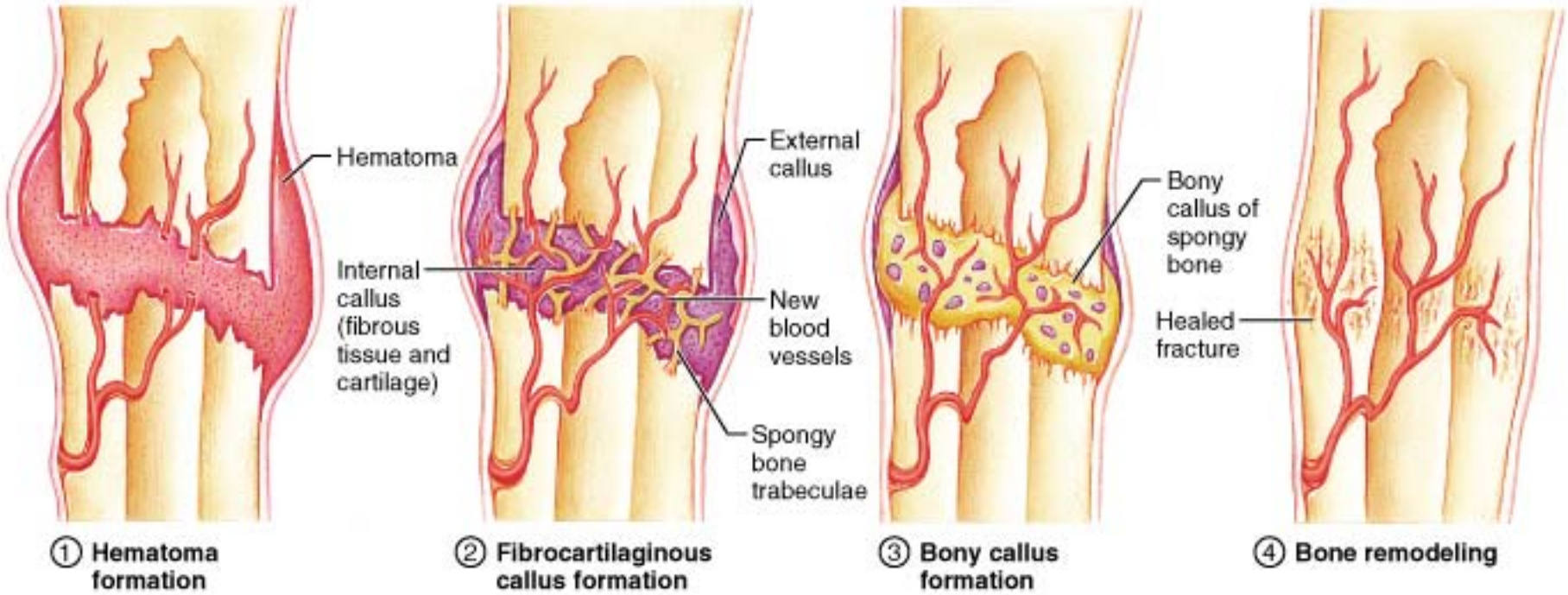
Fractures
Healing & Management

Traumatology
RHS 231
Dr. Einas Al-Eisa
Lecture **4**

Fractures

- Despite their strength, bones are susceptible to fractures.
- In young people, most fractures result from trauma (e.g., sports injuries, falls, or car accidents).
- In old age, bones become thin and weak, and fractures occur more often.

Fracture healing



Fracture healing

1) Hematoma formation:

- Hemorrhage occurs (within seconds of the injury) as the result of tearing of blood vessels both in the periosteum and inside the bone

- Hematoma occurs as the blood clots

Fracture healing

2) Fibrocartilaginous callus formation = periosteal and endosteal proliferation

- New blood vessels grow into the clot (within a few days)
- The periosteum and endosteum near the fracture site show a proliferation of bone-forming cells which then invade the clot filling it with repair tissue called ***soft callus***
- This tissue forms a bridge between the bone ends
- Haematoma is reabsorbed

Fracture healing

3) Bony callus formation:

- Within a week, trabeculae of new bone begin to form within the callus (immature bone)

- The trabeculae grow thicker and stronger and become firm by about 2 months after the injury

- Visible on x-rays and gives evidence that healing is taking place

Fracture healing

4) Bone remodeling:

- The bony callus is remodeled over the course of many months
- The excess bony material is removed from the exterior of the bone shaft and the interior of the medullary cavity
- Compact bone (lamellar structure) is laid down to reconstruct the shaft walls
- The repaired area resembles the original unbroken bone, since it is responding to the same set of mechanical stresses

Fracture healing

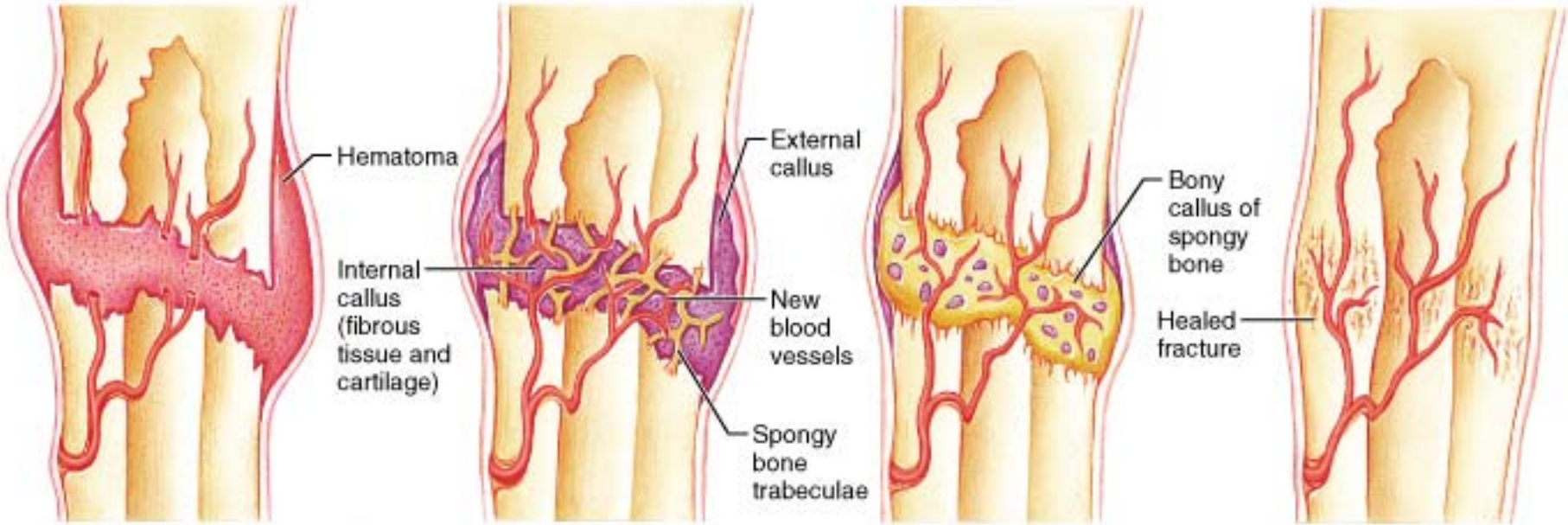
- In children, healing is usually very good and it is difficult to see the healed fracture site on radiographs

- In adults, there may be permanent area of thickening, which may be felt or seen in a superficial bone

