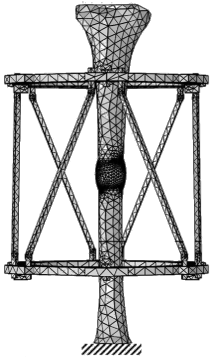
Bone fracture healing under Ilizarov fixator: Influence of fixator configuration, fracture geometry, and loading



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Bone fracture healing

Primary bone healing

- Every day process
- Requires absolute stability

- Plate fixation
- intramedullary nailing

Secondary bone healing

- Occurs with relative stability
- Involves callus formation - new bone

- External fixation

Secondary bone healing

- Bone ends are not in direct contact
- Relative motion between bone ends - Interfragmentary movement (IFM)
- Bone healing is influenced (theories) by Interfragmentary strain (IFS)

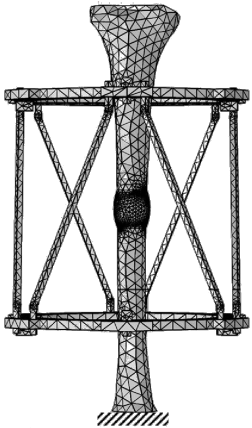
- Found 10 different mechanoregulation measures in literature

Generally, 2–10 % engineering strain is desired

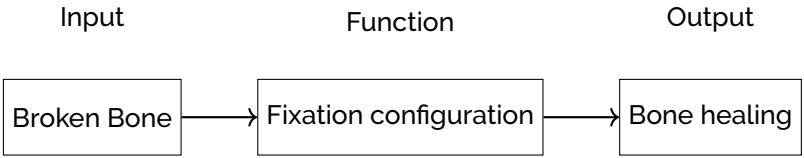
Ilizarov fixator

- Circular rings
- Tensioned wires - k-wires - 1.5–1.8 mm
- Half pins - Schanz screws - 3–6 mm
- Threaded rods

Taylor Spatial Frame (TSF)



Focus of the talk



Finite element model

- Second order tetrahedral elements - all parts
- $\approx 215\,000$ elements
- Convergence criteria:
  - 0.1 mm for displacement (Absolute)
- Mesh convergence study
  - ≤ 2 % difference between meshes considered converged