ORTHOPAEDICS INTERNATIONAL

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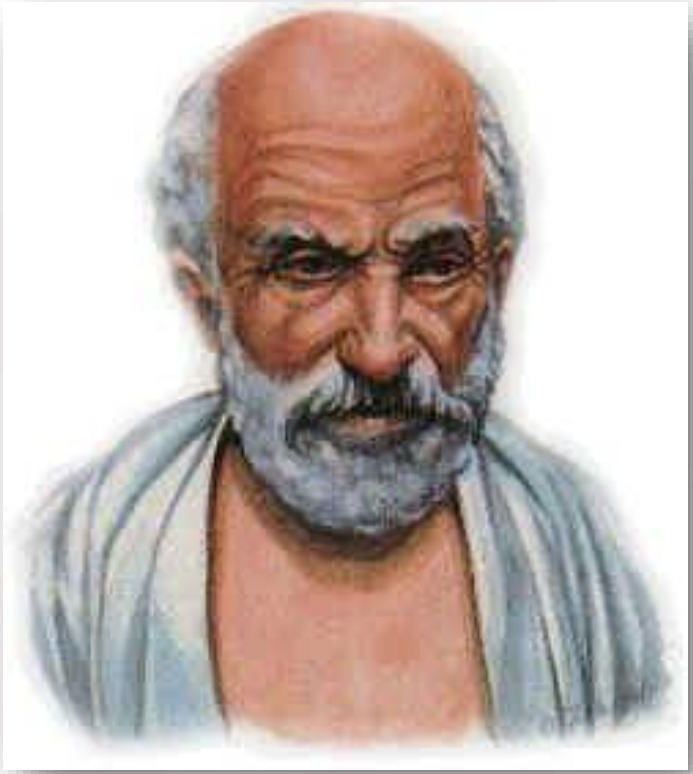
Medical Aid International
Supporting Healthcare in Low Resource Environments

External Fixation History and Training

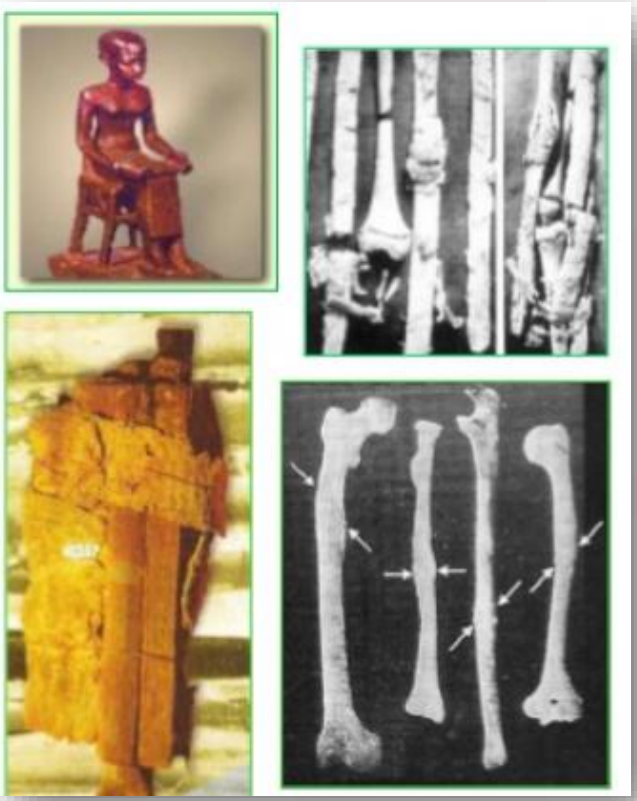
History of External Fixation



“he who desires to practice surgery must go to war”

Hippocrates c400BC

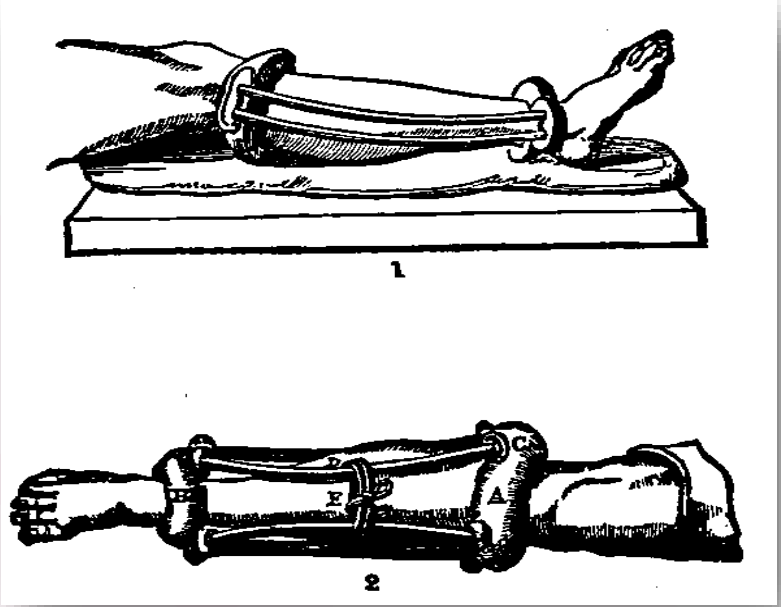
Ancient Egypt – 5000BC



Splints

Evidence found on mummies made from bamboo, reeds and wood or bark, padded with linen

