Trends in Fracture management a progressive evolution

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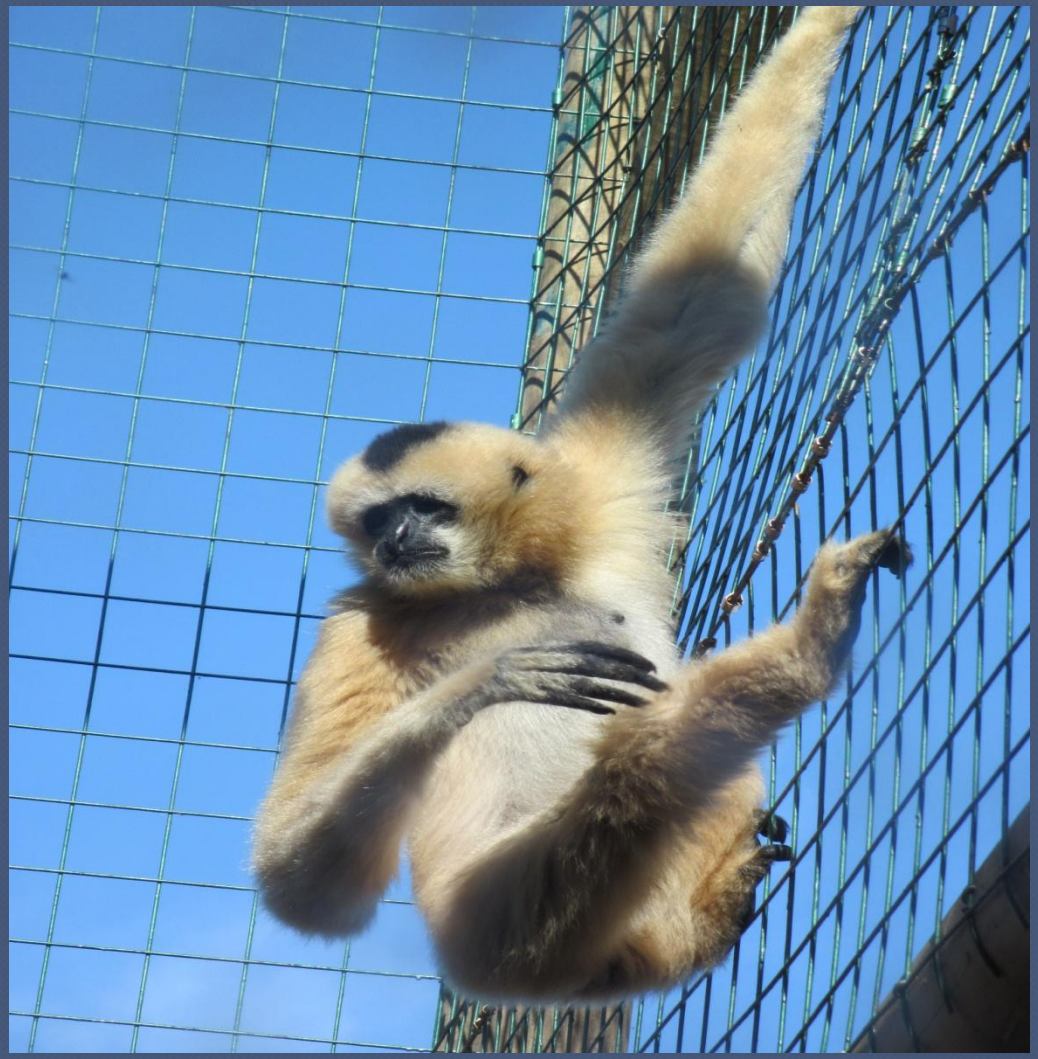
- 20th October 2009

MAIN OBJECTIVES: Review of development of Orthopaedics – where and when and what next.



The Path to Perfection?

Fractures in our animal world.

- Limb Injuries / fractures very common in nature
- Certain animals can regenerate lost limbs (lizards, starfish)
- Mammals can not

History overview: Egyptians 300BC

- **Imhotep** (Edwin-Smith Surgical Papyrus) describes reduction of fractures, immobilisation with splints and bandages

- **Archaeological excavations**
  Specimens of healed or splinted fractures

History overview: Egyptians 300BC

Fracture forearm with a splint from a mummy of the 5th dynasty

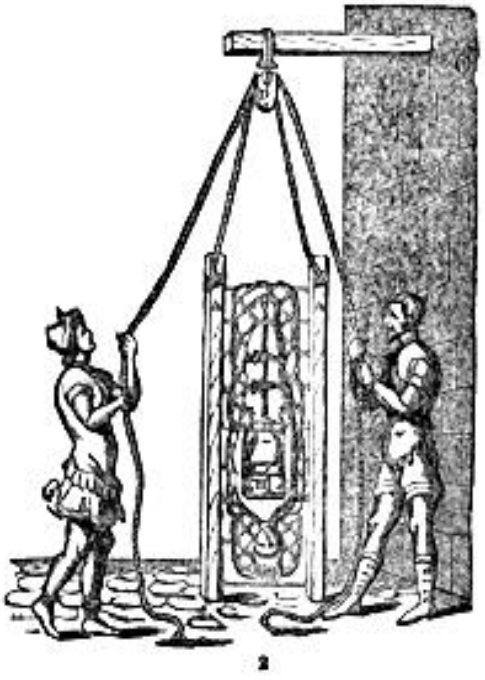
History overview: Greeks 400BC

- **Hippocrates**

  - describes reduction of fractures and dislocations with mechanical aids

  - innovating bandaging techniques (wine and oil)