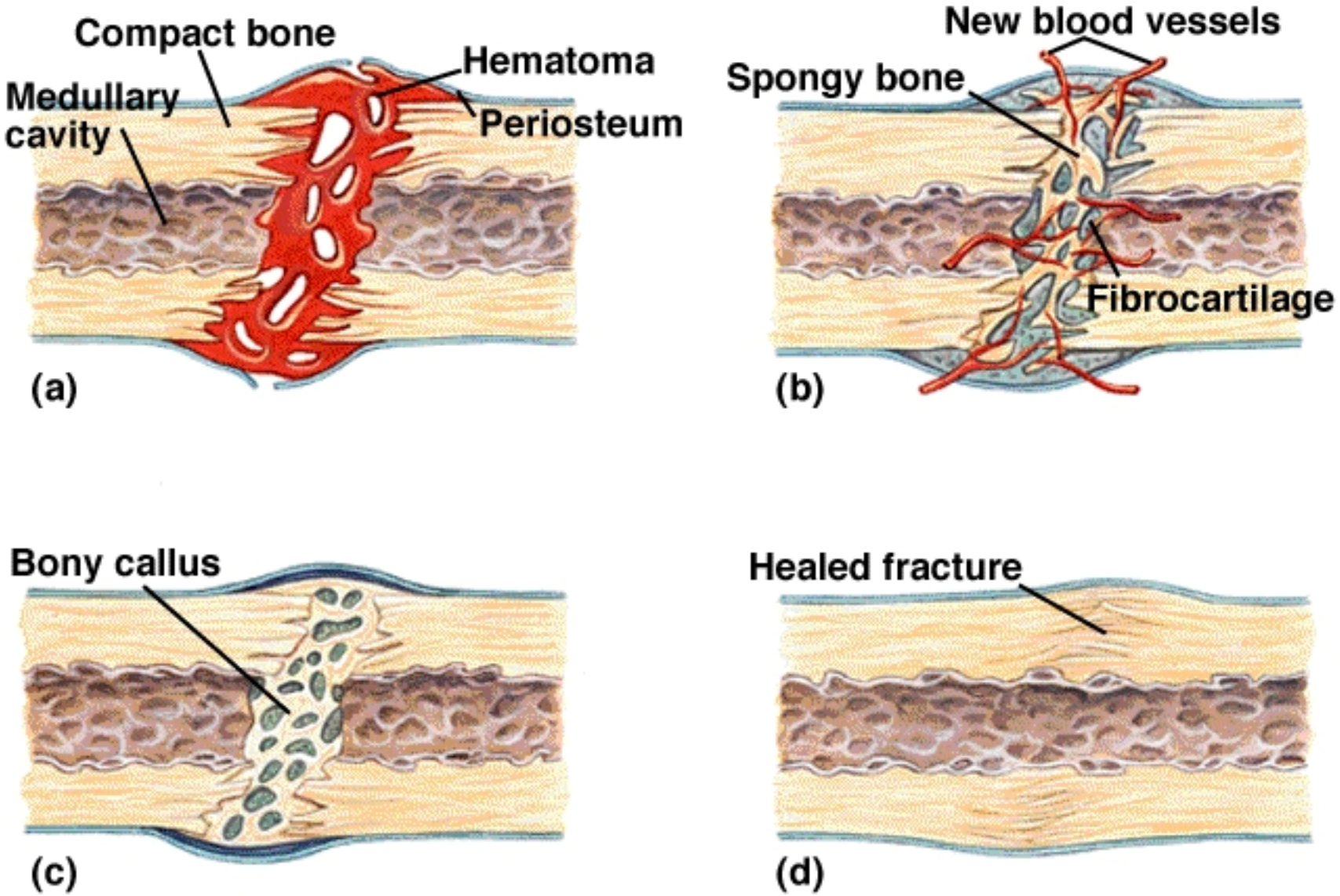
Fracture healing

- Fractures through cancellous bone, with a good blood supply, surrounded by muscles, and without soft tissue lesions, have an excellent chance of healing.

- Fractures at the middle of shaft of long bones, especially with extensive soft tissue damage, have a high incidence of non-union.



Fracture Repair



When is a fracture healed?

Depends on:

1. **The type of bone fractured**:
   - Cancellous bone heals more quickly than compact bone
   - Healing of long bones depends on their size, so bones of the upper limb unite earlier (3-12 weeks) than do those of the lower limb (12-18 weeks)

When is a fracture healed?

2. **Classification of fracture** (the type of fracture sustained):

- It is easier to obtain good apposition of bone ends with some fractures than others

- This depends on the position of the fragments before the reduction and the effect of muscle pull on the fragments

When is a fracture healed?

3. **Blood supply**:
   - Adequate blood supply is essential for normal healing
   - Some parts of a bone have poor blood supply. Example, the lower third of tibia, which *normally* does not require rich blood supply because there is little muscle bulk. Therefore, fractures of the lower third of tibia are slow to heal

When is a fracture healed?

4. **Fixation**:
   - Adequate fixation prevents impairment of the blood supply which may be caused by movement of the fragments.
   - Also, fixation maintains reduction and prevents deformity.
   - But, if a fracture is rigidly immobilized, the stimulus for callus to form is lost. So, small amount of movement at fracture site encourages fracture healing.

When is a fracture healed?

5. **Age of the person**:

- In children, union of fracture is quick and consolidation may occur within 4-6 weeks.

- In adults, age makes little difference to union, unless there is accompanying pathology

When is a fracture healed?

- Revascularization of devitalized bone and soft tissues adjacent to the fracture site
- The mechanical environment of the fracture
- Treatment undergone
- Smoking
- Certain drugs (e.g., anti-inflammatory)
- Ultrasuond

When is a fracture healed?

- The following suggest complete healing:
  - Absence of pain on weight-bearing, lifting, or movement
  - Absence of tenderness on palpation at the fracture site
  - Blurring or disappearance of the fracture site on X-ray
  - Full or near full functional ability

Principles of fracture management

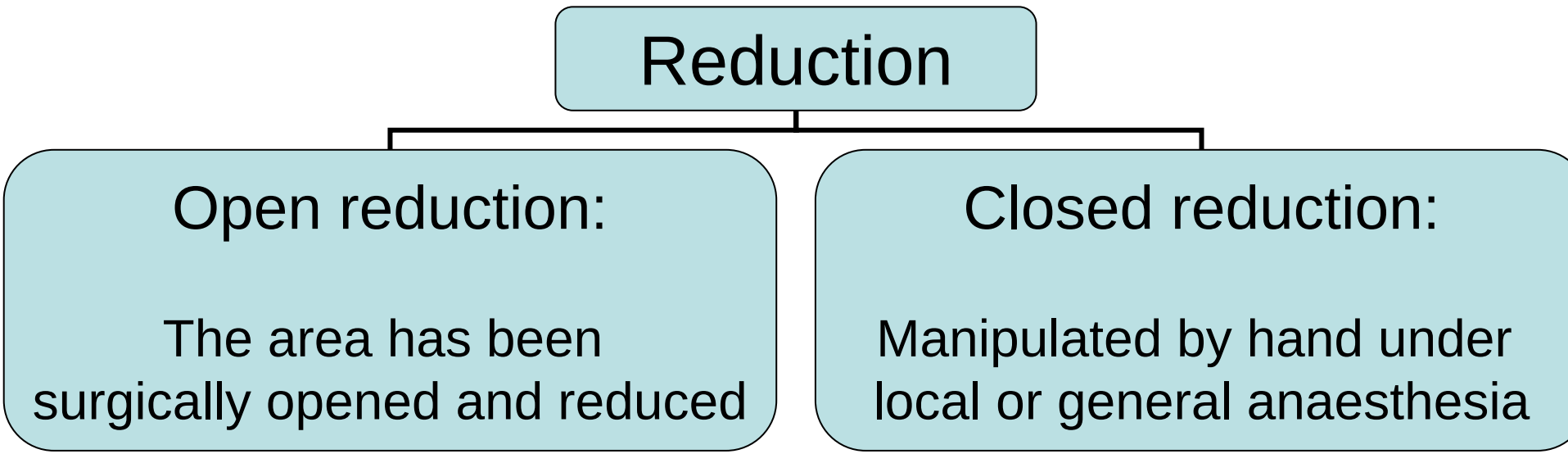
1. **Reduction** of the fracture

2. **Immobilization** of the fracture fragments long enough to allow union

3. **Rehabilitation** of the soft tissues and joints

Reduction

- = to realign the bone into the normal anatomical position or as near to the normal position as possible


Reduction
Open reduction:
The area has been surgically opened and reduced
Closed reduction:
Manipulated by hand under local or general anaesthesia

Methods of **reduction**

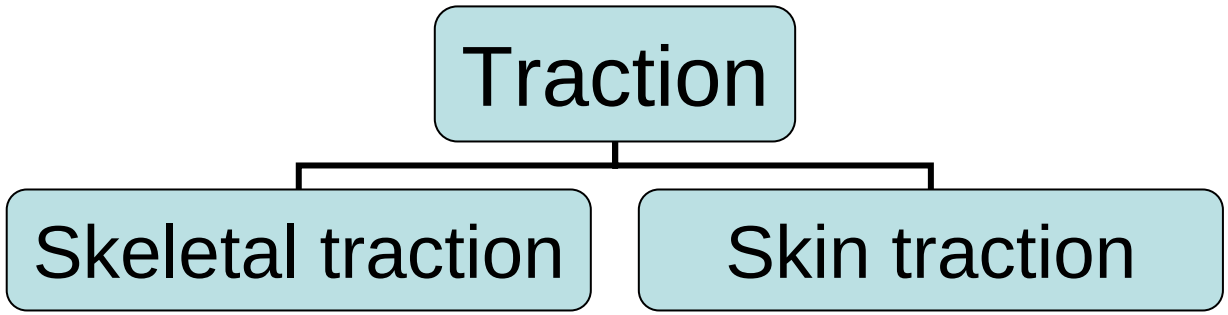
1. Traction
2. External splints/braces
3. External fixation
4. Internal fixation

Note: Some fractures are not displaced, and therefore do not require reduction

Traction

- = pulling on a broken limb to draw the bone fragments into line

- Traction must be strong enough to overcome the muscle power (which tries to shorten the limb), but not too strong that it holds the ends apart