377BC - fracture splinting

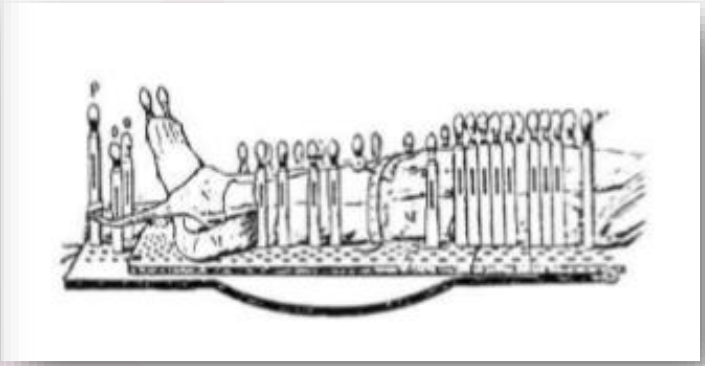


Hippocrates first documented the external fixator

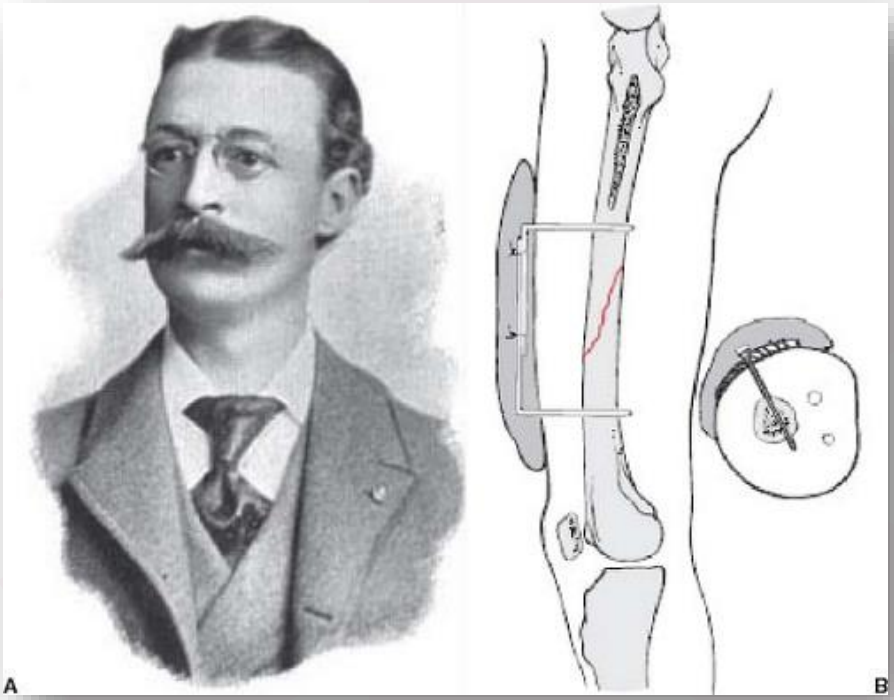
1840 Jean-Francois Malgaigne

Credited with been first to produce an external fixation device using a crude pin

1893 - Keetley fixator



1894 - Clayton Parkhill

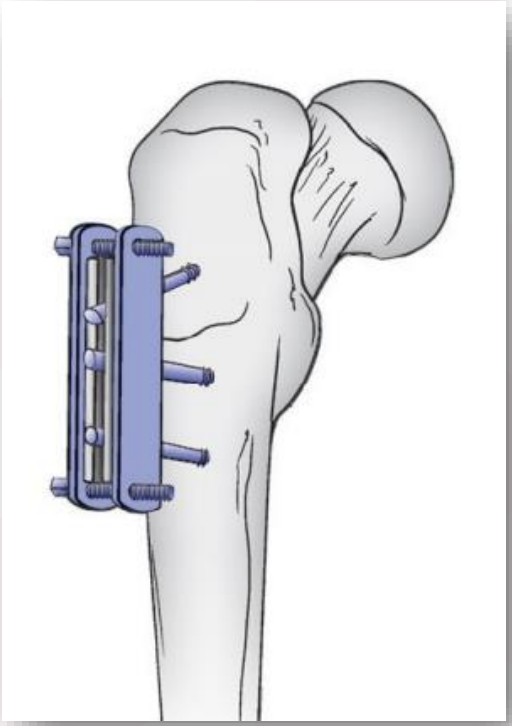


‘more accurate fixation of the bones’

Bone Clamp

Wooden pins!

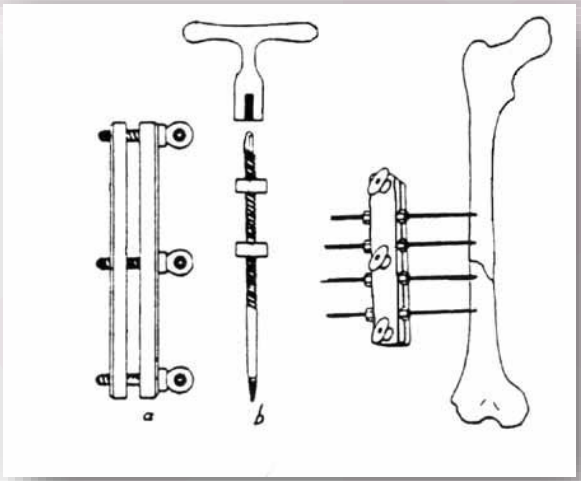
1902 - Freeman fixator



Belgian physician Lambotte

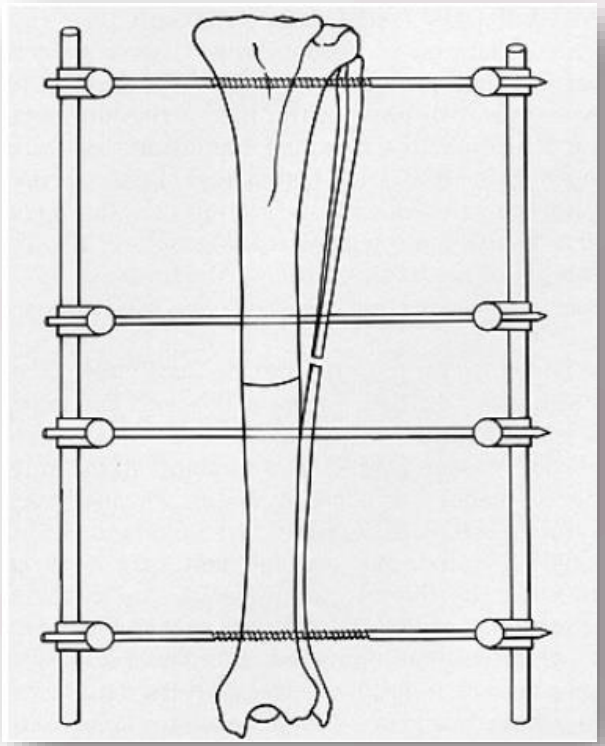
Pins connected to each other by an external device - permitting stabilization pins and bone segments

1902 - Lambotte



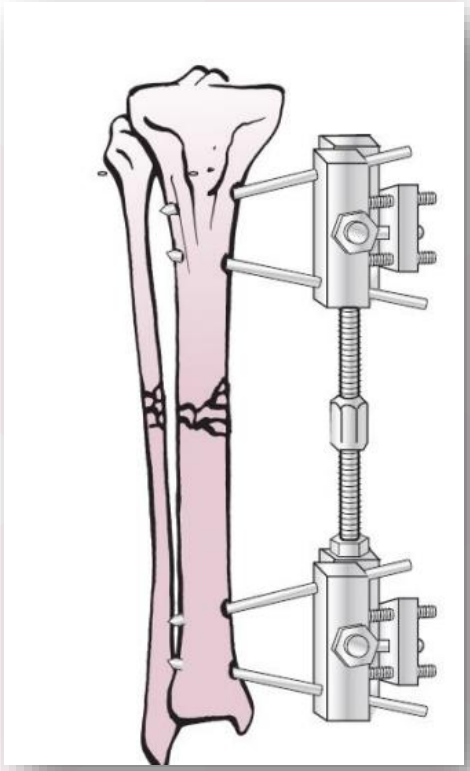
First specially designed device for external fixation