  - first fracture table



History overview: Greeks 400BC

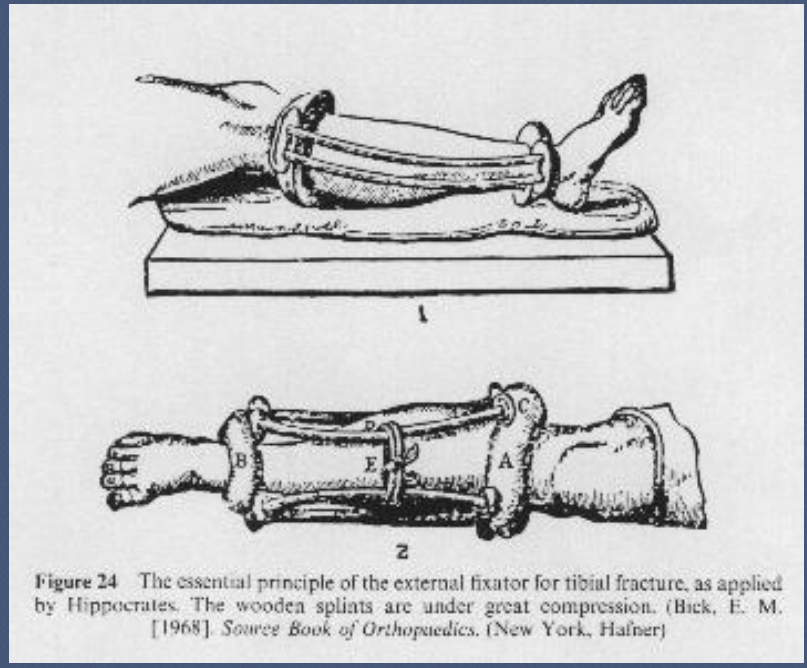


Figure 24 The essential principle of the external fixator for tibial fracture, as applied by Hippocrates. The wooden splints are under great compression. (Bick, E. M. [1968]. *Source Book of Orthopaedics*. (New York, Hafner)

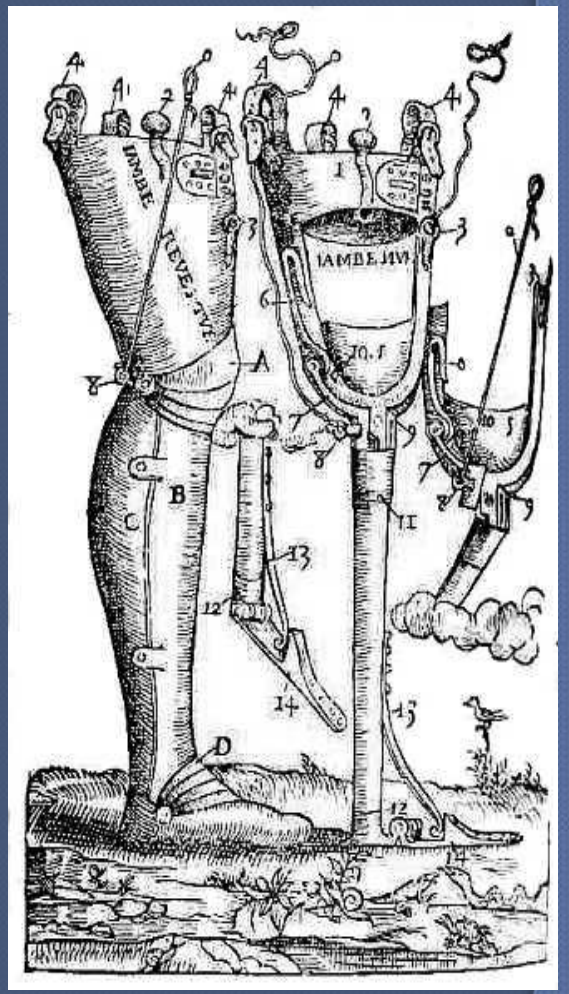
History overview: Ambroise Pare 1540

- **French Military Surgeon**

- Described manipulation of coccyx fracture
- Described fracture of patella

- Described treatment of hip fractures

- Developed various prosthesis



History overview: 19th Century

- **Mathijesen 1852**

  - Dutch army surgeon

  - Use of Plaster of Paris to immobilise fractures

History overview: Guy de Chaulliac 1363

- **French Surgeon**
  - "Book of Fractures"
  - Used ointments
  - Presbribed isometric traction by weight attached to a cord and passing through a pulley

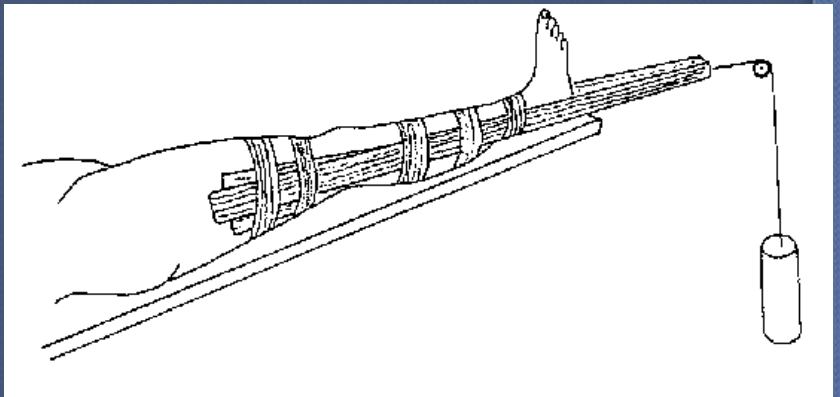


Figure 148
SKIN TRACTION: counter-traction from the weight of the patient inclined at 45°

History overview: Romans 160AD

- **Galen**
  - Great anatomist
  - Described a wide variety of bandages including a spica

History overview: Arabs 1000AD

- **Rhazes, Avicenna and Albucassis**

  - Practiced open reduction

  - Treatment of malunion with excision of callus

  - Plasters made with mill dust and eggs

The Birth of Orthopaedics

- Surgical texts 4th to 5th Century – Hippocrates
- Orthopaedics – in mid 19th Century
- Surgical approaches limited
- End of 19th Century :

Introduction of anaesthesia, anti-sepsis, x-rays revolutionalised orthopaedic-trauma

- General surgeons in trauma – till mid 20th Century.
- 1741 Nicholas Andry – Paris, translated Orthpaedia from two Greek words – straight /child

Turning point

- 19th Century benchmarks
  The word Science – William Whewell of Cambridge -1837
- Industrial Revolution, science and technology

- The Microscope – belated use

- The Science of Bacteriology

Orthopaedics and Trauma

- End of 19th Century :

Introduction of anaesthesia, anti-sepsis, x-rays revolutionalised orthopaedic-trauma

- General surgeons in trauma – till mid 20th Century.