Traction
Skeletal traction
Skin traction

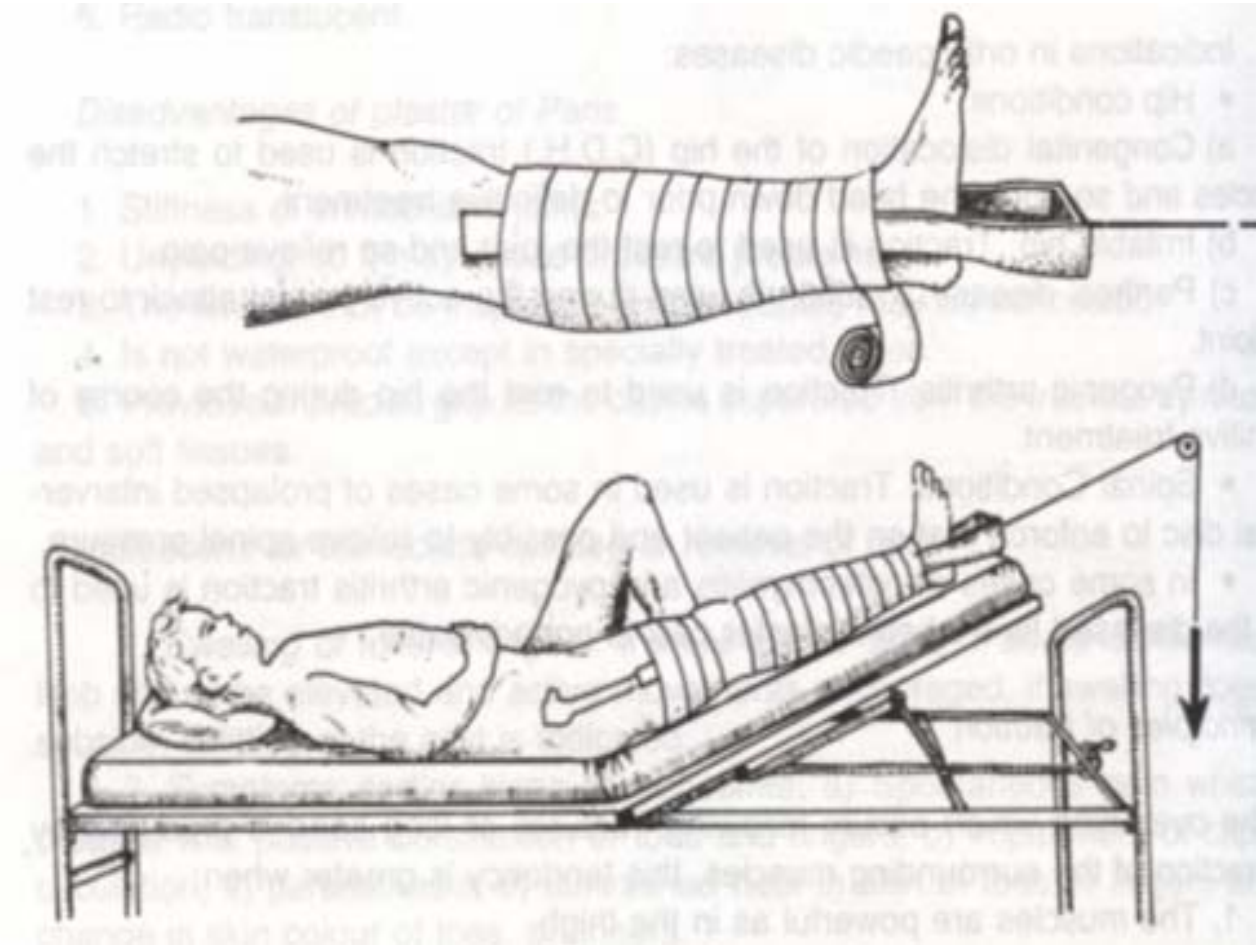
Skeletal traction

- = traction applied to metal pins passed through the bone
- Allow substantial loads to be applied to the bone itself, and may be more comfortable than skin traction
- Commonest sites: upper end of tibia, calcaneum, distal femur, olecranon

Types of metal pins
used in skeletal traction

Skin traction

- = traction applied by means of adhesive strapping stuck directly onto the skin
- Rashes are common (skin beneath the strapping becomes sweaty)
- The weight is applied to the bone indirectly via the soft tissues, which can be disrupted if too much weight is applied



Skin traction

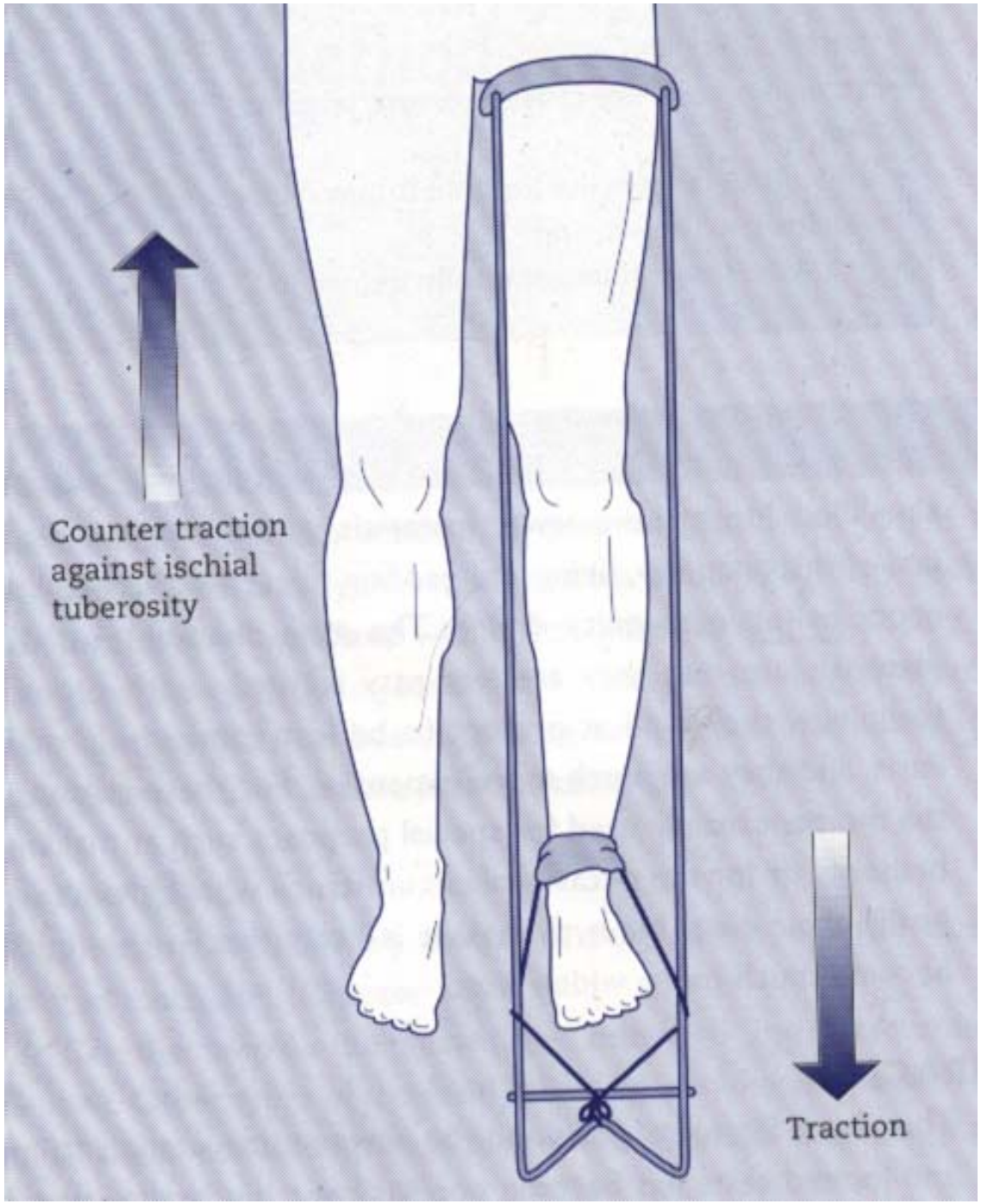
Skin traction

- The upper limit is 5 kg
- Only suitable for children and as a temporary measure in adults

Mechanics of traction

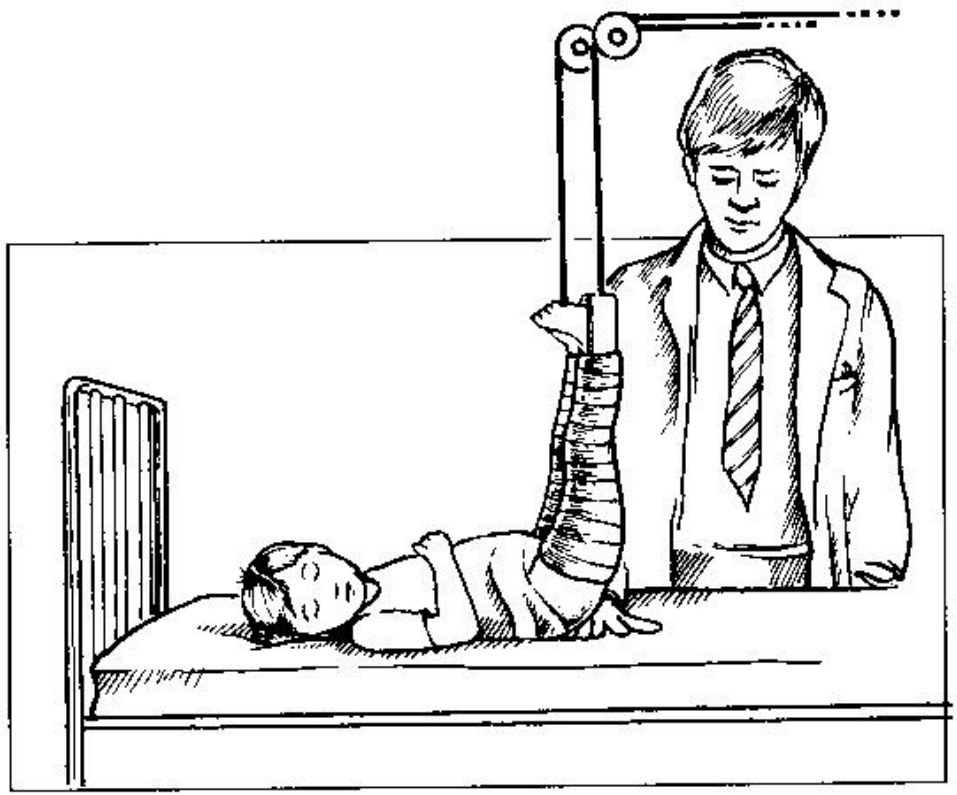
- **Fixed traction with a splint**:
  - The limb is rested on a splint (Thomas splint), and traction is applied to the lower end of the splint (Spanish windlass), and the upper end of the splint under the ischial tuberosity
  - Ideal for transporting patients because it is self-contained and does not need pulleys or weights