1934 - Roger Anderson



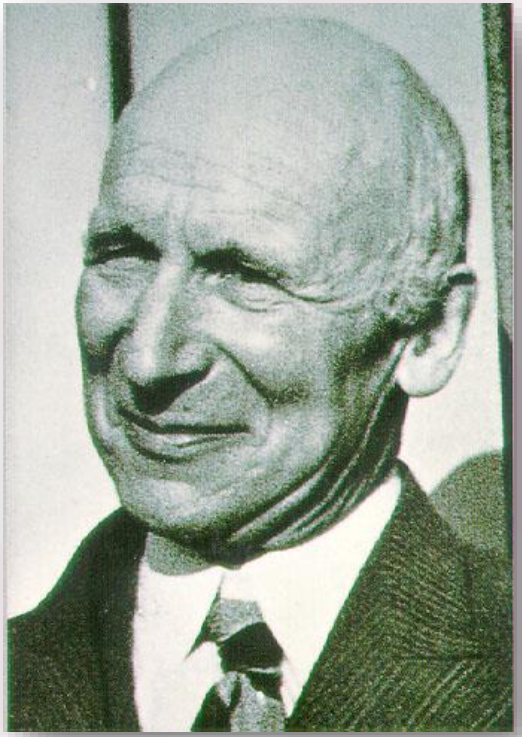
Developed an apparatus for the reduction of fractures which was made up of transfixion pins connected to metal clamps

1937 - Otto Strader



Developed a stabilization system for fractures that lead to a reduction of fractures in three planes

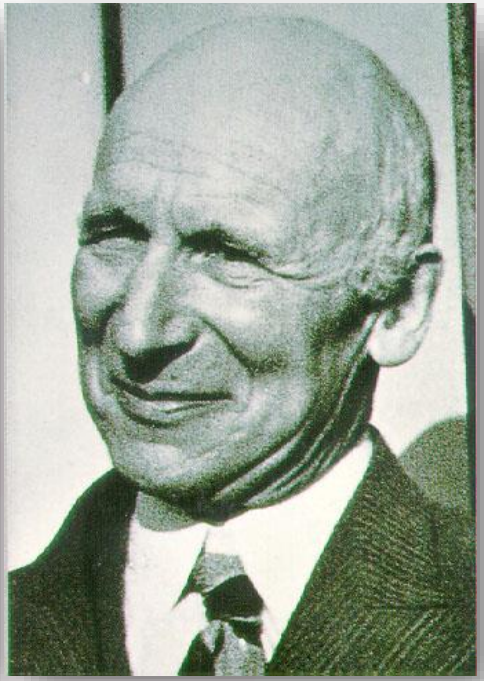
1938 - Raoul Hoffmann



Swiss Surgeon

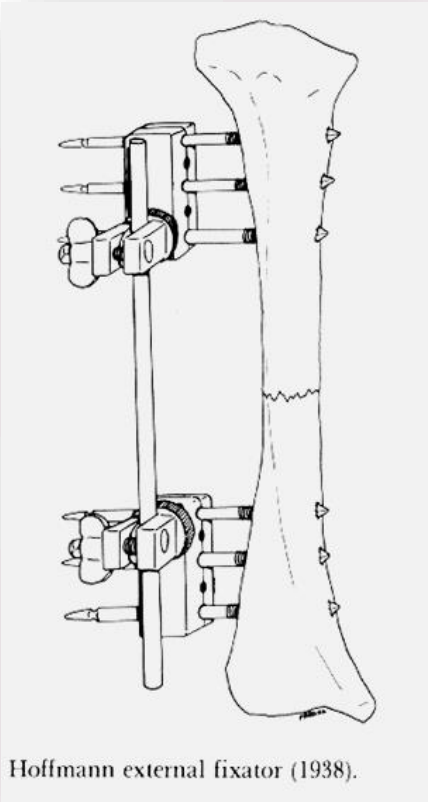
First to patent external fixation

1938 - Henry Jaquet



Forms a partnership with Raoul Hoffmann

1938 - Original design goals



Hoffmann external fixator (1938).

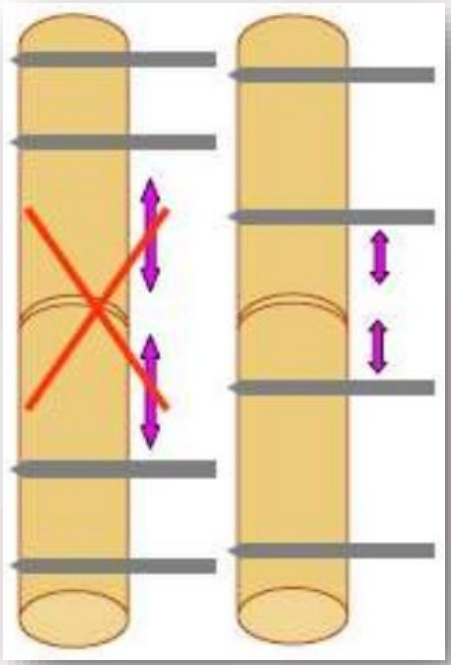
3-dimensional

Universal ballpoint

Connected with rods

Reduction with fixator

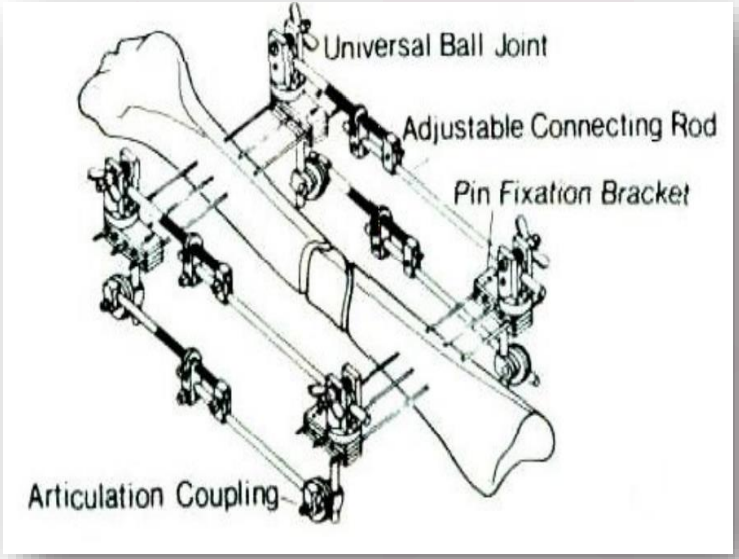
1942 - Lewis and Breidenbach



First to describe the advantages of positioning the pins as far away as possible from the fracture