In the beginning

- First 40 years of Orthopaedics spent correcting deformities and paralytic deformities

- Treatment options – splinting, manipulation and tenotomy

X-rays

- W. C. Rontgen physicist in Wurzburg –
- Robert Jones had a boy patient – pellet in wrist
- Oliver Lodge of Liverpool made exposure.
- Robert Jones – as Inspector Military Ortho – WW1
- First link between orthopaedics and fractures – by Harry Platt who established fracture clinic in Manchester.

Trauma surgery

- Jacques Delpech Prof of Surgery Montpellier involved in care of war wounded. Environment
- Percival Pott 18th century, full surgeon age 75
- Hunter – 1728-1793 – growth and repair of bone., researcher. Formation of sequestrum.
- William John Little, foot deformity and efforts

Advent of Antisepsis

- John Lister 1827-1912 – Glasgow Royal Inf.
- Inspiration by Louis Pasteur
- Principles – attention to technique – access of organisms.
- Carbolic spray
- William Halstead at John Hopkins Hospital 1889 – rubber gloves
- Gauze masks by Johann Mickulicx-Radecki 1897
- Robert Koch 1843 – 1910: germ theory
- By 1883,autoclave –moist heat under pressure

Facts to remember from St Bartholomew's Hospital, 1865

- 397 beds
- Average operations during preceding five years – 370, of which 78 were amputations ~ 20%

Fracture fixation

- William Arbuthnot Lane (1856-1943) earliest to practice internal fixation of fractures – ''Operative Treatment of fractures' – 1905
- Lane – pioneer but his plates were poor
- 1887 American Orthopaedic Association
- 3rd Nov 1894 – Br Ortho Society - ceased 4yrs years.
- BOA founded in 1918
- Germany – 1929, Trauma added 1936
- 1937 Girdlestone appointed in Oxford Prof

The facts that don't change

- In order to survive we developed efficient processes of skeletal repair and remodelling
- The biological process of fracture healing has never changed
- Mechanical methods we use on fractures aid this process but not substitute it

History overview: 19th Century

- **Lister 1865**
  - Scottish Surgeon
  - First to apply antiseptic principles to the treatment of fractures

- **Thomas 1875**
  - developed a splint for immobilising fractures
  - splint saved many lived during WW1

History Overview: 19th Century

The splint – Thomas

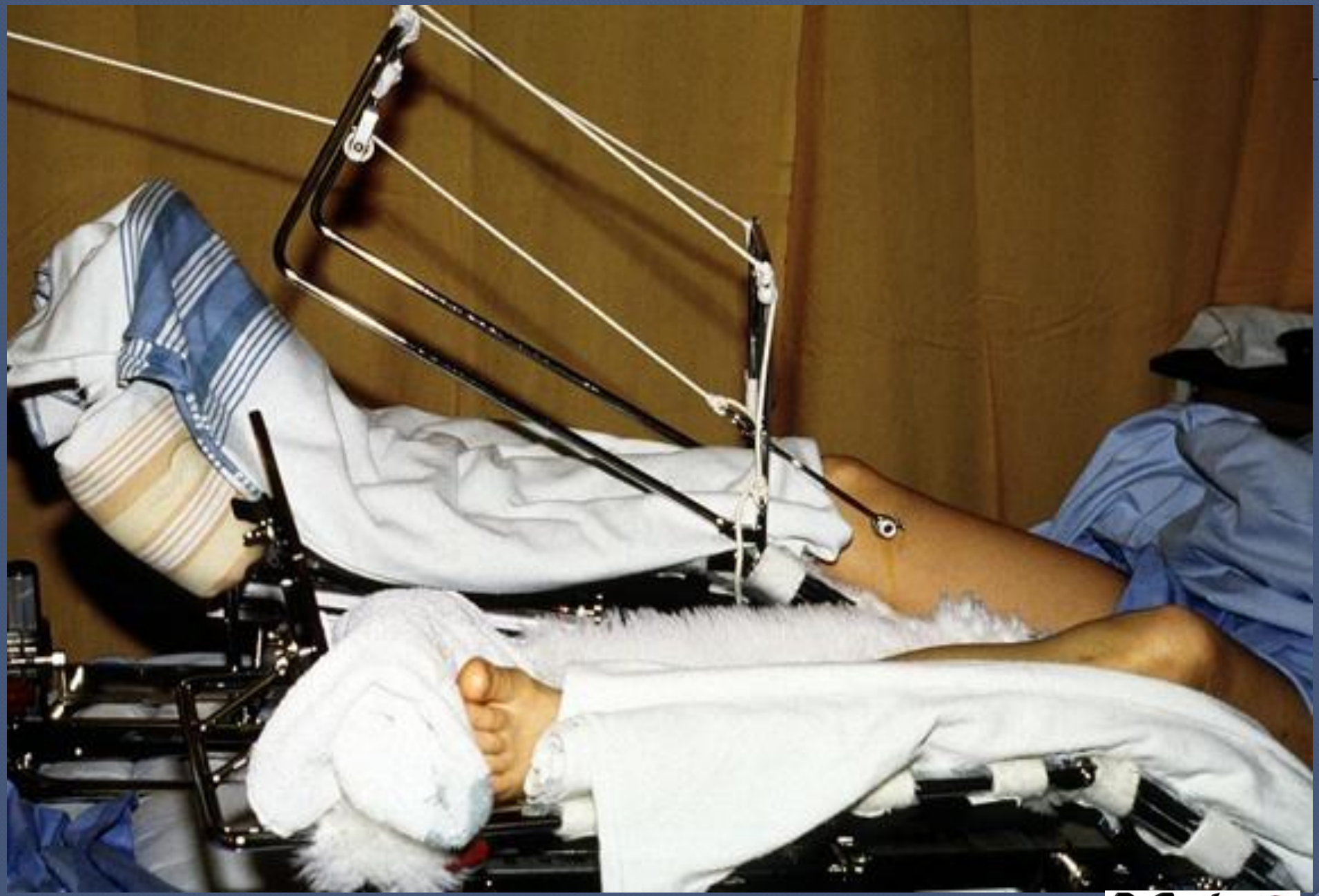
History overview: 20th Century

- **Steinman 1907**
  - German Surgeon
  - Described skeletal traction

- **Kirschner 1927**
  - Developed fixation of fractures with thin wires

- **Charnley 1950**
  - Developed techniques of fracture reduction

History overview: 20th Century



Orthopaedic splinting- Precursors of POP

From antiquity until 1852:

- Wooden splintage
  - Ancient Egypt, Hippocrates, Celsus
- Clay gum mixtures, flour and egg (Arabs)
- Lime & white of egg (Arabs)

Plaster of Paris

- **Mathijesen 1852**
  - Use Plaster of Paris

Traction

- For reduction of fractures (Hippocrates, Galen)
- First continuous traction (Guy de Chauliac)
- Established as acceptable treatment (Albert Hoffa)

Traction

Functional bracing

- 1767 Gooch – First Description
- 1900 Sarmiento - Established
- 1970 Mooney - Hinged casts

Wire Fixation

- Bone suture 1827 – Dr Kenny Rodgers USA

- Cerclage wire 1851 – Dr Berenger France

Screw & Plate Fixation

- **Screw Fixation**
  - 1850 Cucuel and Rigaul – France described 3 cases of fracture patella and ulna and sternum

- **Plate Fixation**
  - 1886 Hansmann - Germany (20 patients)
  - 1890 Lambotte – France → Term of Osteosynthesis

Intramedullary Nailing

- **Aztec's in Mexico 16th Century**
  - Wooden sticks in canals of patients with non-union

- **1890 Gluck Germany**
  - Ivory nail with holes at the end for interlocking

- **1931 Smith Pattersen**
  - First Stainless steel nail

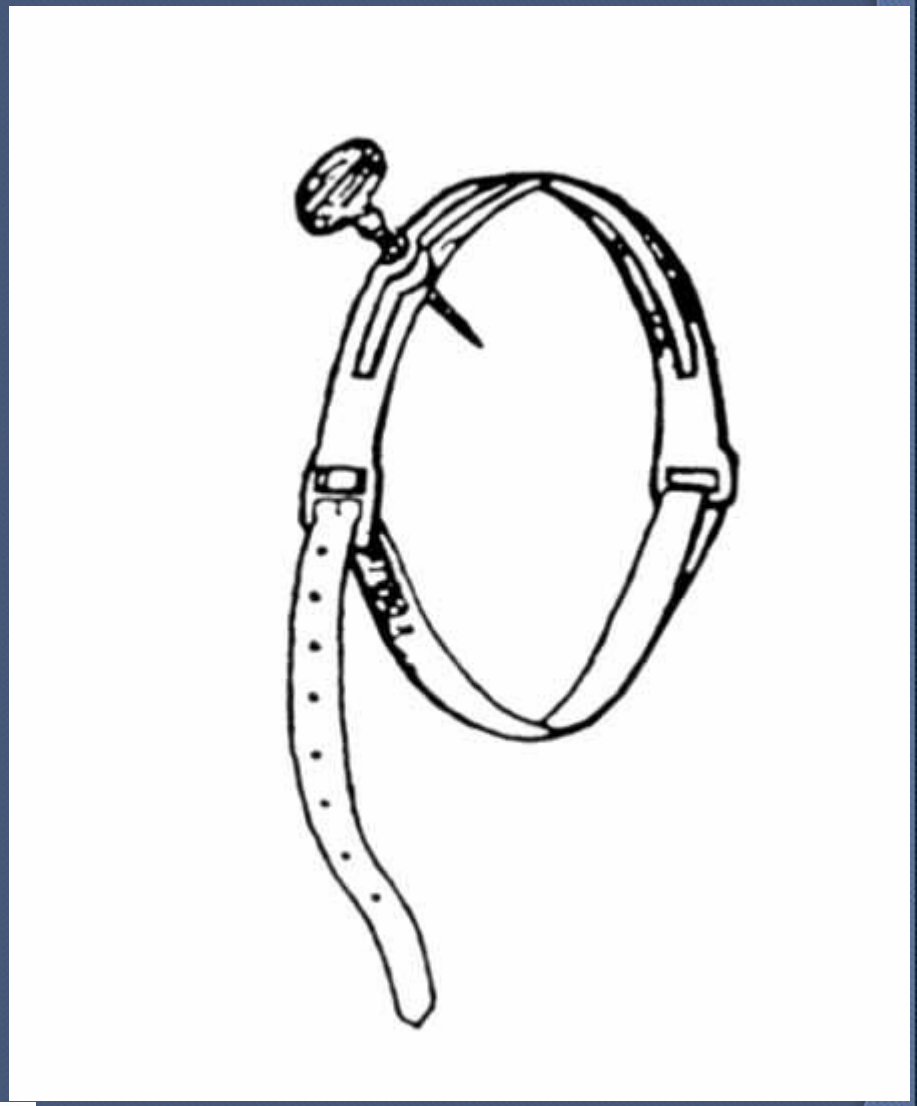
Intramedullary Nailing

- **1939 Geghard Kuntcher**
  - Established as treatment

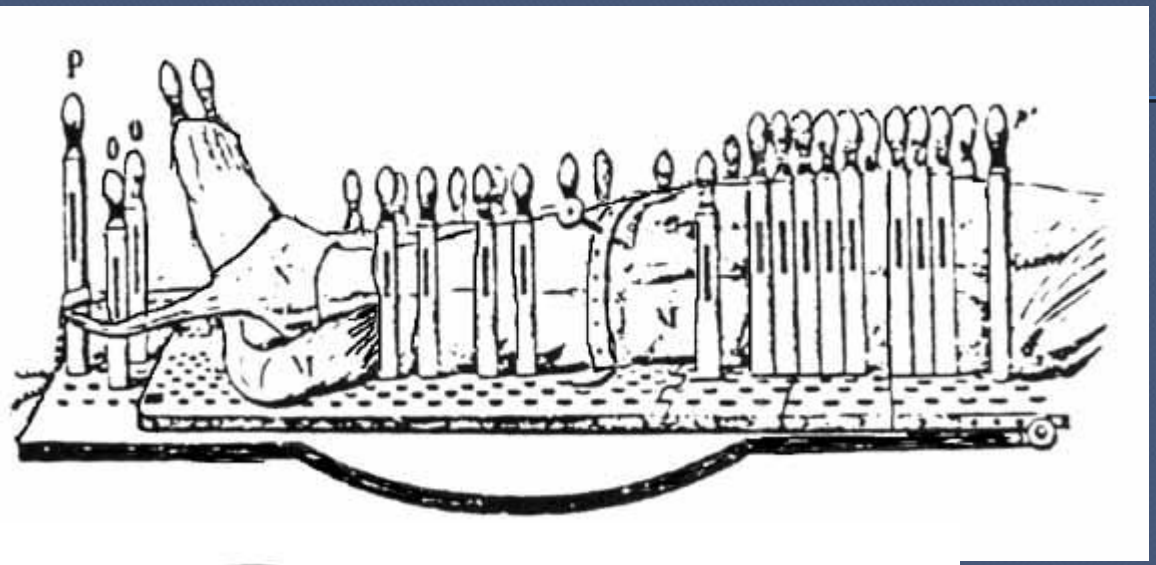
- **1942 Fischer**
  - Use of Reamers

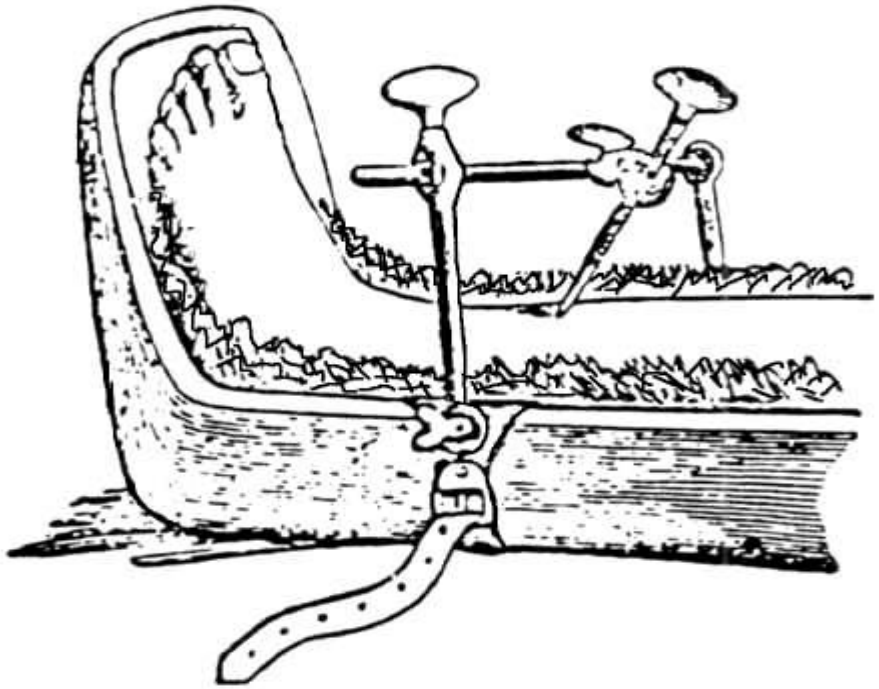
External Fixators

- **1840 Malgaigne**
  Treatment of tibial #
→ leather strap with pin



External Fixators



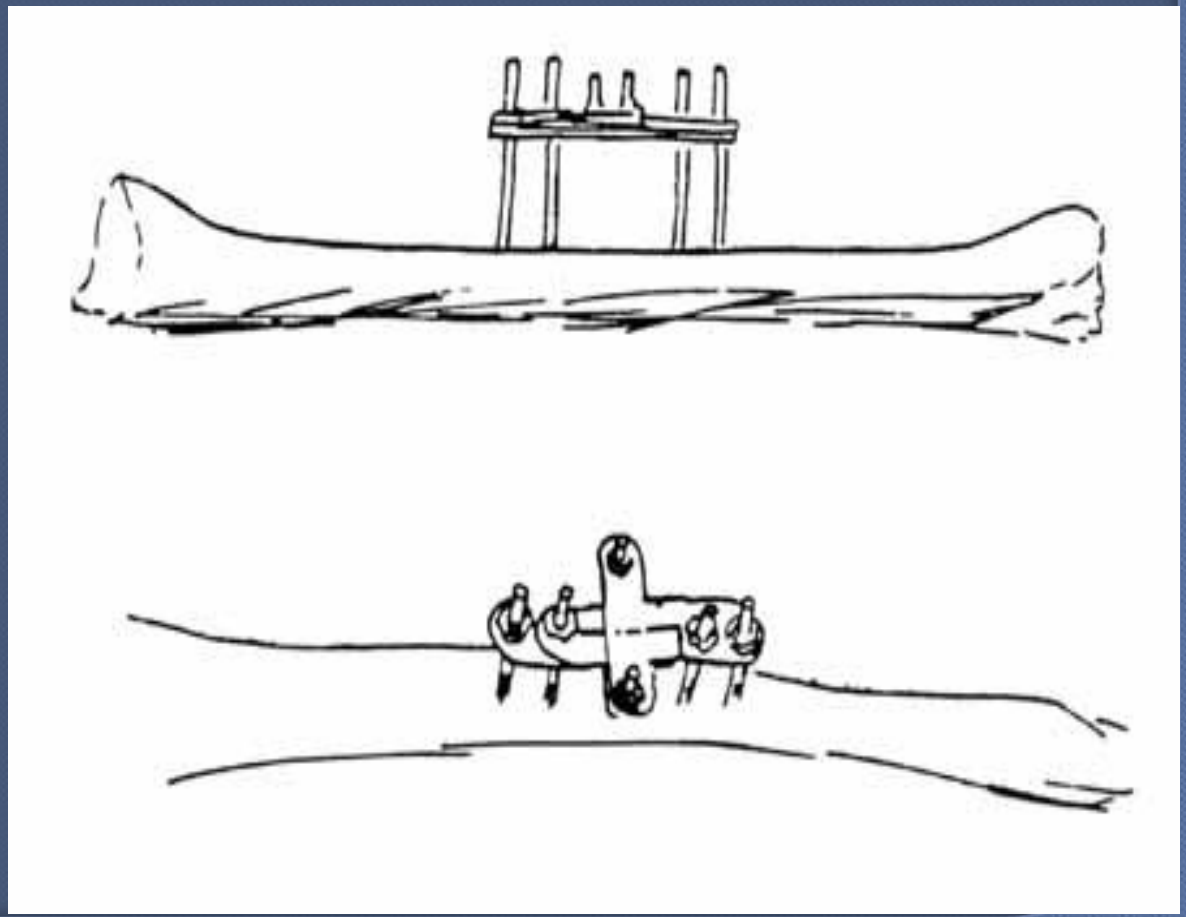


Modified by Olier

External Fixators

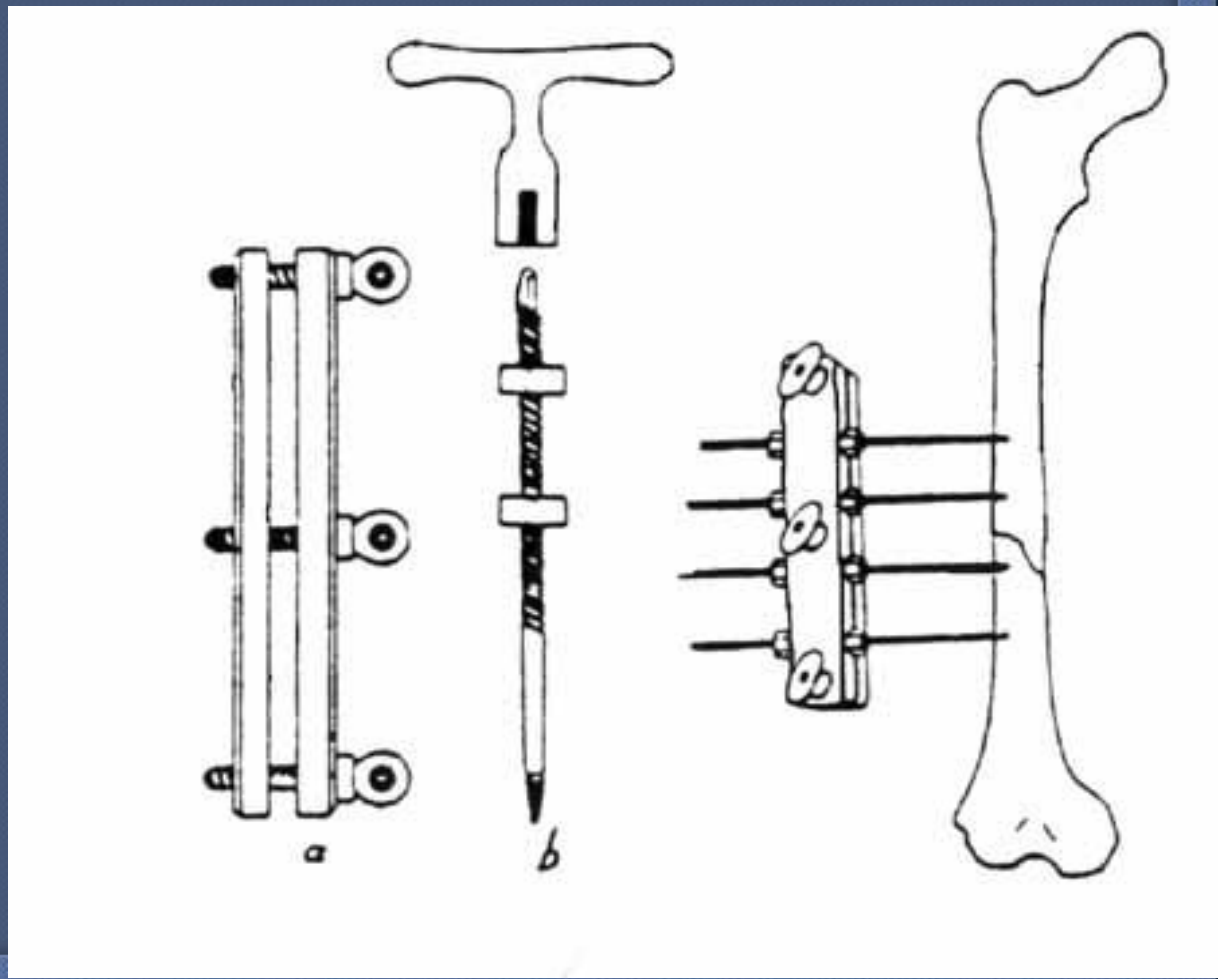
- **Parkhill 1894 USA**

- Pins implanted to bones and connected by plates externally



External Fixators

- **Lambotte 1902 Belgium**
  - First External Fixator Device



Distraction Osteogenesis

- **Gavril Ilizarof – Siberia 1950s**
- Slow, steady distraction of recently cut bone → formation of new bone
- Circular frame

The AO Group

- Switzerland 1958
- 13 Orthopaedic surgeons
- Aim to put science on surgical management of trauma

The AO Group

- Practised evidenced based medicine
- Standardisation of implants
- Largest educational group in orthopaedic traumatology

Biology of bone healing

- **Reactive phase**
  - Fracture
  - Inflammation

- **Reparative phase**
  - Callus formation
  - Lamellar bone deposition

- **Remodelling phase**

Enhancement to bone healing

- **Osteoinduction**

Recruitment of immature cells and stimulation of those to develop to osteoblasts

- **Osteoconduction**

Pnenomenon of bone growing on a surface (implants, etc)

Bone healing depends mainly on osteoinduction

Bone Grafts

- **Osteoconductive**
  Bone graft acts as a scaffold for new bone growth
- **Osteoinductive**
  Bone graft triggers recruitment of immature cells to develop osteoblasts
- **Osteogenic**
  Osteoblasts from graft contribute to bone growth

Bone Grafts: Types

- **Autografts**

- Bone from the same individual
- Osteoinductive, osteoconductive and osteogenic

- **Allografts**

- Bone from a different individual
- Osteoonductive, possibly osteoinductive but not osteogenic

Bone Grafts: Types

- **Xenograft**

- Bone from another species such as bovine
- Osteoconductive but not osteoinductive or osteogenic