Fixed traction with a splint



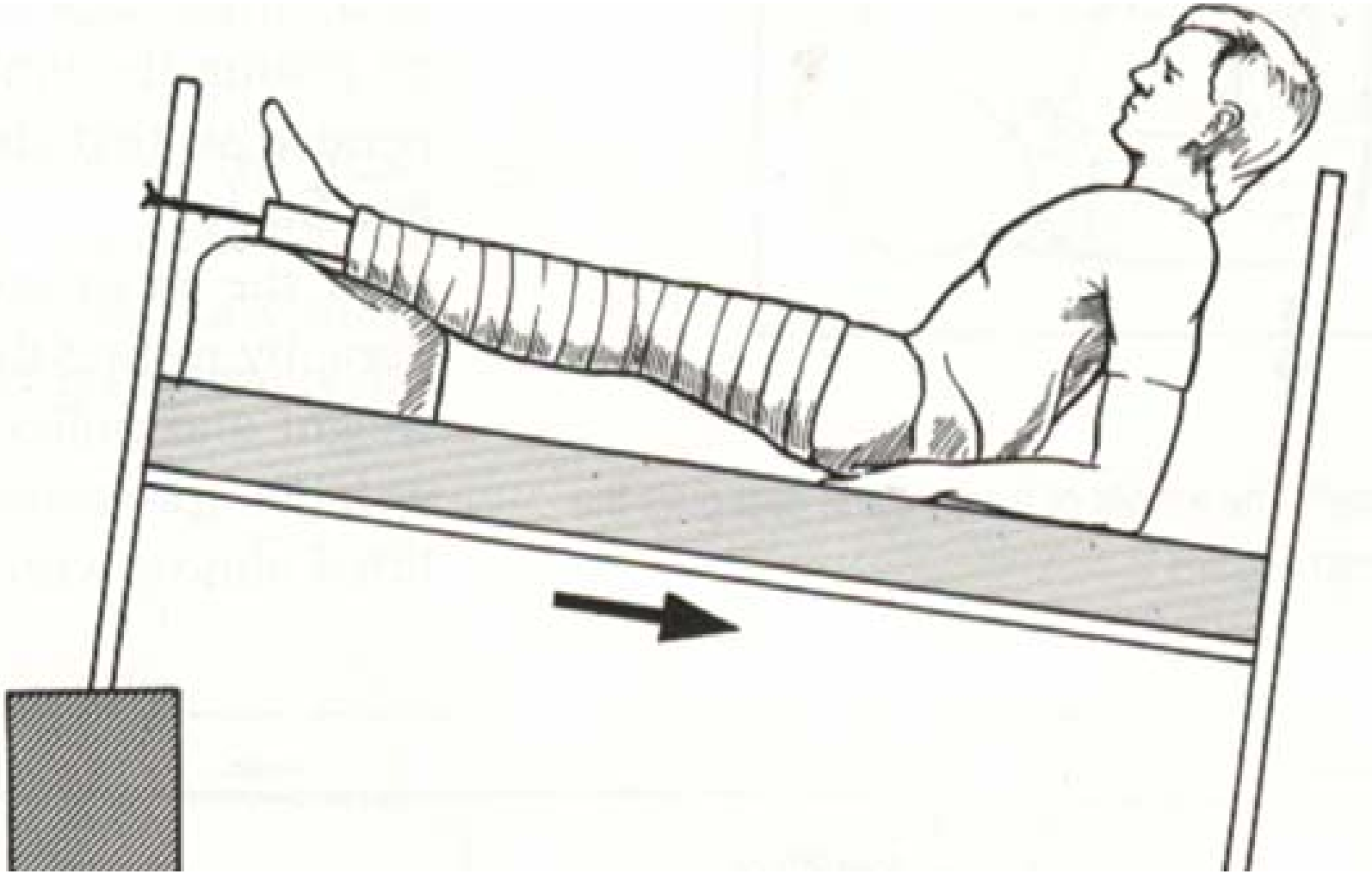
Mechanics of traction

- **Fixed traction using gravity**:
  - To string the injured limb and leave them hanging until the bone has joined
  - Or by fixing the patient's leg to the foot of the bed, which is then raised so that the patient slides down towards the pillow
  - Example: fractures of the humerus in which a cast is applied and suspended by a collar and cuff cast, so that the weight of the arm and cast pull the humerus into line



Gallows traction (fixed traction using gravity)

For children under the age of 3 with femur fracture



Fixed traction using gravity

Fixed traction using gravity

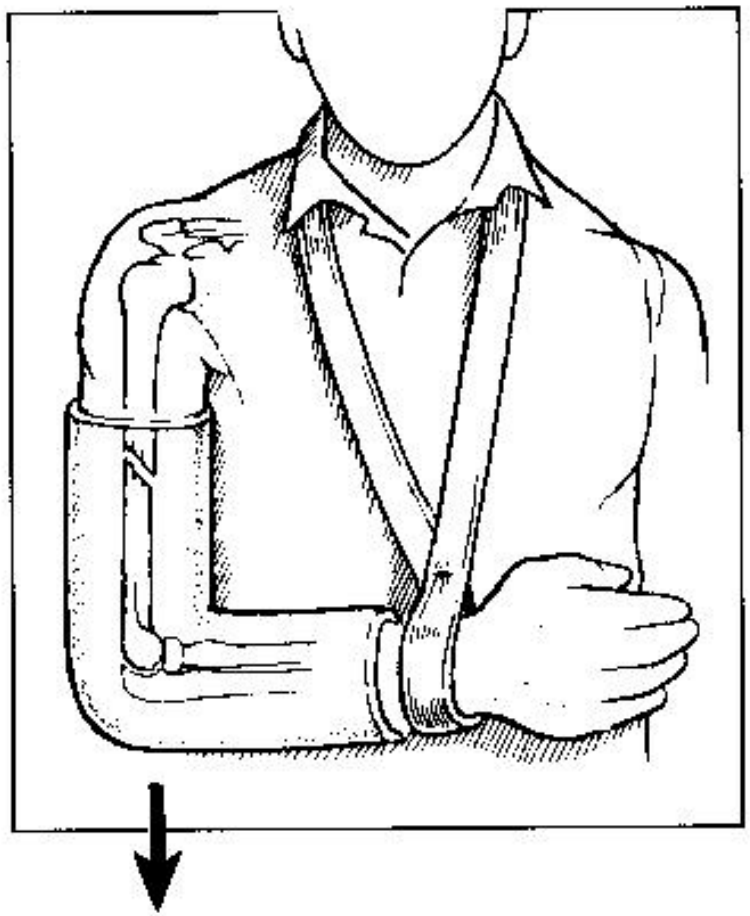
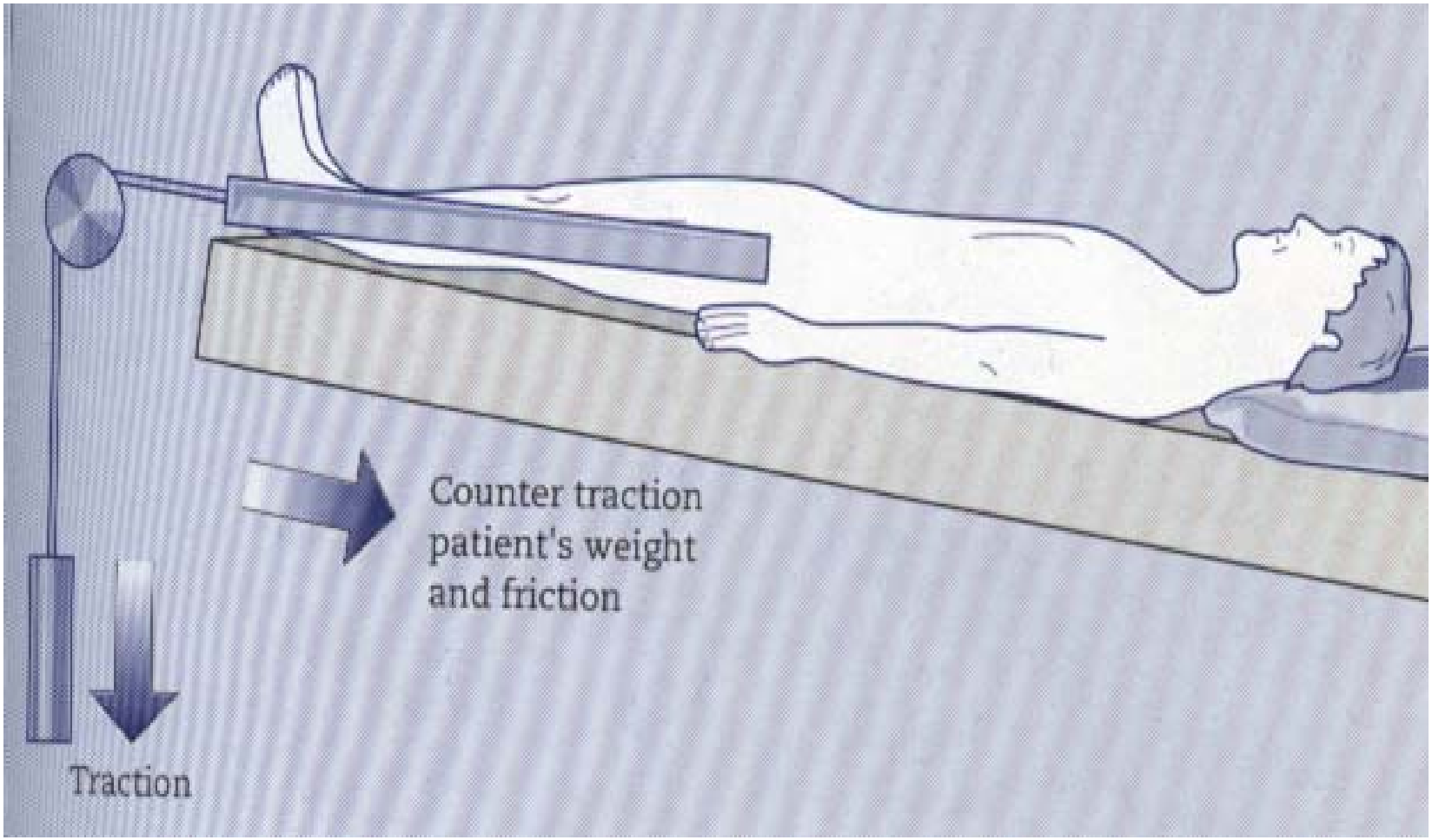