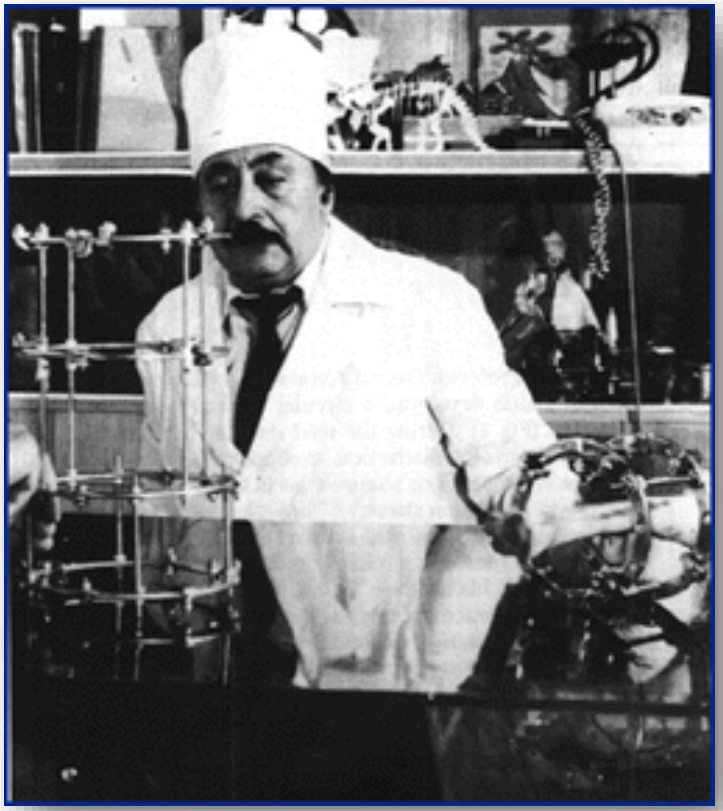
(near and far placement)

1958 - Vidal



Built on the Hoffman fixator designing a quadrilateral frame to guarantee fixation even more rigid and stable and demonstrating its utility in biomechanical studies

1964 - Gavril Ilizarov



Kurgen Institute
Siberia

Distraction
Osteogenesis

Introduced to
the west in 1974

1977 AO ASIF

Manual on AO/ASIF Tubular External Fixator in 1977 released, recommending the use of external fixation. This document provided precise indications on use