- **Alloplastic grafts**

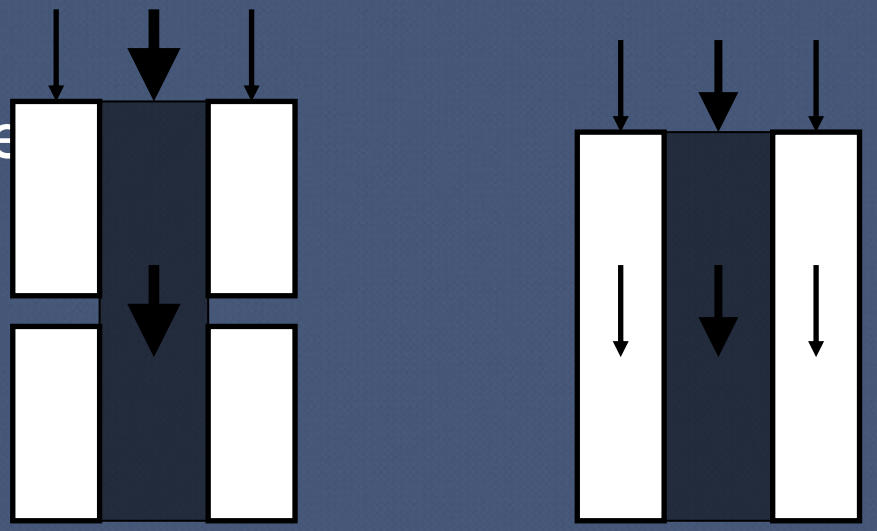
- From hydroxyapatite
- Osteoconductive only

- **Growth factor Enhanced grafts**

Early detection and prediction of fractures

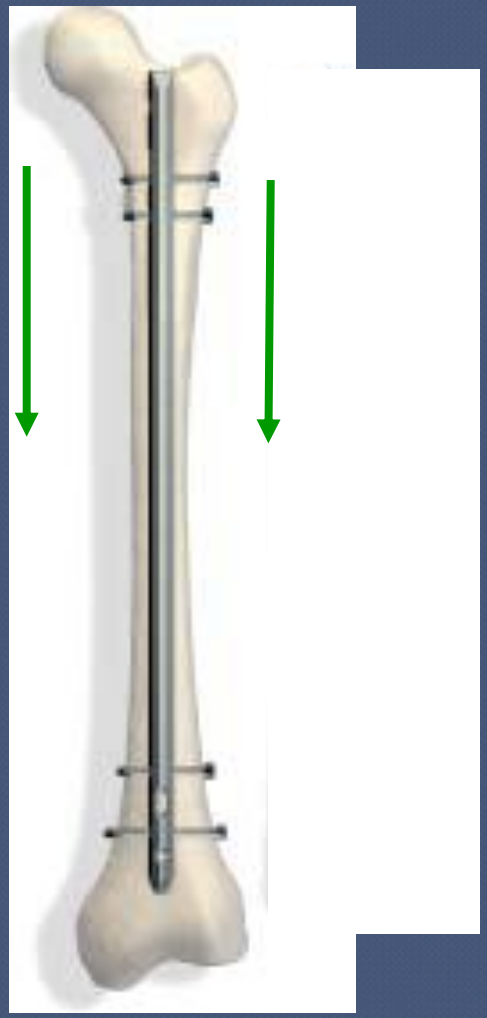
- Measurement of bone density – Osteoporosis
- Genes that predispose to lower bone density
- Biochemical markers of bone turnover such as urine osteocalcin

- What is an IM Nail? (Biomet – six slides for teaching)
- Why Use an IM Nail?
  - Biomechanical Advantage
  - Minimally Invasive
  - Return to Function

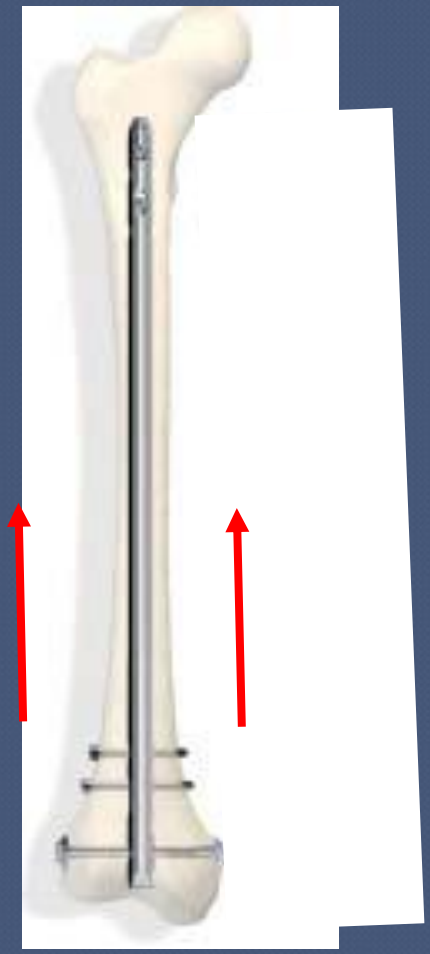


Antegrade vs Retrograde

Antegrade



Retrograde



Radius of Curvature

Piriformis Fossa

2M - 3M Radius of Curvature

In line with the Medullary canal

Greater Trochanter

M/L Valgus Bend

2M Radius of Curvature

Easier to locate off starting point axis

IM Reaming

- To Ream
  - Allows excellent IM splinting of the fracture and use of a larger diameter, stronger nail
  - With the currently available nails, the placement of large diameter nails with an intimate fit along a long length of the medullary canal is no longer necessary
  - Potential negative effects are elevated IM pressures, elevated pulmonary dysfunction, increased fat embolism

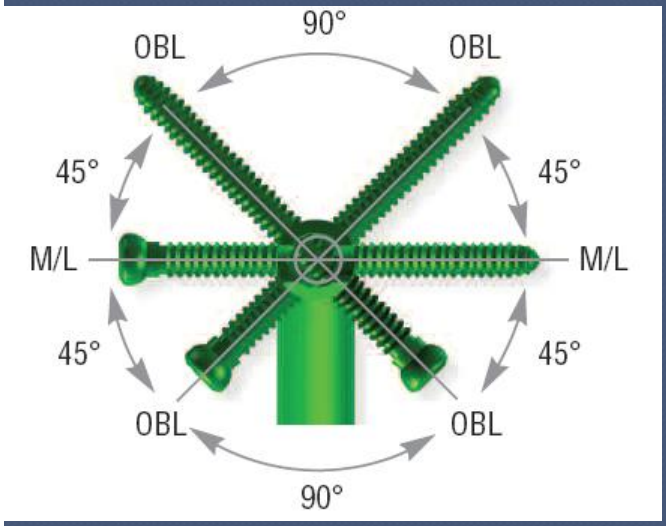
Not to Ream

- Designed to preserve the endosteal IM blood supply in open fractures where the periosteal supply has been destroyed

- Disadvantage is that it is significantly weaker than the larger reamed nails ???

