the guide wire is used to gauge the length of the screw required (usually 10 mm less than the distance between the shaft and the head margin). The DHS triple reamer (2) is adjusted to the size of the screw, and used to cut a tapping hole for the screw, a hole for the plate sleeve, and a bevel for its shoulder. If the bone of the head is dense, it may be tapped for the screw.



93. **DHS insertion (3):** The screw (1) is inserted with a guide (3) and its position checked; its stem has flats (2) sliding in keyways in the plate sleeve to prevent rotation; these must be aligned. The guide wire is removed and the plate driven home with an impactor (4). It is screwed to the shaft (5) with AO cortical screws. A compression screw (6) which threads into the stem of the DHS screw and abuts on a shoulder (7) in the sleeve may be used to draw the fragments together.

76. Complications (1): Avascular necrosis: (Illus.) This is a serious

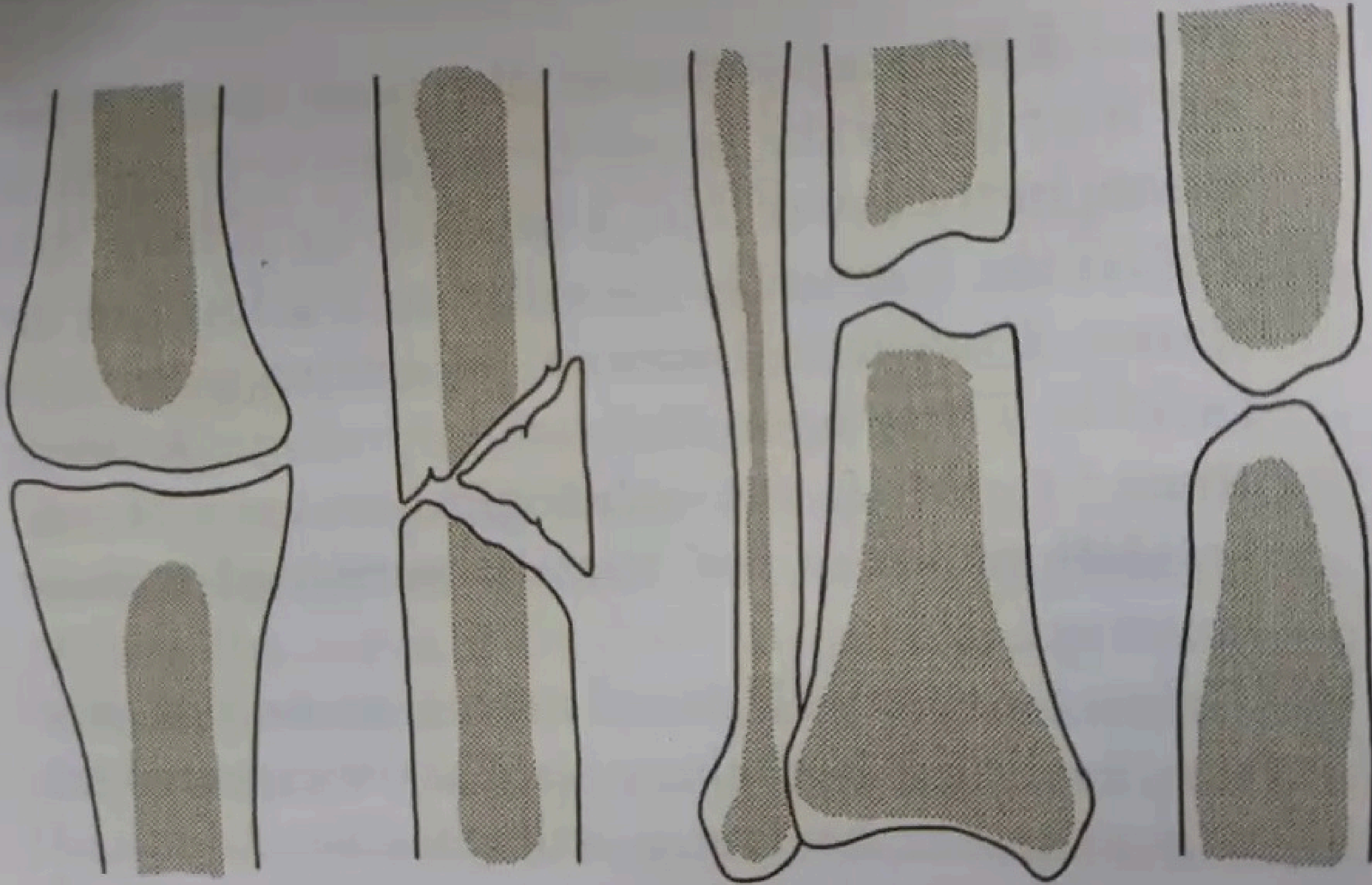
a)

(b)

(c)

(d)