1980 - DeBastiani

Verona

Orthofix

Monoaxial

Dynamic

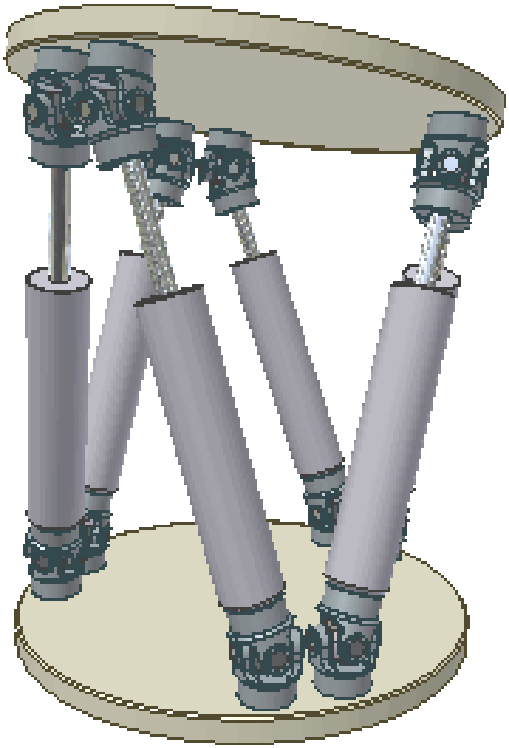
1995 - Charles Taylor

Taylor Spatial frame

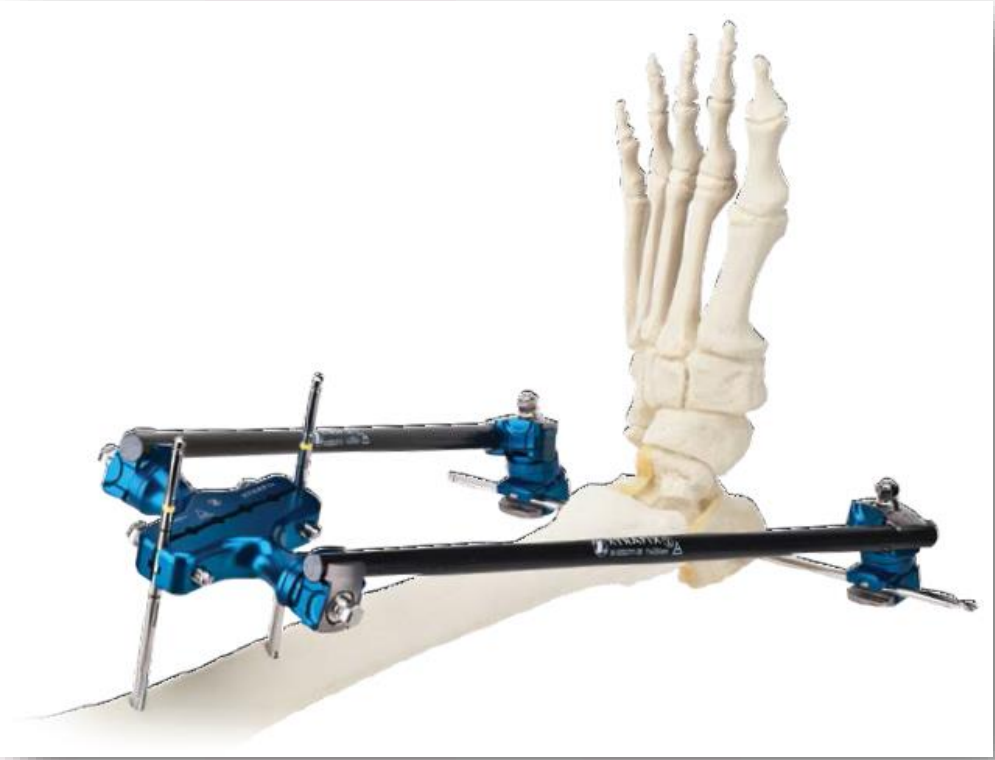
Computerised distraction

Osteogenesis using an octahedral assembly of struts

1995 - Taylor Spacial Frame



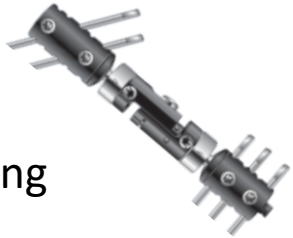
External Fixation Training



Four types of External Fixation

MONOLATERAL FIXATOR

- deformity correction
- limb lengthening



PIN-TO-BAR FIXATOR

- modular fixation in multiple planes
- temporary damage control

CIRCULAR FIXATOR

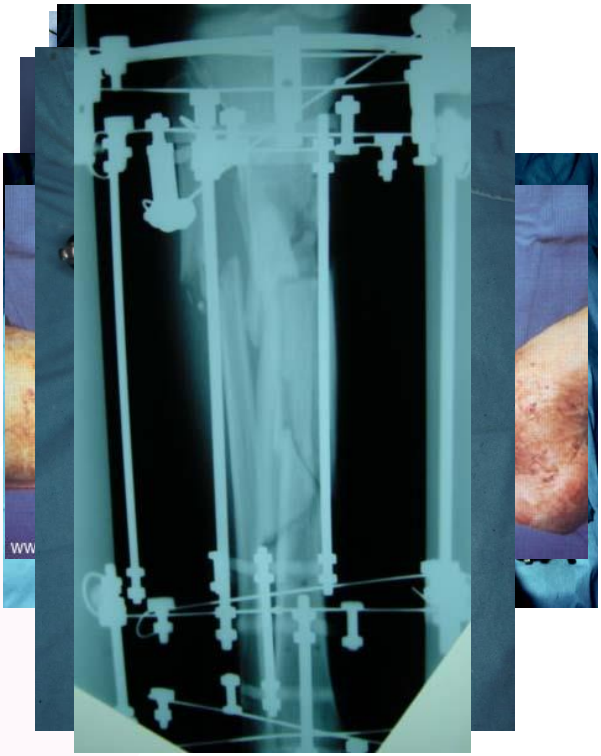
- for complex fractures and deformities in long bones

HYBRID FIXATOR

- for complex periarticular fractures in long bones

Types of fixator

Monoplanar rigid frame
Modular / Unilateral frames
Bridging frames
Peri-Articular frames
Pin less Fixators
Ring Fixators



For and against

Advantages

- ✓ Rapid
- ✓ Small incisions
- ✓ Easily removed
- ✓ Bone transport
- ✓ No knee pain
- ✓ 'Second hit'

Disadvantages

- ✗ Cumbersome
- ✗ Insufficient stability for weight bearing
- ✗ Loss of position
- ✗ Poor access to soft tissues
- ✗ Pin site infections
- ✗ Septic arthritis

Mechanisms of injury

High energy impact

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Gunshot

Open Fracture

Soft Tissue

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Why ex fix and not ORIF?

"First stage of staged treatment for challenging injuries"

- ✓ quick & minimally invasive fracture fixation
- ✓ allows soft-tissue recovery & stabilization
- ✓ allows imaging of reduced fracture
- ✓ gives time for preparing a pre-operative plan for the final treatment
- ✓ voids complications & complex treatments

Indications

Impossible to nail

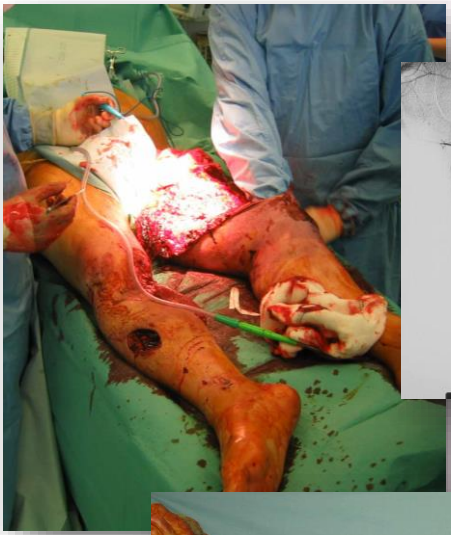
- ✓ too proximal or distal
- ✓ canal deformity
- ✓ skeletally immature
- ✓ battlefield trauma
- ✓ complex reconstruction