Fig. 9.6 Hanging cast. The weight of the arm and cast pulls the humeral fragments into line.

Mechanics of traction

- **Sliding traction**:
  - Similar to fixed traction, but uses weights and pulleys, and the patient can move freely in the bed
  - Example: Hamilton-Russel traction



Sliding traction

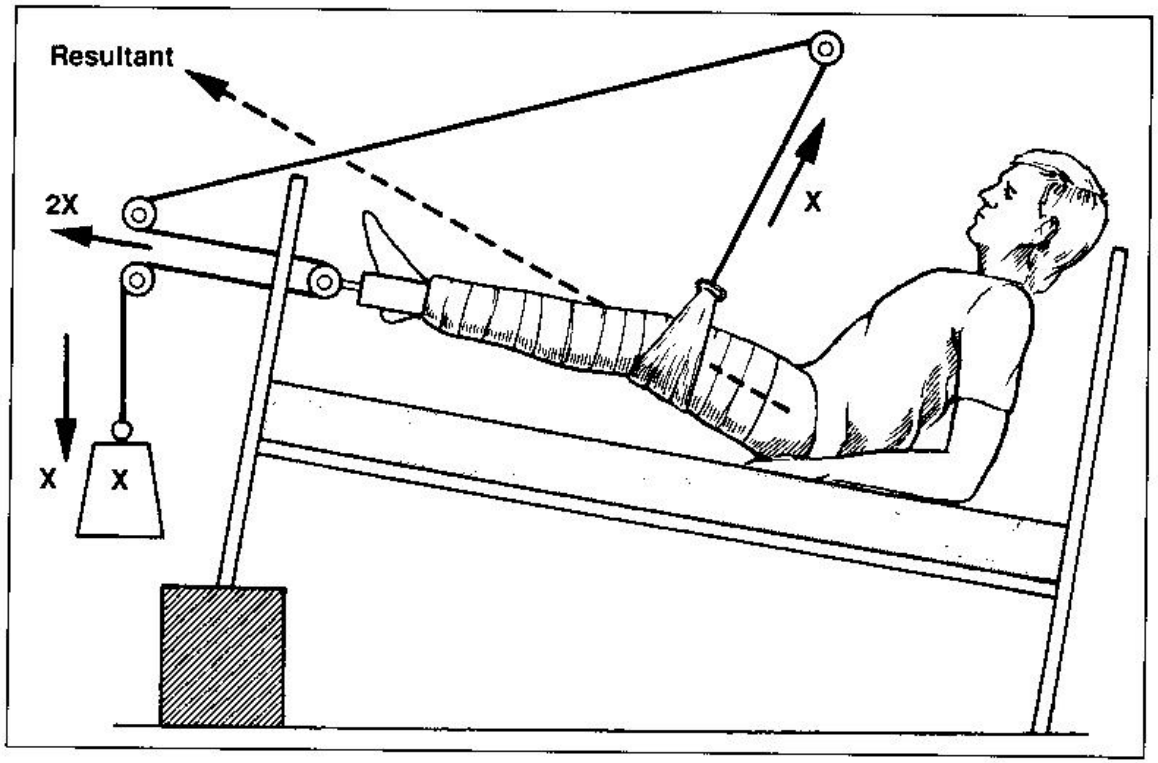


Fig. 9.7 Hamilton–Russell traction. The longitudinal traction has a velocity ratio of 2 and the vertical traction a velocity ratio of 1. The resultant force is 2.24 times the mass of the weight applied at an angle of 27° to the horizontal.

Sliding traction

Mechanics of traction

- **Balanced traction**:
  - Resting the limb in a splint (Thomas splint) with weight and pulley attached to each end of the splint, so that the limb is completely lifted in a gravity free field
  - The weights at both ends have to be adjusted and balanced
  - Difficult to apply and maintain