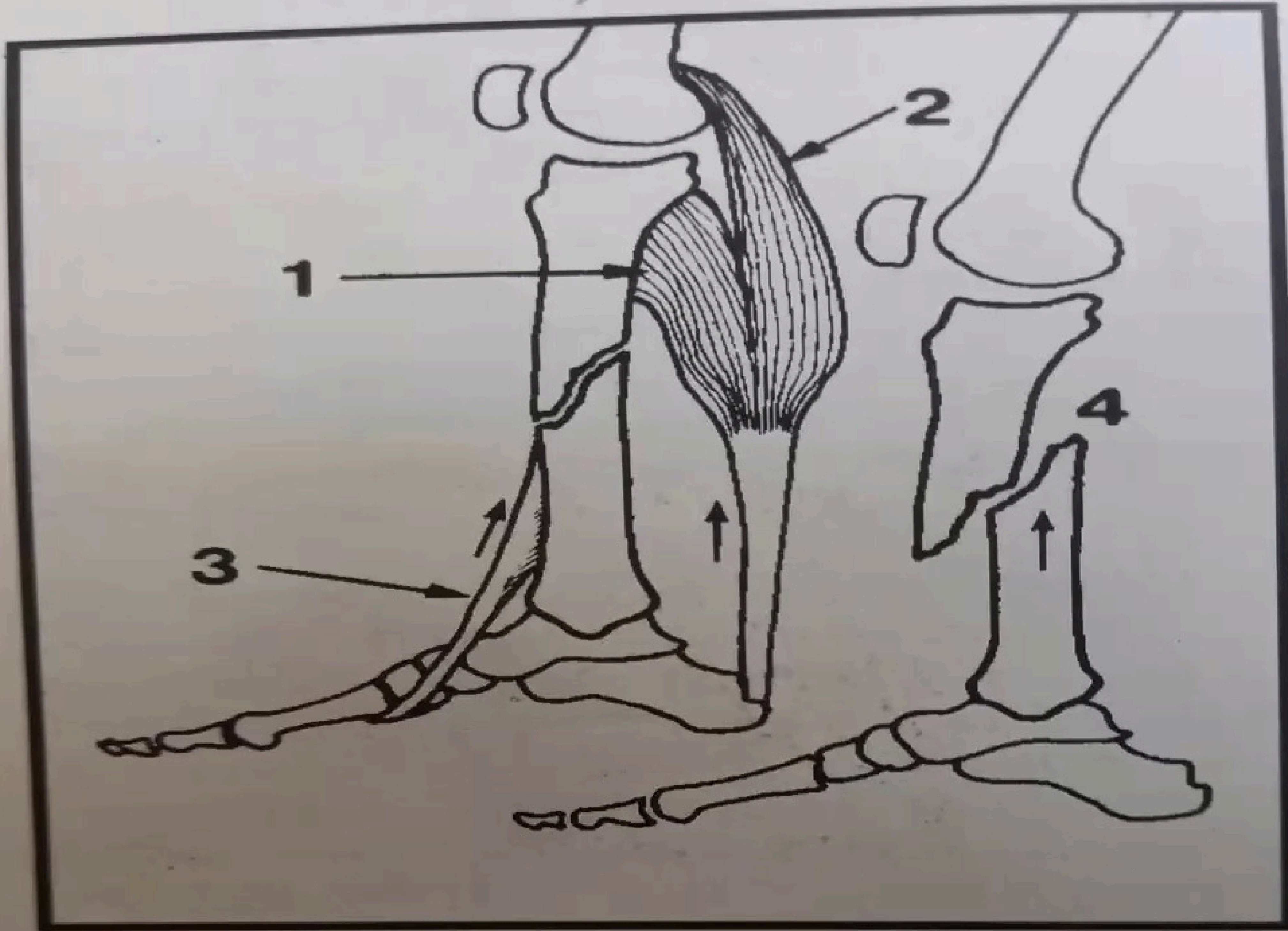
igure 23.26 Complications of fractures Fractures can become infected (a,b), fail to unite (delayed union, non-
nion) (c) or unite in poor alignment (malunion) (d).