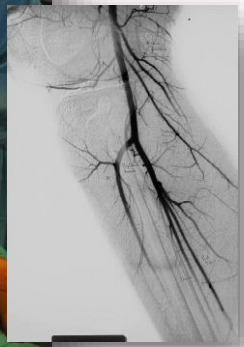
Rapid stabilisation

- ✓ soft tissues
- ✓ vascular injury
- ✓ peri-articular
- ✓ distraction device

Surgeon choice

Temporary spanning fixator



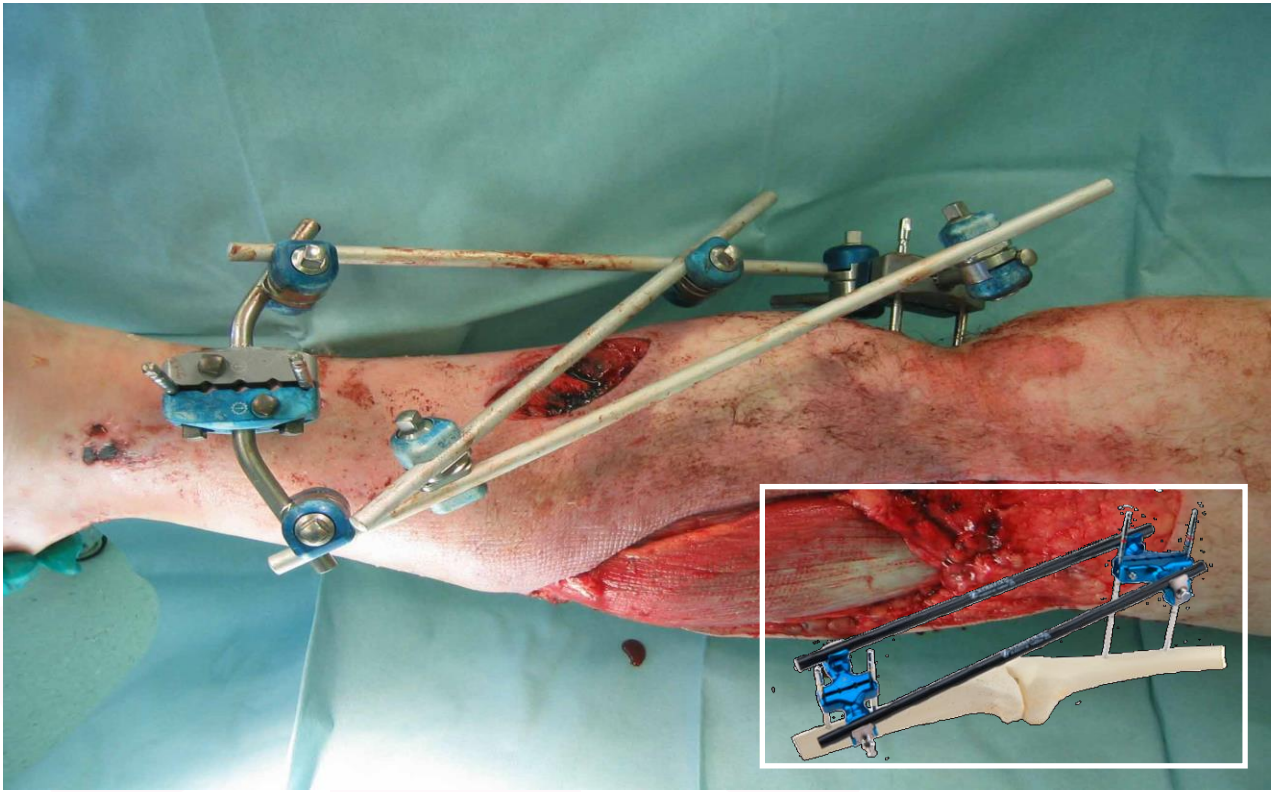


- ✓ Emergency stabilisation
- ✓ Soft Tissues are the Priority
- ✓ Poor soft tissues
- ✓ Vascular injury
- ✓ Compartment Syndrome