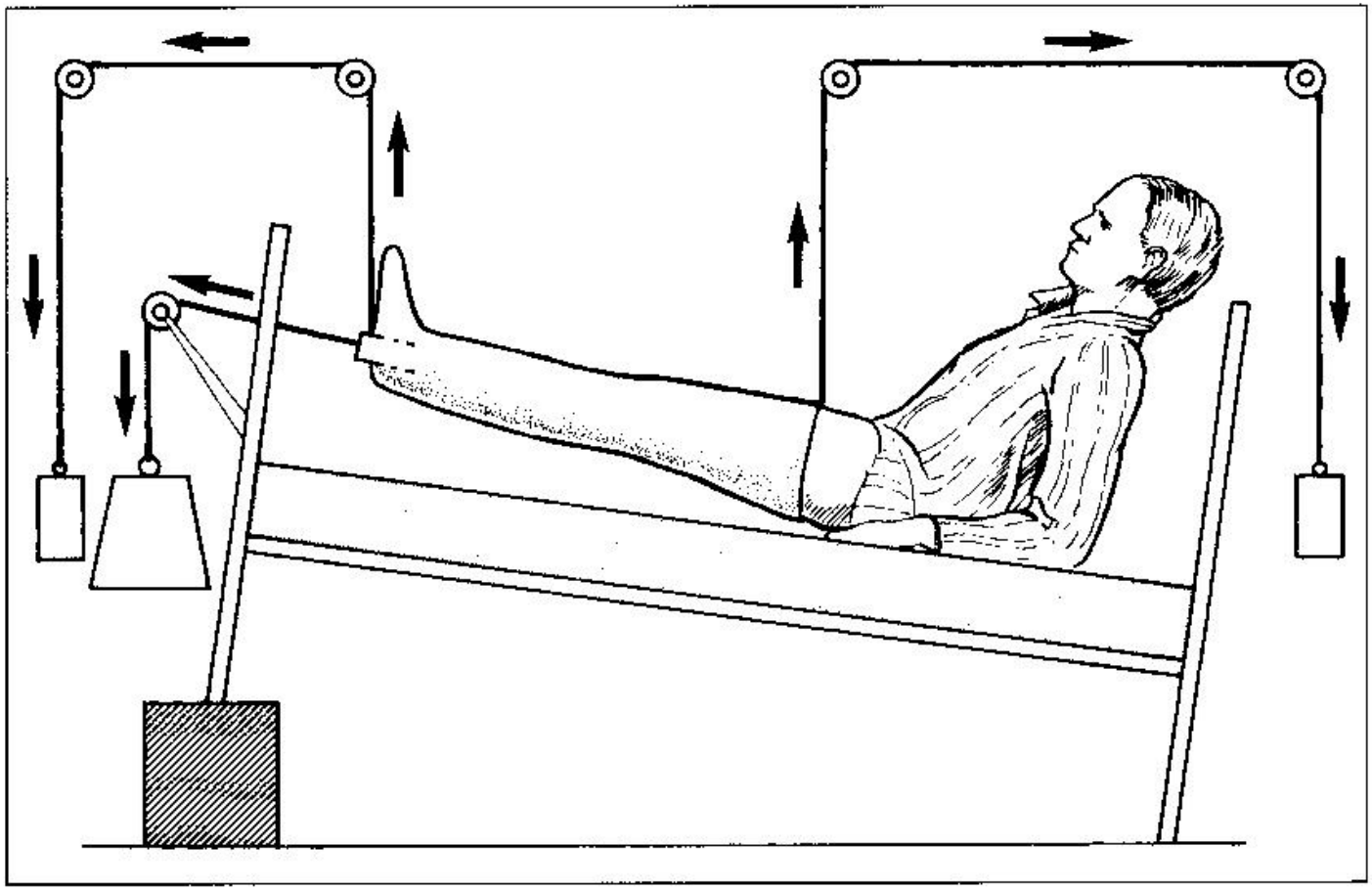
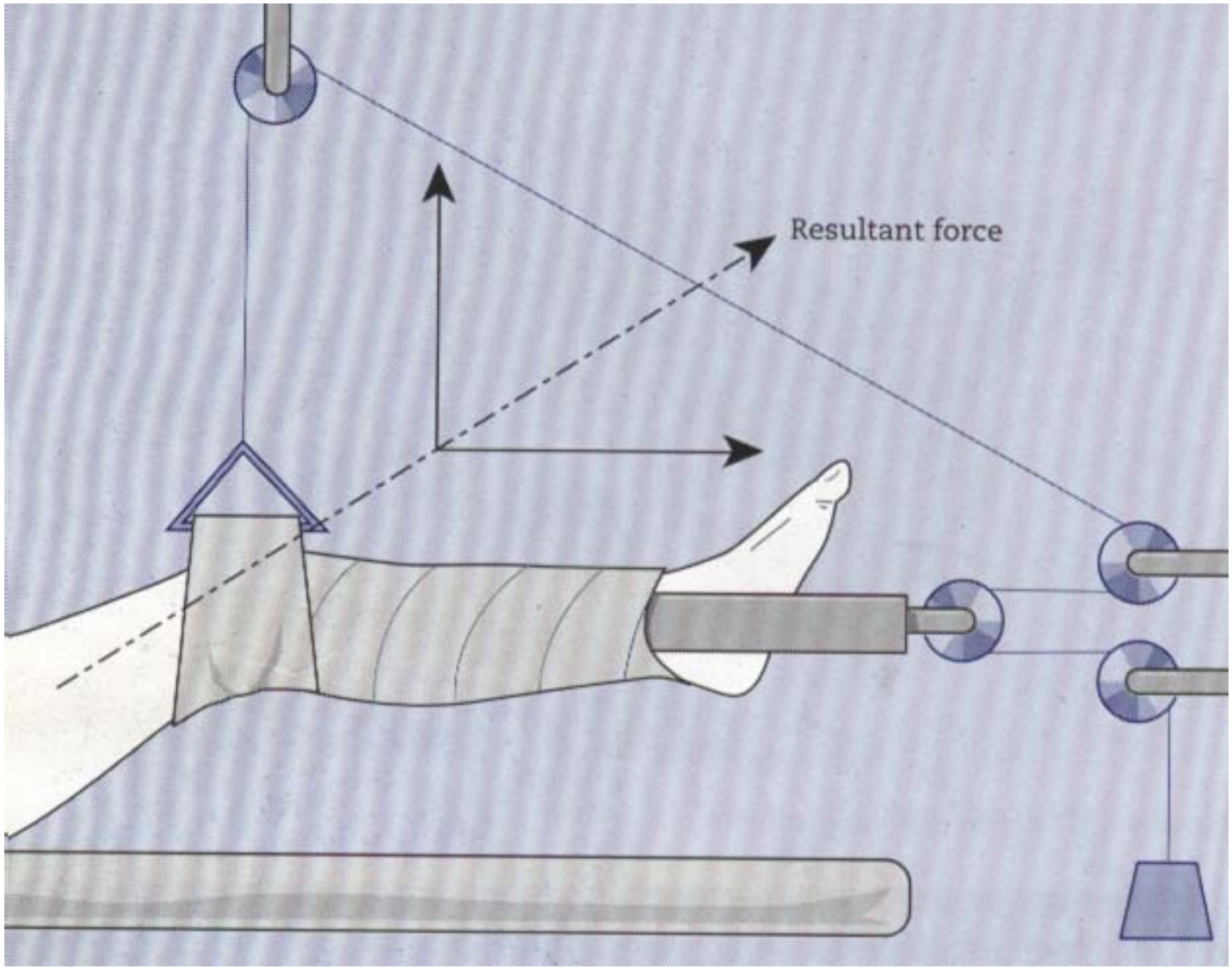


Fig. 9.8 Balanced sliding traction. One weight applies longitudinal traction and others are applied to the upper and lower ends of the limb so that it 'floats' in a gravity-free field.

Balanced traction



Balanced traction

External splints, slings, braces

- Splint = any device that holds a fracture steady
- Cast = devices that set hard around the limb and hold the limb straight
- Pressure must be applied to the cast so that the bones are held by 3-point pressure

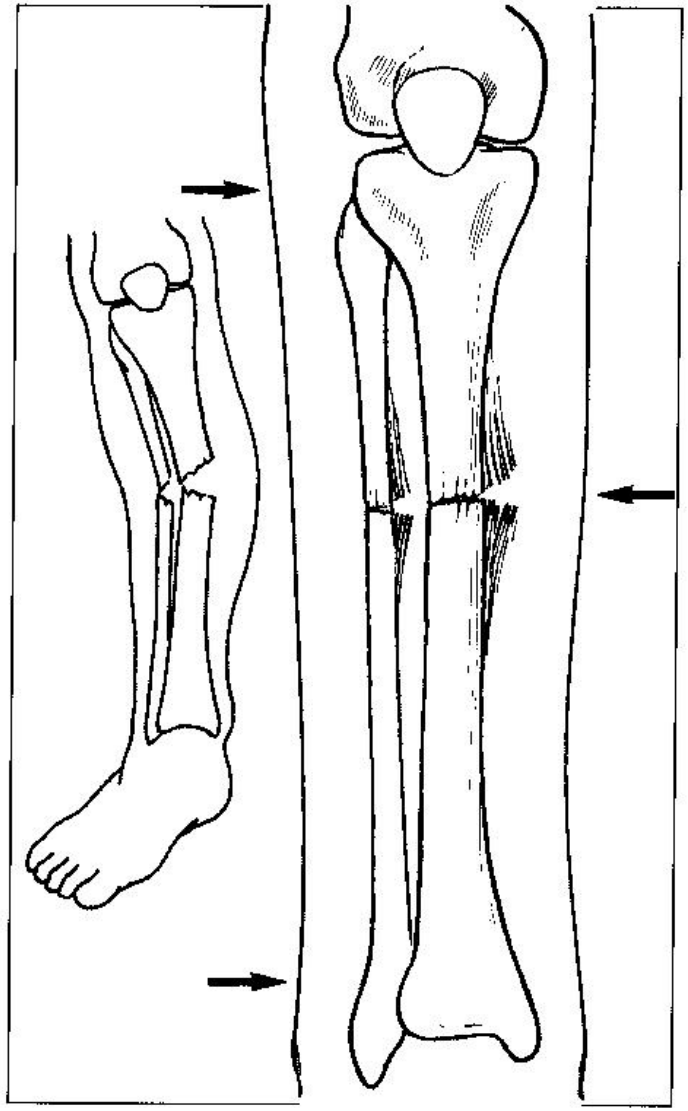
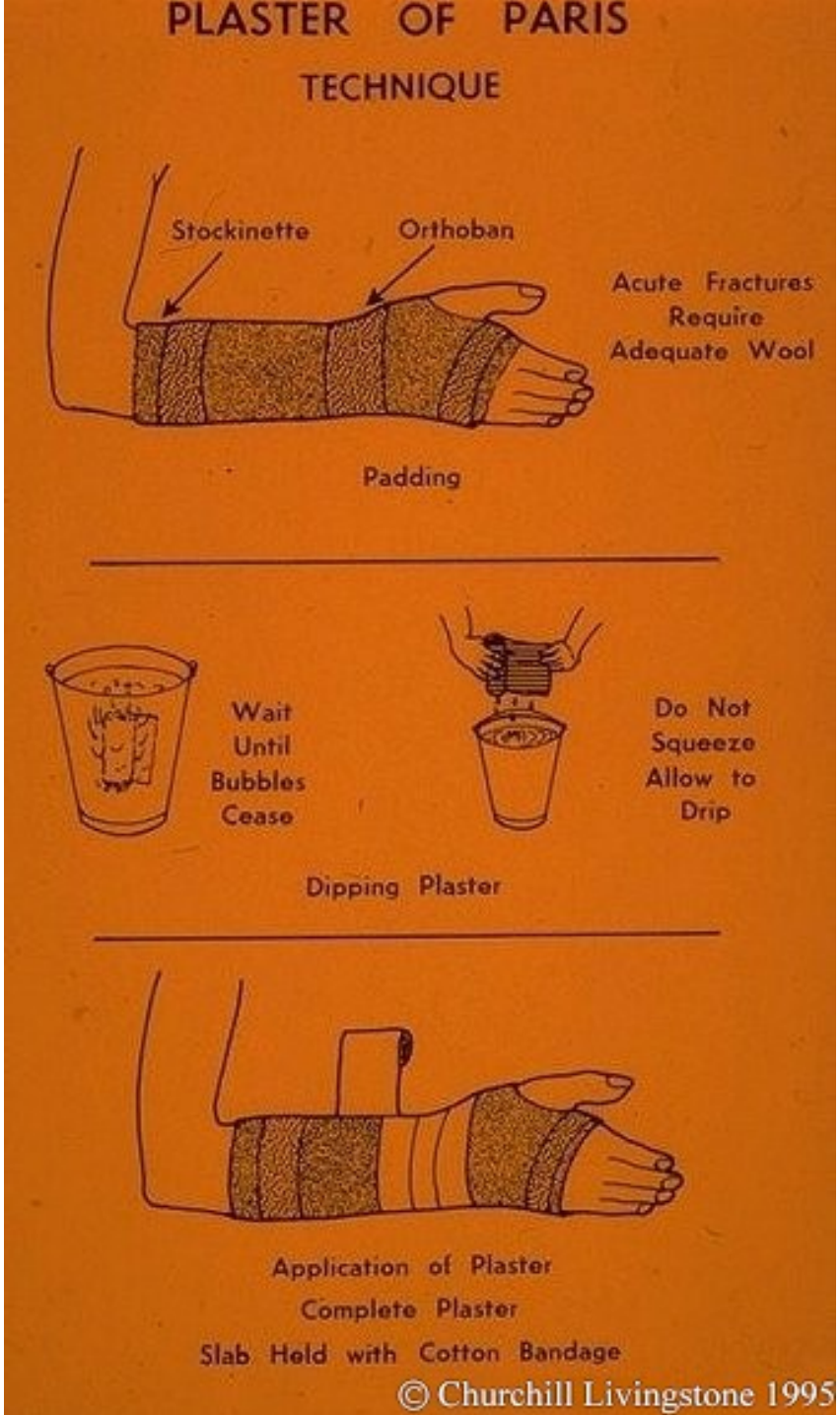