(a) (b) (c) (d)

69. What is this pattern of fracture? What is the importance of accurate reduction in this case?

99. **Alternative treatments (2):** A



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2
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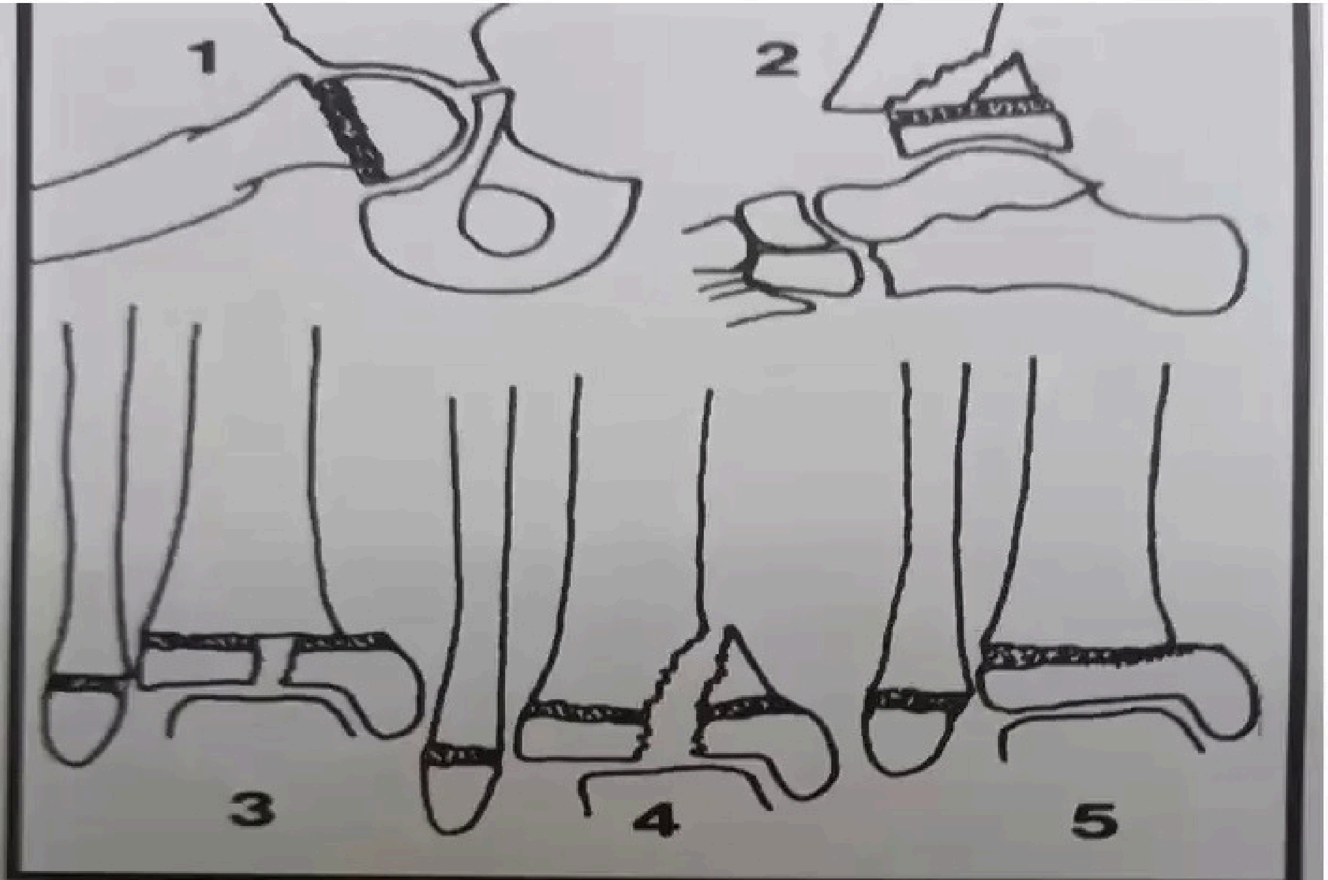
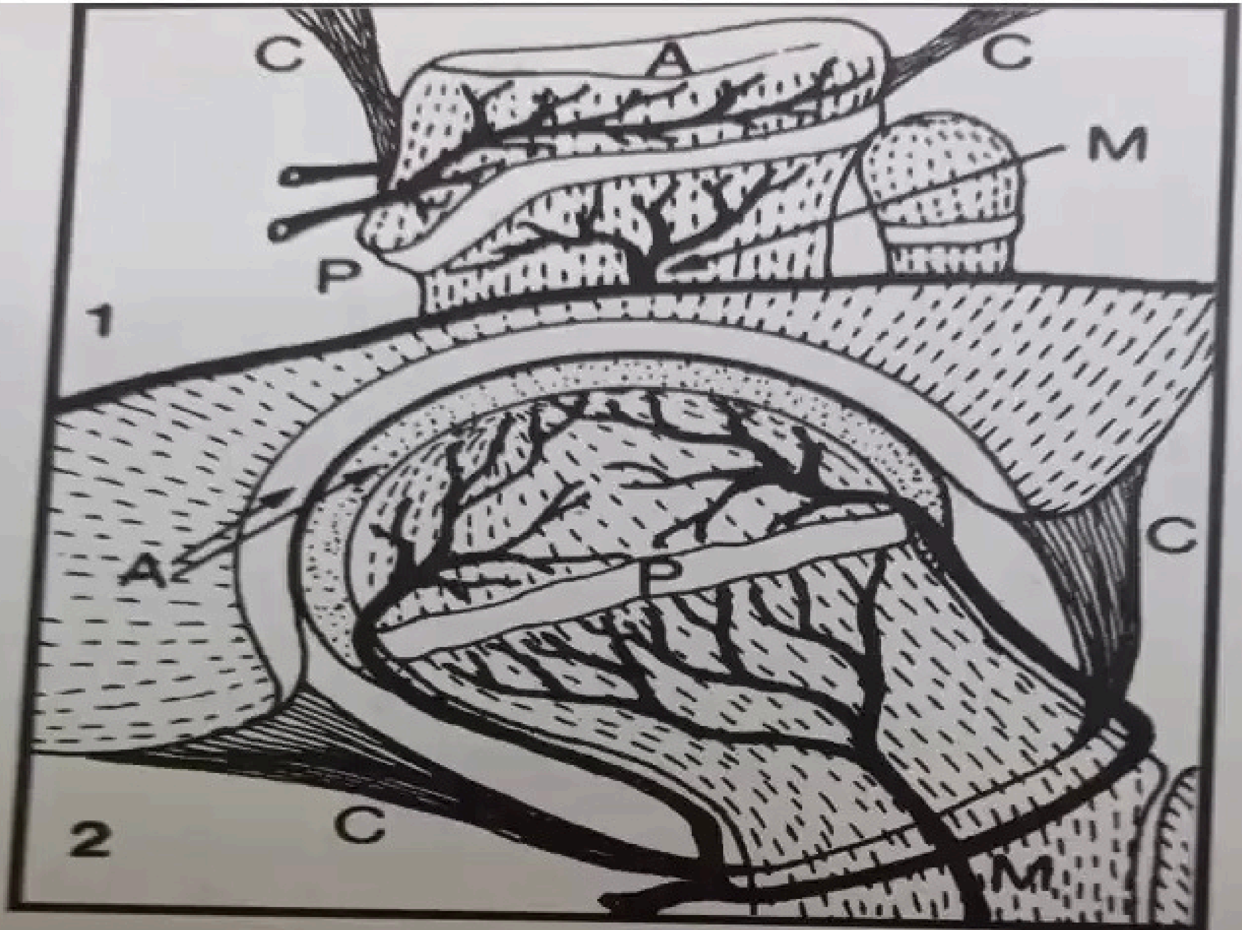
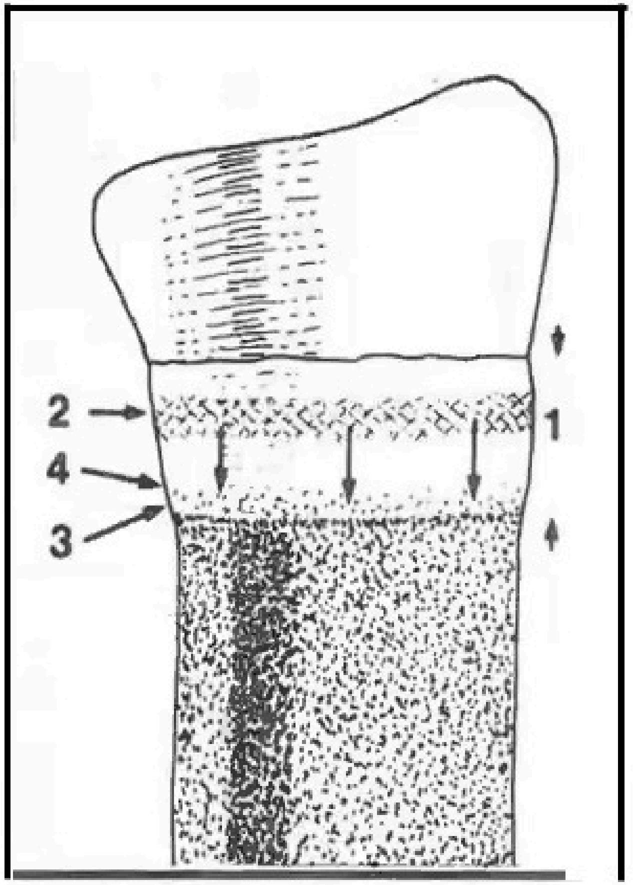


