Trends in Fracture management
a progressive evolution

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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
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, Halsted)
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
Mathijesen 1852

- Dutch army surgeon
- Use of Plaster of Paris to immobilise fractures
Guy de Chaulliac 1363

- **French Surgeon**
  - "Book of Fractures"
  - Used ointments
  - Prescribed isometric traction by weight attached to a cord and passing through a pulley
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 revolutionised orthopaedic-trauma
- General surgeons in trauma – till mid 20th Century.
- 1741 Nicholas Andry – Paris, translated Orthopaedia from two Greek words – straight /child
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 19\textsuperscript{th} Century:
  Introduction of anaesthesia, anti-sepsis, x-rays revolutionised orthopaedic-trauma

• General surgeons in trauma – till mid 20\textsuperscript{th} Century.
In the beginning

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

• Treatment options – splinting, manipulation and tenotomy
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
- 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 4 yrs 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 lives 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)
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 Berenguer 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
1840 Malgaigne
Treatment of tibial #
→ leather strap with pin
External Fixators

Modified by Roux

Modified by Olier
External Fixators

- **Parkhill 1894 USA**
  - Pins implanted to bones and connected by plates externally
Lambotte 1902 Belgium
- First External Fixator Device
Distraction Osteogenesis

- **Gavril Ilizarof – Siberia 1950s**
- Slow, steady distraction of recently cut bone $\rightarrow$ 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**
  Phenomenon 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
  - Osteoconductive, 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

In line with the Medullary canal

Greater Trochanter

Easier to locate off starting point axis

2M - 3M Radius of Curvature

M/L Valgus Bend

2M Radius of Curvature

= 2M - 3M Radius of Curvature
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
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.
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

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