Important Things To Know

Number of cross locking screws allows control over **Alignment, Length & Rotation**



Surgical Technique

- Blocking Screws
- The principle of the use of a blocking screw is to prevent posterior nail passage by decreasing the effective diameter of the canal and directing the nail more anterior

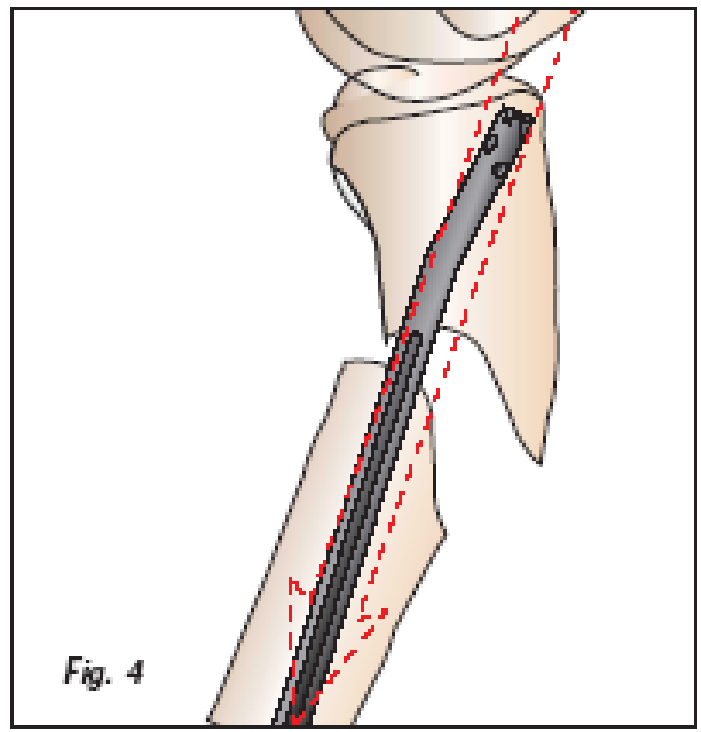


Fig. 4

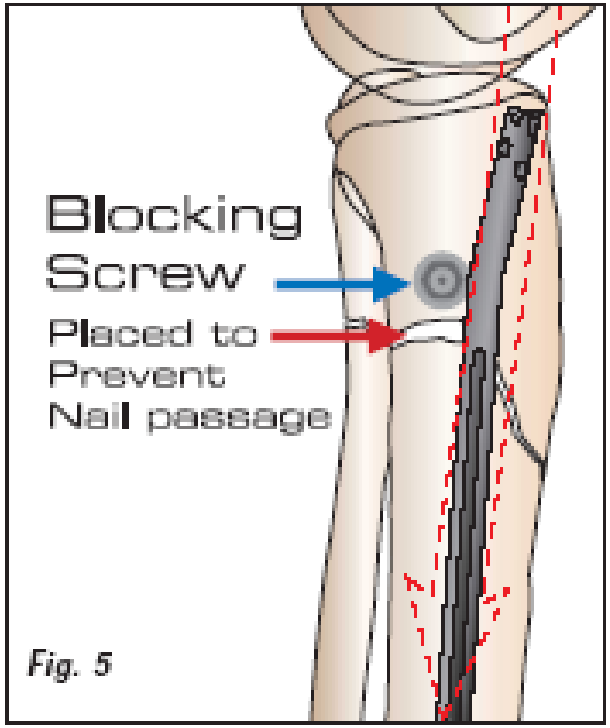


Fig. 5

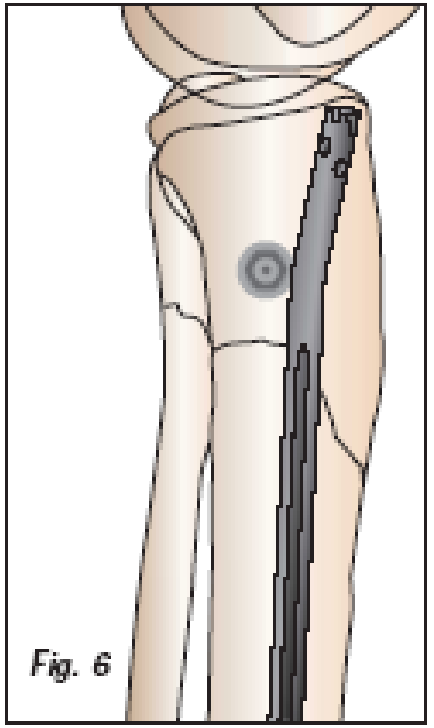


Fig. 6

Doubts or frontiers of knowledge?

- Enhancement of bone tissue growth in the laboratory
- Enhancement of bone healing by electrical, ultrasound, magnetic stimulation?
- Creation of new bones/limbs
- Gene therapy

Look back in time and see whether you can make it safely better. THANK YOU

References

- W. Clark. History of fracture treatment up to 16th century. JBJS Am. 1937;19;47-63
- Rockwood and Green's. Fractures in adults
- Bartonicek. History of fractures of the proximal femur. JBJS Br.2002;84B;795-797
- Browner. Skeletal Trauma 4th edition.
- Leslie Klenerman. The Evolution of Orthopaedic Surgery.2001.
- Dick Blackwell's training package – Biomet