77. **Epiphyseal plate injuries** (Salter and Harris Classification):
Type 1: The whole epiphysis is separated from the shaft.
Type 2: The epiphysis is displaced, carrying with it a small, triangular metaphyseal fragment (the commonest injury).
Type 3: Separation of part of the epiphysis.
Type 4: Separation of part of the epiphysis, with a metaphyseal fragment.
Type 5: Crushing of part or all of the epiphysis.



76. **Pressure epiphyses (c):** The metaphyseal side of the plate is nourished by vessels from the shaft (M). In the tibia (1) the epiphysis is supplied by extra-articular vessels. Vessels to the femoral head (2) lie close to the joint space and epiphyseal plate (P). There is a variable (up to 25%) contribution from the ligamentum teres. Epiphyseal displacements may lead to avascular necrosis or growth arrest. The head of radius is similarly at risk. C = capsule, A = articular cartilage.



75. **Pressure epiphyses (b):** Within the epiphyseal plate (I) is a layer of active cartilage cells (2). The newly fanned cells undergo hypertrophy. Calcification and transformation to bone occur near the metaphysis (3). When there is an epiphyseal separation, it occurs at the weakest point, the layer of cell hypertrophy (4). The active region (2) remains with the epiphysis.

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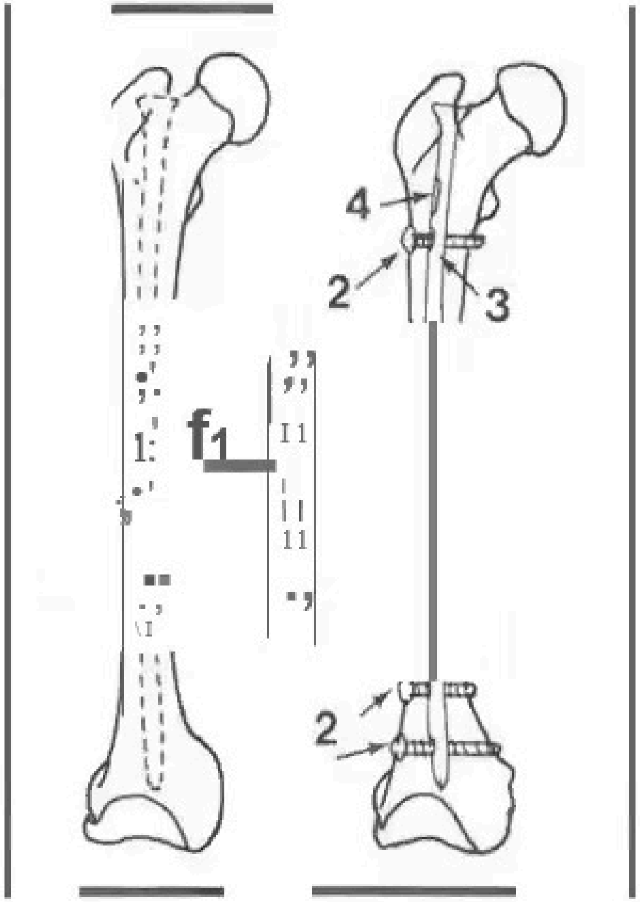
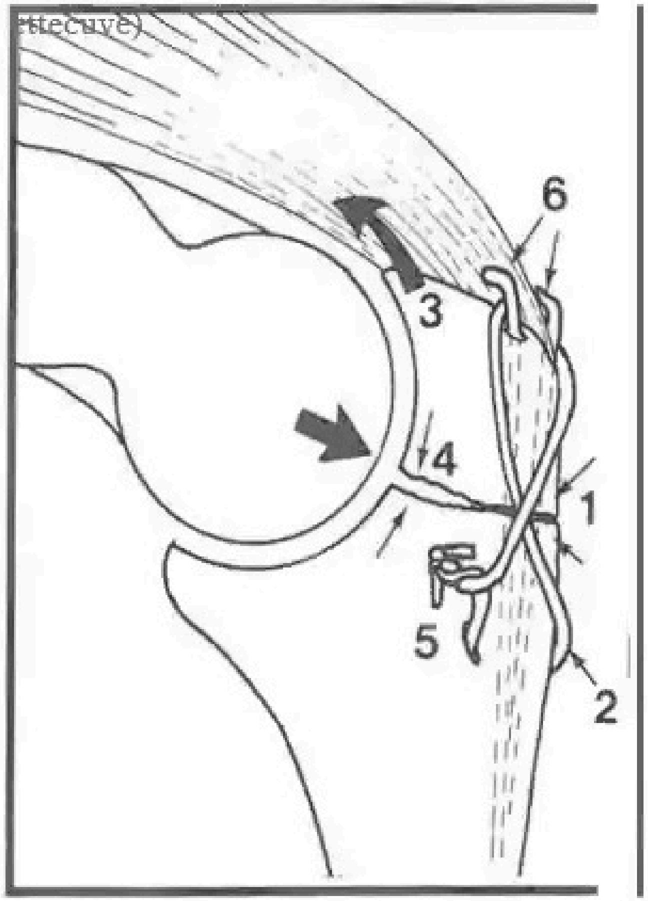
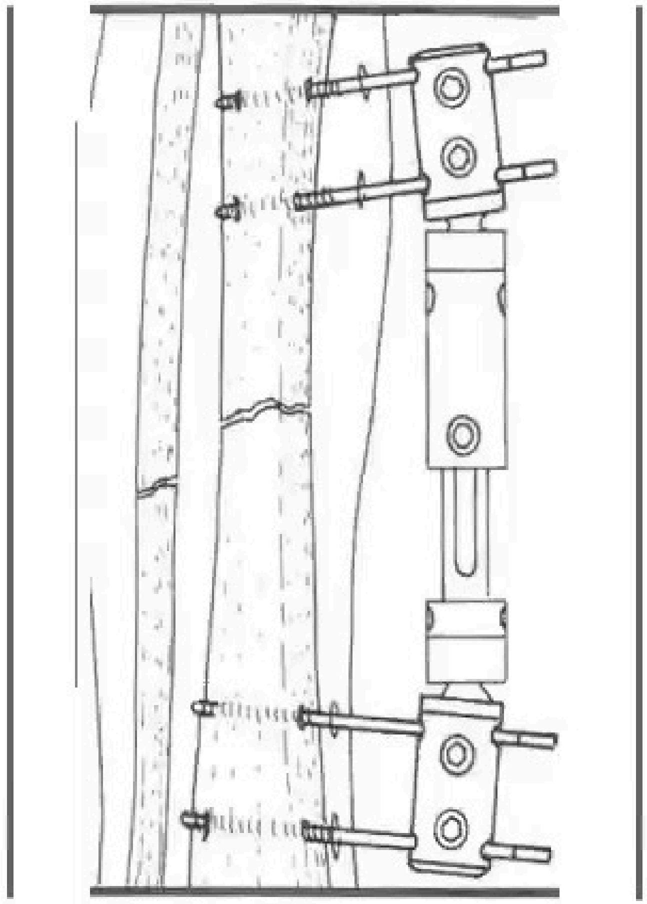