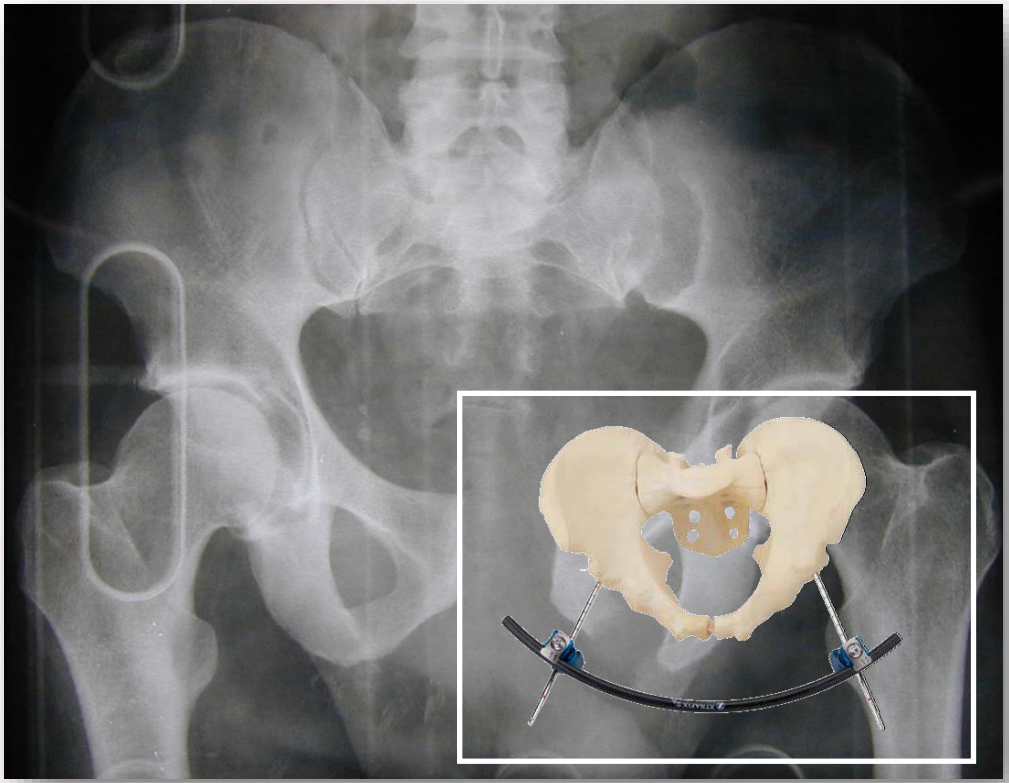
Diasphyseal/ Long bone fractures

Metaphyseal fractures

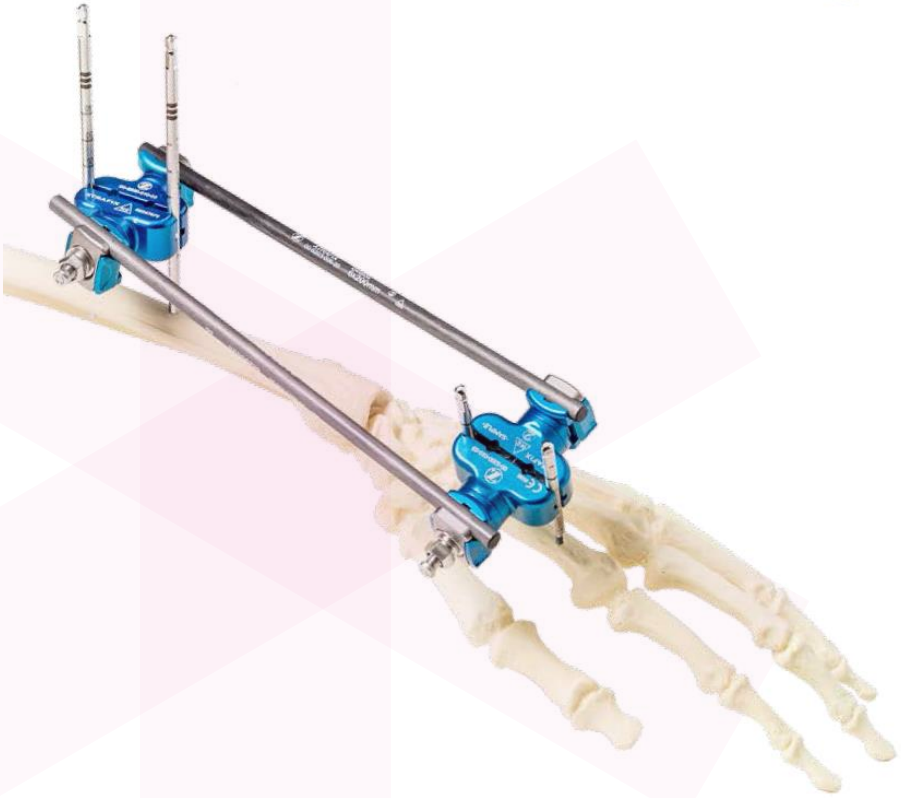
Intra articular fractures



Pelvic fractures



Wrist fracture



Bone transport

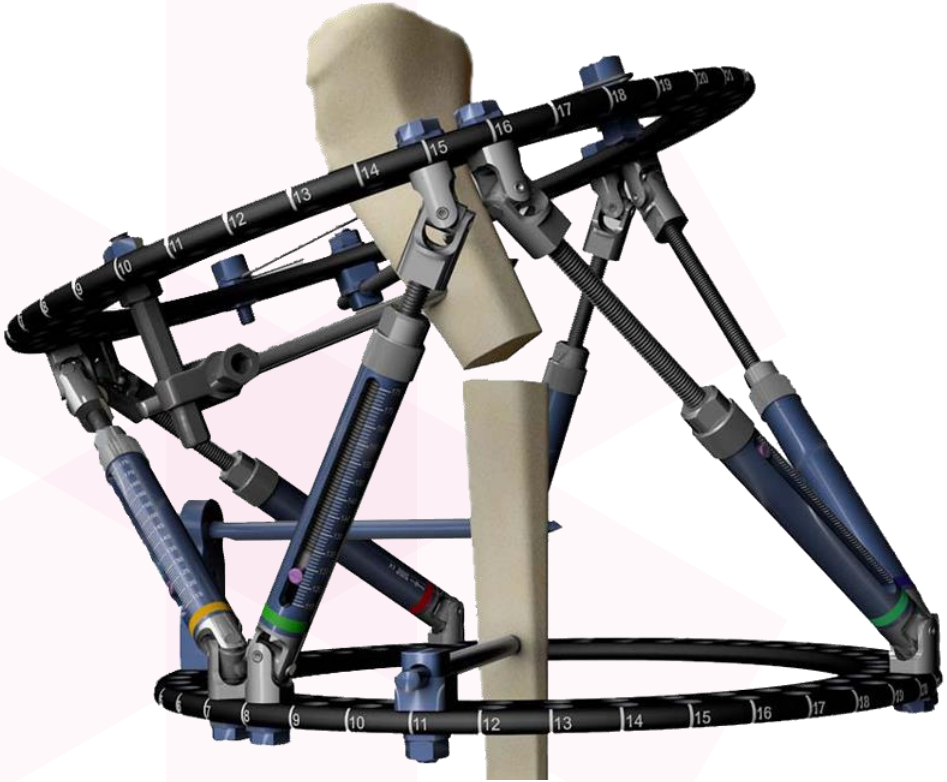
Distraction Osteogenisis

Bone in soft tissue sleeve

Large defects possible

Acute shortening with later bone transport

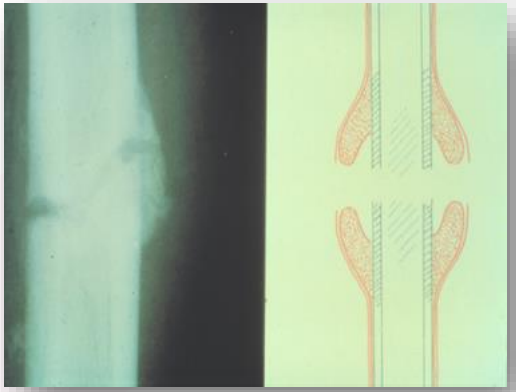
Biomechanics

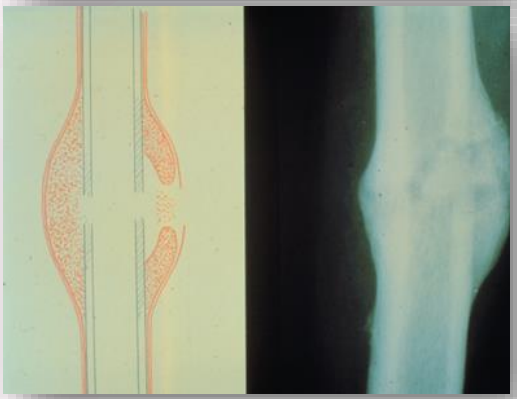


A.G.Apley

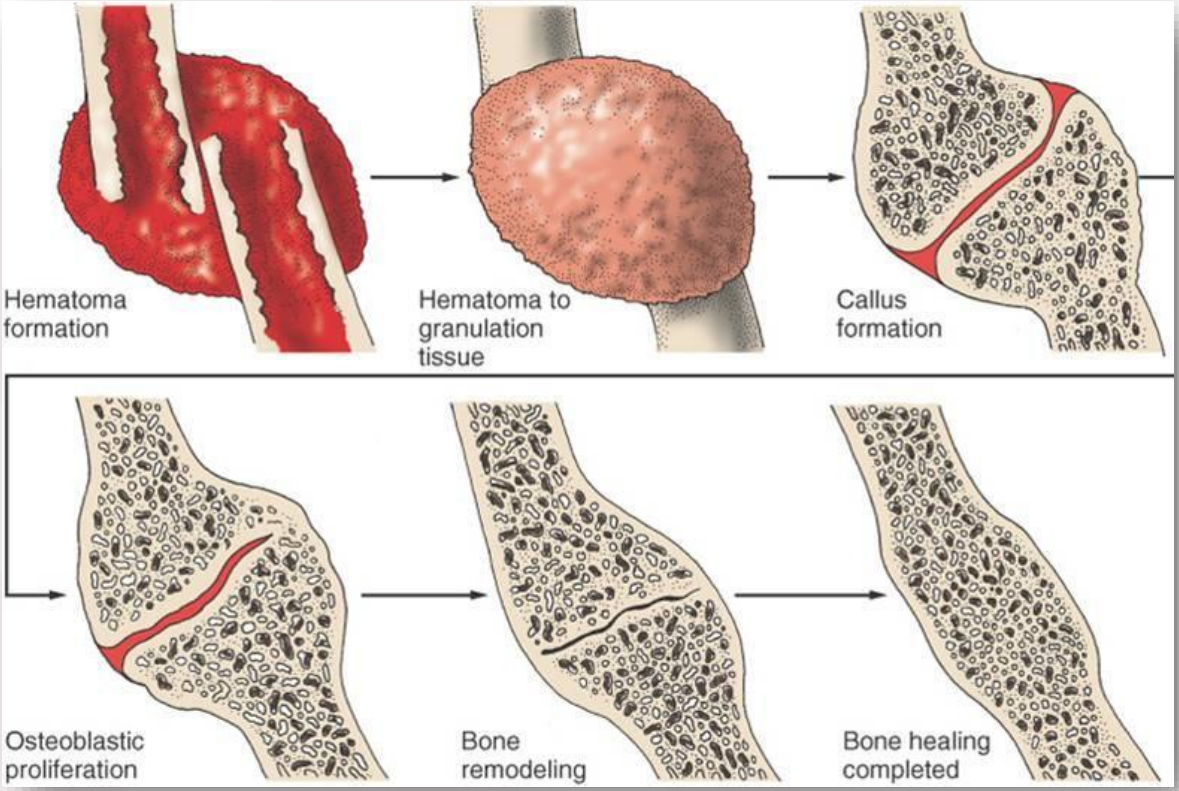
‘it joins two things together’

‘it needs a little movement’





