



Fracture healing

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Fracture Healing

- Healing of fractures is in many steps.
- Fracture begins to heal as soon as the bone is broken, and through a continuous series.
- Steps of healing of cortical bone(FROST, 1989) :
 - 1.Stage of haematoma
 - 2.Stage of granulation tissue
 - 3.Stage of callus
 - 4.Stage of remodelling (formerly called consolidation)
 - 5.Stage of modelling (formerly called remodelling)

1.

Hematoma Formation



2.

Granulation Tissue Formation (Inflammation)



3.

Callus Formation



4.

Consolidation



5.

Bone remodelling



1. Stage of Haematoma

- Lasts up to 7 days.
- When the bone is fractured, blood leaks out through torn vessels in the bone and forms a haematoma between and around the fracture.
- The periosteum and local soft tissues are stripped from the fracture ends, results in ischaemic necrosis of the fracture ends over a variable length, usually only a few mm.
- Due to deprived blood supply some osteocytes die whereas some are sensitised to respond subsequently by differentiating into daughter cells, which contribute to the healing process later on.

Stage of granulation tissue

- Lasts for about 2-3 weeks.
- The sensitised daughter cells produce cells which differentiate and organise to provide blood vessels, fibroblasts, osteoclasts etc.
- Collectively they form granulation tissue in the space between fracture fragments.
- This loose fibrous mesh serves as a framework for the ingrowth of fibroblasts and new capillaries.

3. Stage of Callus

- Lasts for about 4-12 weeks.
- In this stage the granulation tissues differentiate further and creates osteoblasts.
- These cells lay down an intercellular matrix which soon becomes impregnated (Soak) with calcium salts, and results in callus formation (woven bone).
- Callus is first sign of union visible in X-ray.

4. Stage of remodelling

- Woven bone is replaced by mature bone .
- It is a slow process and takes from 1-2 years.

5. **Stage of modelling:** Bone is gradually strengthened.

- Shapening of cortices occurs at the endosteal and periosteal surfaces
- The major stimulus to this process comes from the weight bearing stresses and the muscle forces when the person resumes activity.

Healing of Cancellous bones

- Follows a different pattern
- The bone one is of uniform spongy texture and has no medullary cavity.
- Union can occur directly between the bony trabeculae.
- Subsequent to haematoma and granulation formation, mature osteoblasts lay down woven bone in the intercellular matrix, and the two fragments unite.

Primary and Secondary fracture healing

- **Primary fracture healing** occurs where fracture haematoma has been distributed, as in fracture treated operatively.
- The bone heal directly, without callus formation, and it is therefore difficult to evaluate union on X-rays.
- **Secondary fracture healing** Occurs in fractures where fracture hematoma is not disturbed. As in cases treated non operatively.
- There is healing with callus formation, can be evaluated on X-rays.

Factors affecting fracture healing

- Age of the patient
- Type of bone
- Pattern of fracture
- Disturbed patho-anatomy
- Type of reduction
- Immobilisation
- Open fractures
- Compression of fracture site

References

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