31. **Intramedullary nails**
(2): Interlocking of the fragments, a well-reamed canal and a close-fitting nail may suffice to resist torsional forces which might jeopardise the quality of the fixation. Bone absorption at the fracture site is usually taken up by telescoping (1). If torsional control is poor. an interlocking nail may be used; with this device twisting forces
are neutralised by transversely running locking
bolts (2) which pass through holes (3) or slots (4) in the intramedullary nail. Where reaming is undesirable (e.g. in certain open fractures)

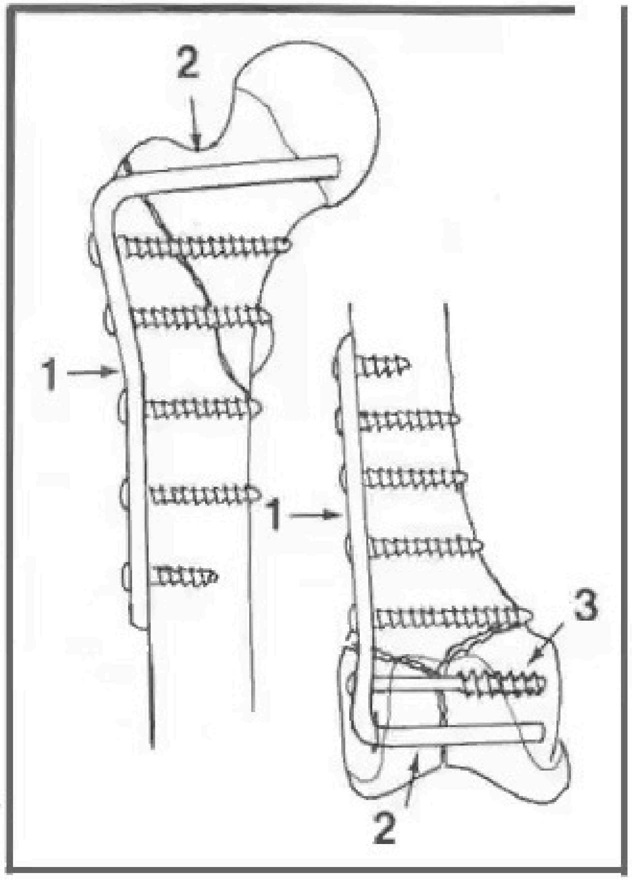


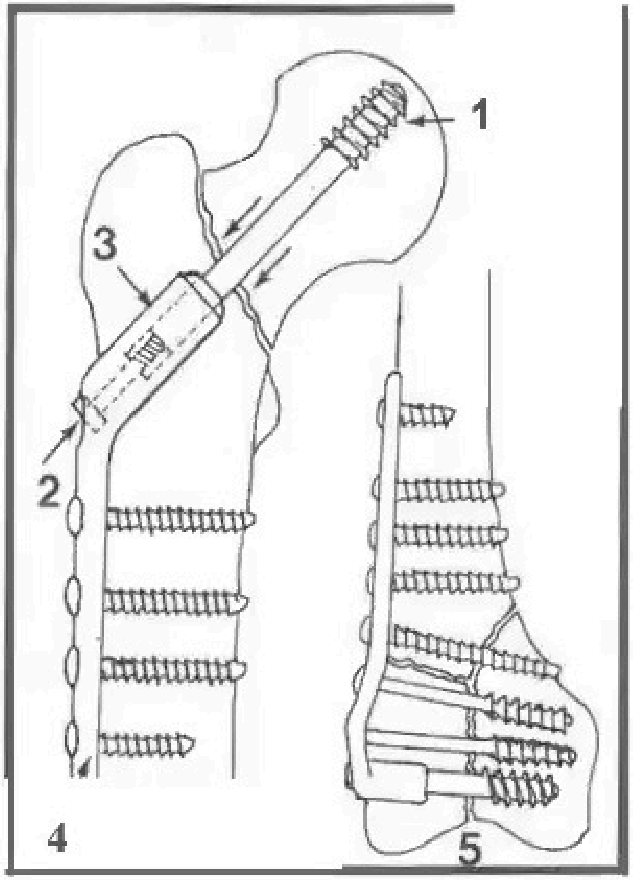
32. **Tension band wiring:** This is used most frequently in olecranon and patellar fractures. The surfaces away from the articular side of the fracture (1) are drawn together and pre-loaded with a high tensile wire (2), while muscle pull (3) acting against the fulcrum of the coronoid (or femoral condyle) brings the rest together (4). The wire is twisted to tighten it (5), and Kirschner wires (6) may be used if

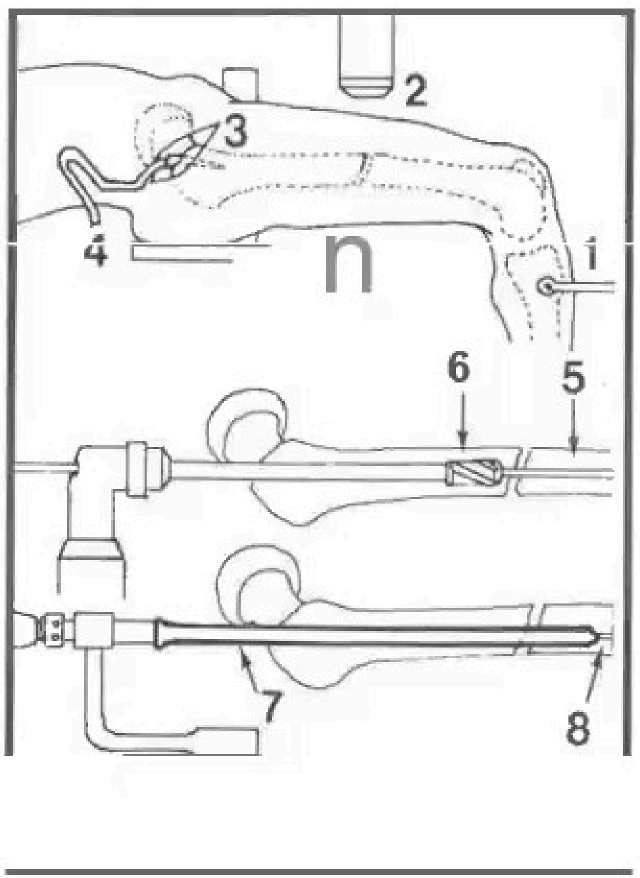
required to preserve longitudinal alignment.



33. **External fixators:** There are many types to deal with a wide range of bone sizes. *The pins* must be rigid (flat-threaded Schanz pins arc popular) and inserted through 'safe' areas to avoid damage to underlying nerves or blood
vessels. Single-side (unilateral or cantilever) systems give the best access for dressing open wounds, with bilateral systems being now reserved mainly for arthrodeses. *The skin* must be meticulously cleaned, and sealed round the pins with suitable dressings to reduce the risks of pin-track infection.