Fig. 9.9 Three-point pressure. The fracture line is closed by pressure at three points.

Plaster of Paris is the cheapest and easiest method of holding an unstable fracture after closed reduction.

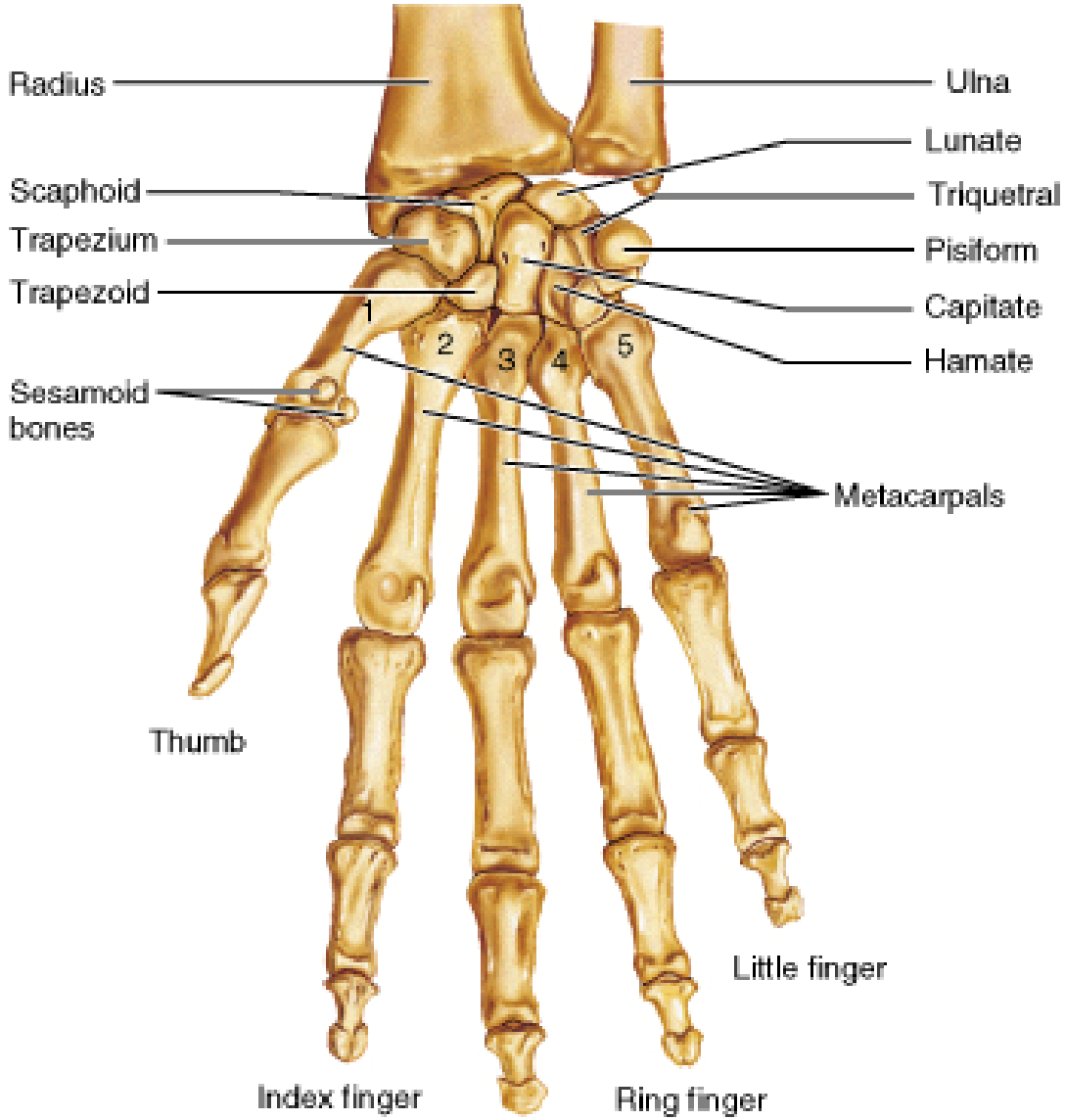


Pathological fracture due to a secondary deposit in the mid shaft of the humerus (metastasis).

Will require early operative internal fixation followed by radiotherapy.

This shows a plaster back slab used to hold the reduction of a **Colles' fracture**.

The **scaphoid** skelecast
is the ideal lightweight type of support.
This is because scaphoid fractures do
not usually require prior manipulation.

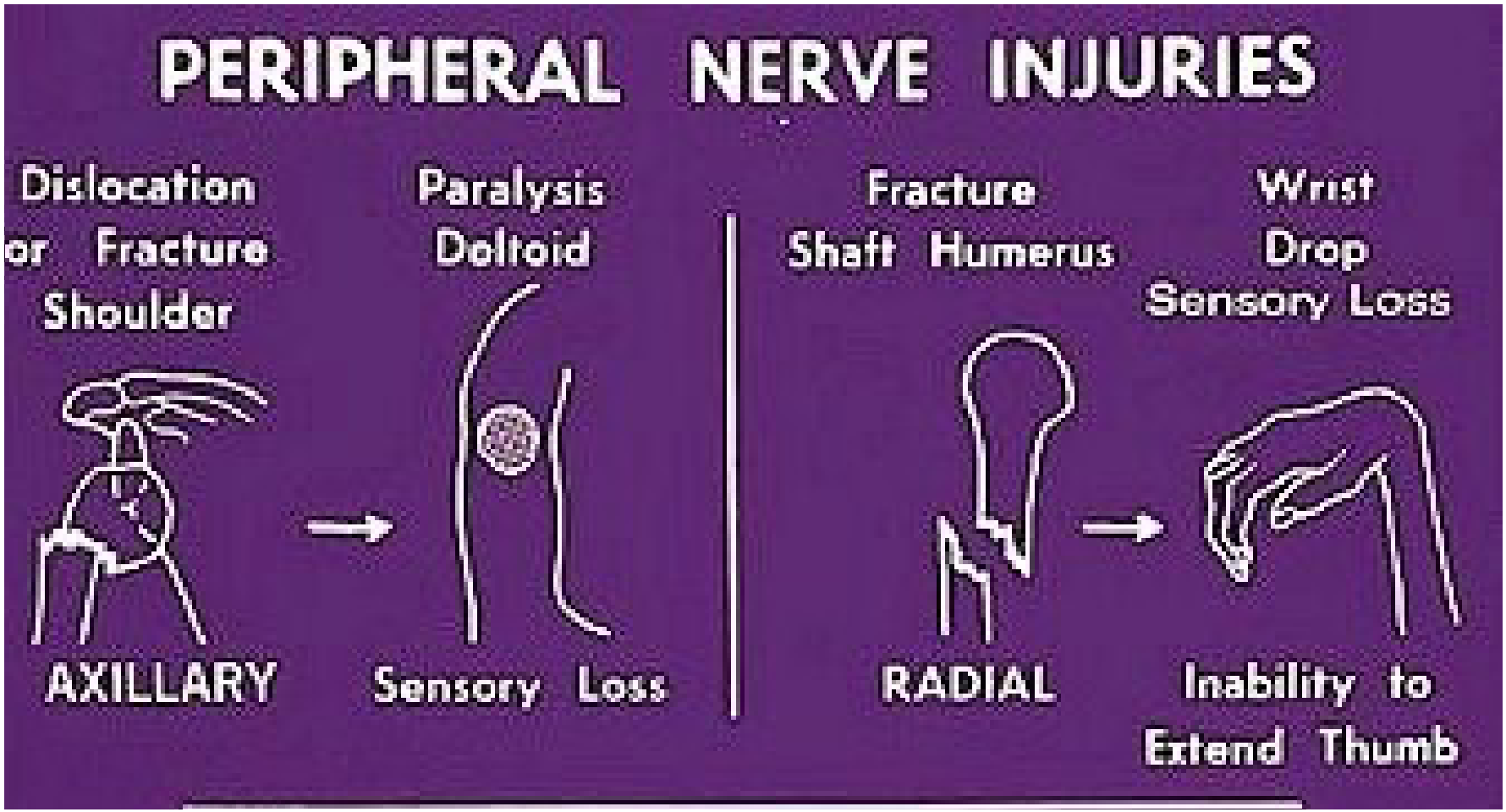


(a) Anterior view

This support weighs about one seventh of the weight of Plaster of Paris.

