Bone healing. Fracture management

Imre SZERB MD, PHD
Uzsoki Hospital, Department of Orthopaedics, Budapest, Hungary
Bone Healing
Hematoma Formation (1st) (Inflammatory Phase)

- Fracture hematoma
  - blood from broken vessels forms a clot.
  - 6-8 hours after injury
  - swelling and inflammation to dead bone cells at fracture site
Hematoma Formation (1st) (Inflammatory Phase)

- Hematoma forms in medullary canal and surrounding soft tissue in first 6-8 hours
- ~4 days (acute inflammation)
Cellular Formation Phase (2\textsuperscript{nd}) (Reparative Phase)

- Influx of endosteal cells from cambium layer
Callus Formation Phase (3rd) (Reparative Phase)

- Fibroblasts deposit collagen in the granulation tissue
- **Soft Callus** is formed lasts 3-4 weeks (Unorganized network of woven bone)
Osteoblast
Fibroblast
Collagen fiber
Chondroblast
Cartilage

Fibrocartilaginous callus formation
- Internal callus (grows quickly to create rigid immobilization)
- The size of the callus is affected by the immobility of the fracture site; the smaller the amount of movement, the smaller the callus.
Callus Phase continued

- The hard callus lasts 3-4 months.
- **Hard callus** – a gradual connection of bone filament to the woven bone (Acts like a temporary splint)
- Bone is beginning to strengthen and immobilize
- If proper immobilization does not occur; **cartilage** will form instead of bone
Ossification Phase (4th) (Reparative Phase)

- will occur with adequate immobilization
- Bone ends become crossed with a new Haversian system that will eventually lead to the laying down of primary bone
3 Bony callus formation

Spongy bone

Osteoblasts
Ossification Phase (4th) cont.

- Fracture is bridged and united
Remodeling Phase (5th)

- Remodeling hard callus to compact bone
- May take a few years
- Completed when the fractured bone has been restored to its original form or shape or when it can withstand the imposed stresses placed on it
- Bone remodelling
  - Osteoclasts remodel woven bone into compact bone and trabecular bone
  - Often no trace of fracture line on Xrays.
Conditions that interfere with fracture healing

- Poor blood supply to the fractured area; could lead to avascular or aseptic necrosis
- Poor immobilization of fracture site may cause malalignment or deformity
- Infection – more common with open fractures
Bone healing after a fracture
Fracture of the second metatarsal
10th April 2002
8 weeks to the start of the World Cup
- Fibrocartilaginous callus (lasts about 3 weeks (up to 1st May))
  - new capillaries organise fracture hematoma into granulation tissue - 'procallus'
  - Fibroblasts and osteogenic cells invade procallus.
  - Make collagen fibres which connect ends together
  - Chondroblasts begin to produce fibrocattilage
Bony callus
(after 3 weeks and lasts about 3-4 months (8th May))
- osteoblasts make woven bone.
England v Argentina 7th June 2002
Fracture management

Imre SZERB MD, PHD
Statistics

- Fractures of extremities are the most common
- More common in men up to 45 years of age
- More common in women over 45 years of age
- Before 75 years wrist fractures (Colles’) most common
- After 75 years hip fractures most common
Types of fractures

- Depend on the magnitude and direction of force
- Closed
  - Bone fragments do not pierce skin
- Open/compound
  - Bone fragments pierce skin
- Displaced or undisplaced
Types of Fractures: Transverse fracture (Pattern)

- Usually caused by directly applied force to fracture site
Types of Fractures: Spiral or oblique

- Caused by violence transmitted through limb from a distance (twisting movements)
Types of Fractures: Comminuted fracture (Morphology)

- More bone pieces - high energy trauma
- The distal piece is described in relation to the proximal piece
Comminuted fractures can require serious hardware to repair.
Greenstick

- Occurs in children:
  bones soft and bend without fracturing completely
Type of Fractures: Proximal Fractures (Location)

- Fracture can involve the joint: Intraarticular
- results in malalignment of joint surfaces.
Crush fractures

- Fracture in cancellous bone: result of compression (osteoporosis)
Avulsion fracture

- Caused by traction, bony fragment usually torn off by a tendon or ligament.
- What muscle group attaches to this bony prominence and what nerve also runs in close proximity?
- Forearm flexors (common flexor origin)
- Ulnar nerve
Impacted fracture

- Bone fragments are impacted into each other.
X-ray Parameters of Fractures

- Localises fracture and number of fragments
- Indicates degree of displacement, angulation, rotation, shortening
- Evidence of pre-existing disease in bone
- Foreign bodies or air in tissues
- May show other fractures
Initial Treatment of Fractures

- Reduction, which can be accomplished by either closed (external realignment) or open (direct operative method)
Fracture Management: Reduction

- **Closed reduction**
  - Usually with anaesthesia

- **Traction**
  - Fractures or dislocation requiring slow reduction

- **Open reduction**
  - Allows very accurate reduction
  - Risk of infection
  - Usually when internal fixation is needed ORIF
Fracture Management: Fixation (Holding the reduction)

- 4-12 weeks
- External fixation
  - Plaster of Paris casts
  - Fixateur externe
  - Traction
  - Frame fixation
- Internal fixation
  - Intramedullary nails, compression plates, screws
Fixation (External Method): Plaster cast

- It can be considered as a conservative treatment
Fixation (External Method): External fixation

Used for fractures that are too unstable for a cast.
You can shower and use the hand gently with the external fixator in place.
Fixation (External Method): Traction
Fixation (External Method): Frame fixation

Allows correction of deformities by moving the pins in relation to the frame.
Fixation: Internal fixation