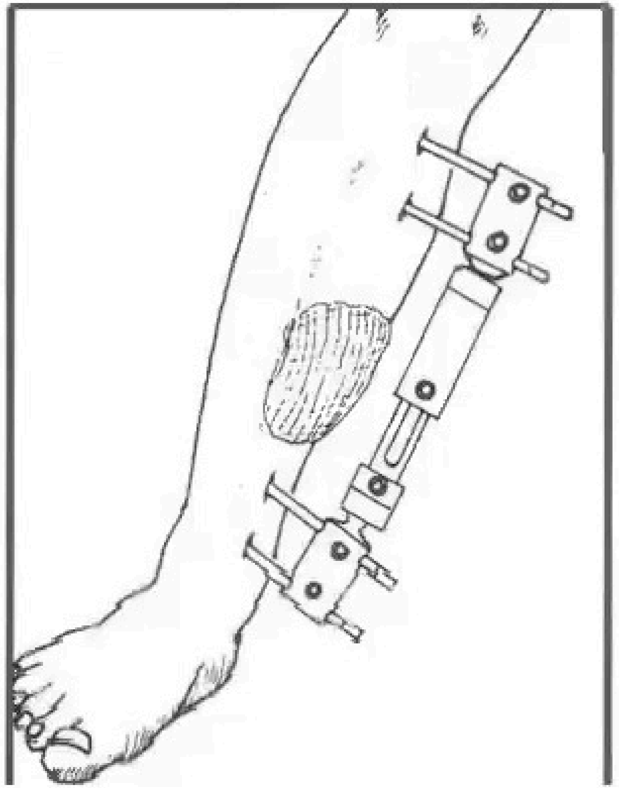


28. **Blade plates:** These are most commonly used at either end of the femur when there is insufficient bone on the epiphyseal side of a fracture to allow an ordinary plate to be used. Blade plates come in a variety of angles and forms: the plate portion (I) is screwed to the shaft of the bone after the blade or spline (2) has been inserted into the bone. Cancellous bone screws (3) may be used for interfragmentary compression.

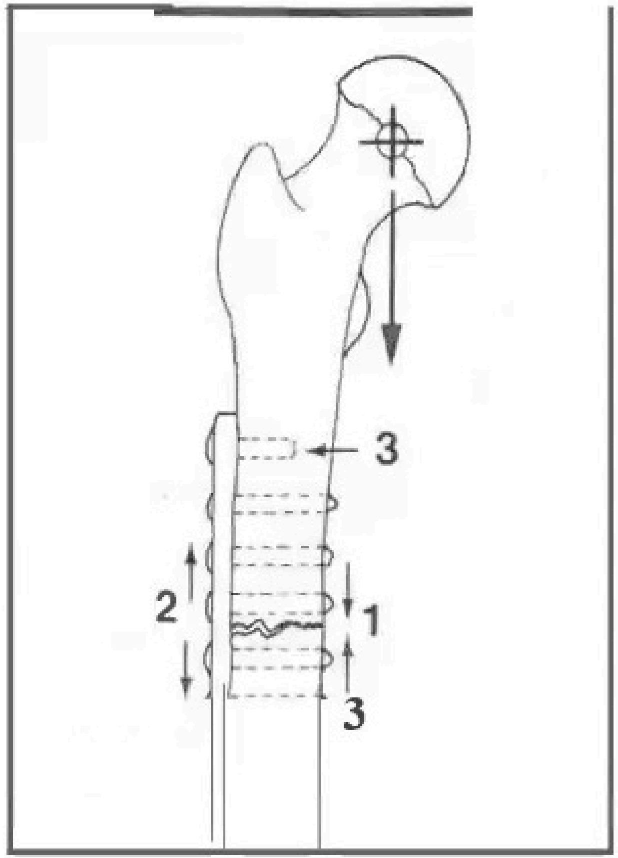
29. **Dynamic hip screw/dynamic condylar screw:** The principle feature of this device is a large diameter cancellous bone screw (I) which can be drawn [with a small screw (2)] into the sleeve (3) of a plate which is screwed to the shaft of the femur (4). In the case of the neck of the femur the soft bone of the head is gripped and the fracture can be compressed; at the distal end of the femur (5) it is of particular value in treating T- or Y-fractures, allowing the aJicular fragments to be drawn together (a

30. **Intramedullary nails (1)**: These are used to treat diaphyseal fractures, particularly of the femur and tibia. In many (but not all) cases the operation can be performed without exposing the fracture. A reduction is obtained using skeletal traction (I) under image intensifier control (2). Through a proximal incision (3) the medullary canal is located (4). Usually a reaming rod (S) is then passed across the fracture and the canal reamed (6) to allow the passage of a close-fitting nail (7) of suitable length and diameter over a guide rod (8).

71. This injury was sustained in a road traffi c accident. Describe the pattern of injury and the deformity.



6. **Type II open fractures** should be managed along similar lines. /11 *Type///* injuries a vigorous debridement should be carried out with copious wound lavage. All foreign material must be removed along with any completely devitalised tissue (including small bone fragments). The wound should be left open but dressed so as to prevent the underlying tissues from drying out. To facilitate further wound management (conducted along the lines suggested in Frame 5) an external fixator may be the best way to hold the fracture.



19. **Plates** (3): Plates should be placed on the tension side of a fracture so that compression loads are taken by bone (I), and tension effects are neutralised by the plate (2). In practice this means that plates should be applied to the lateral side of the femur. In the tibia, either side can be in tension: most commonly plates are fixed to the anreromedial surface (unless damage to the overlying skin dictates otherwise). An absolute minimum of two screws should be insened in each main fragment; preferably three or more should be used, when the end screws may be allowed to engage the near conex only so that stresses may be spread (3).)(

64. Describe the level and any angulation or displacement that you see in this fracture.