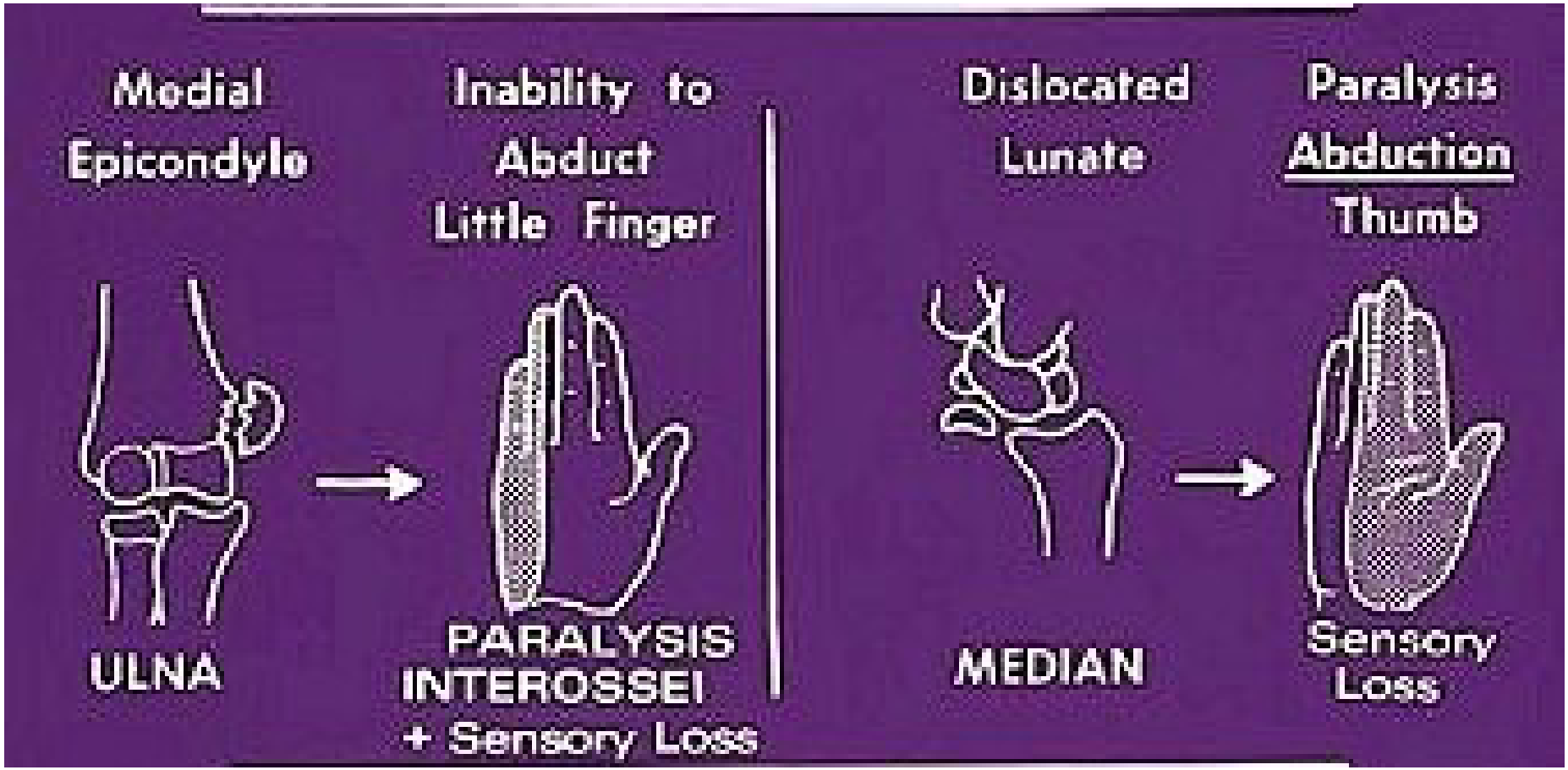
Fractures immobilized in a **skelecast** have been found to heal more quickly than when held with hot heavy complete plaster encasement.

A **knee hinge** can also be easily added to allow the knee to bend, as illustrated.



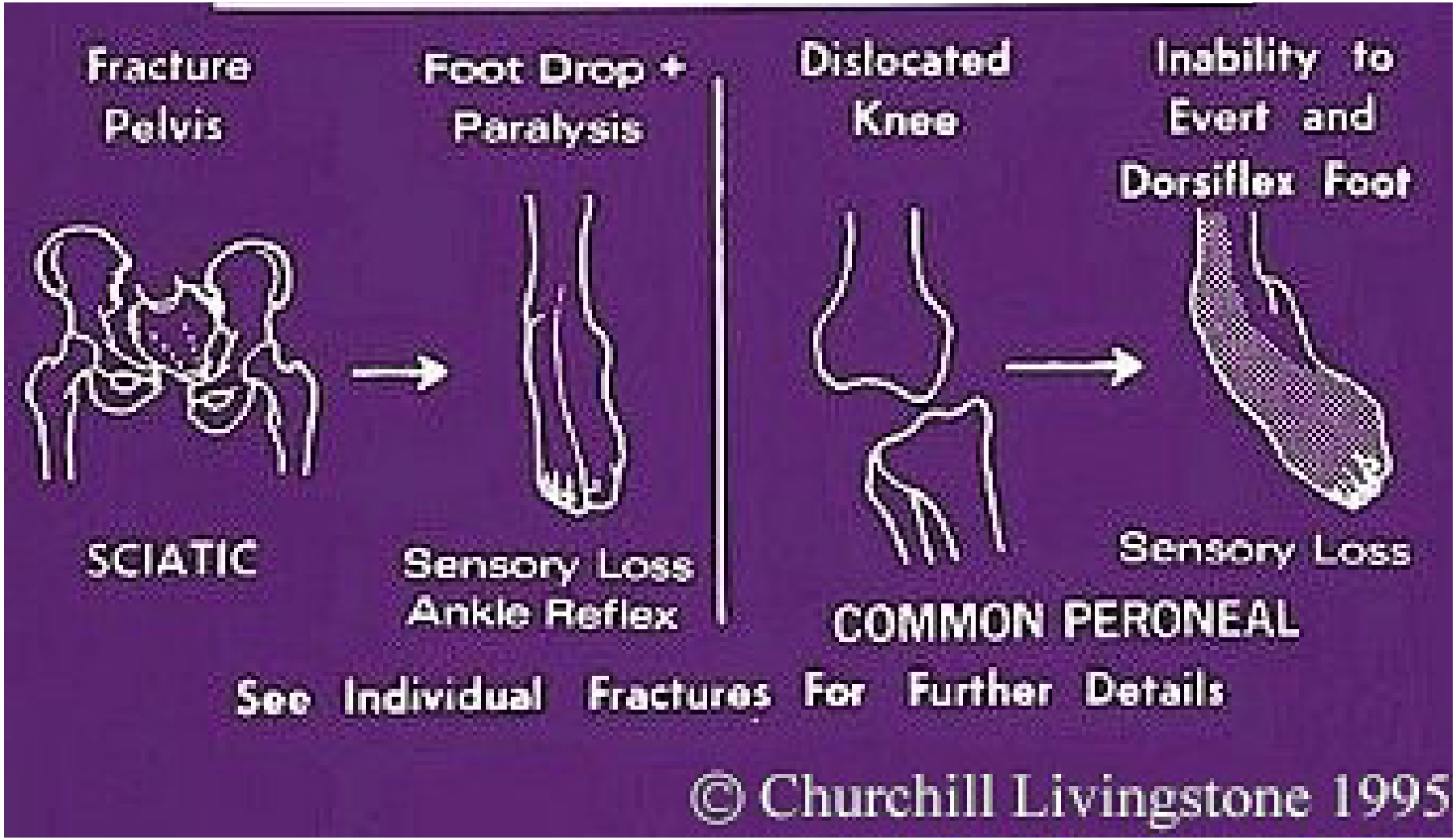
Damage to the **axillary nerve** from fractures of the neck of the humerus and dislocations of the shoulder.

Fractures of the mid shaft of the humerus may cause a **radial nerve** palsy.



Fractures of the medial epicondyle causing an **ulnar nerve** paralysis.

Dislocation of the lunate causing a **median nerve** palsy.



Posterior dislocation of the hip, and a vertical force fracture dislocation of the pelvis may cause a **sciatic nerve** palsy.

Dislocated knee may damage the **common peroneal nerve** as well as the popliteal vessels.