Fracture healing - the basics



Principles - Pins

Conical
Cylindrical
Transfixion

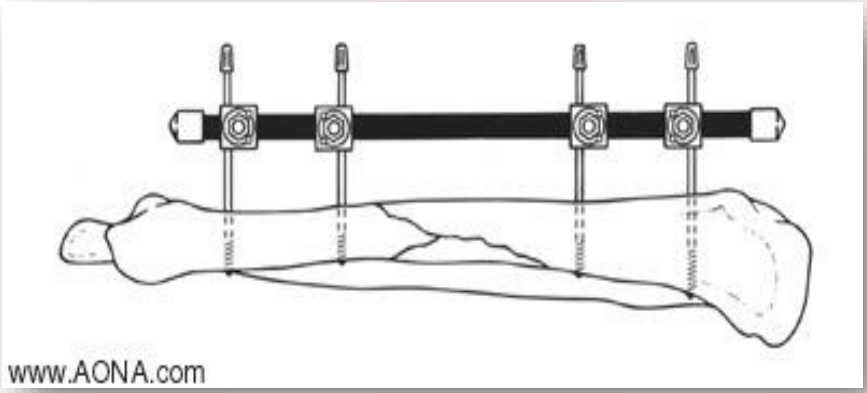
Self Cutting/ Tapping
Blunt

Coatings - Hydroxyl Apatite
Silver Nitrite

Principles - Pins

Safe corridors

Pin and Wire placement



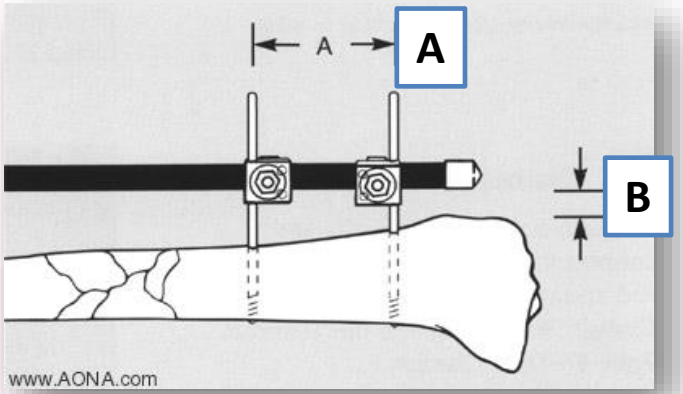
Principles - Pins

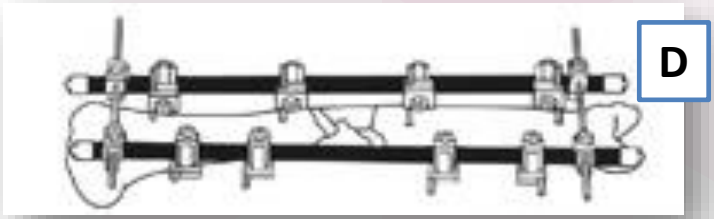
Maximise **A**

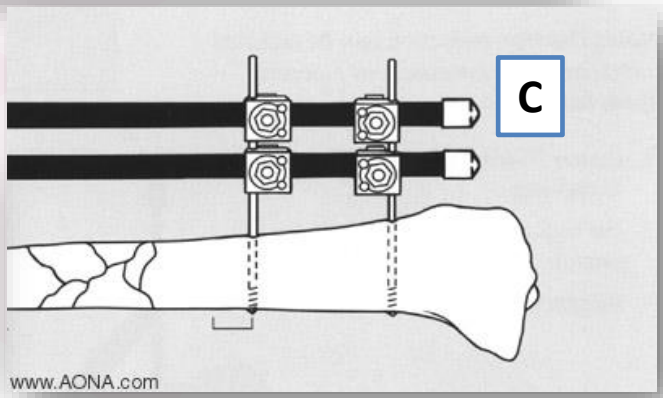
Minimise **B**

Stack bars **C**

Additional planes **D**







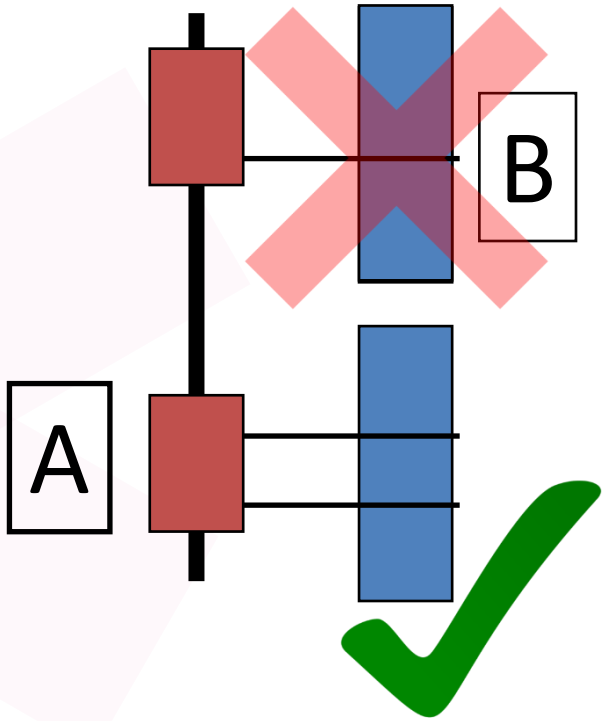
Correct pin placement

A

At least 2 pins per segment

B

One pin allows bone movement around the pin



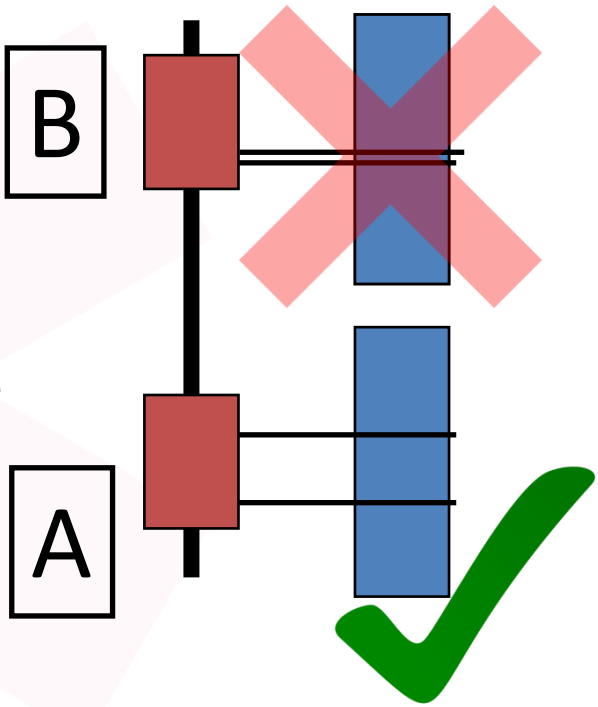
Correct pin placement

A

Spread the pins **‘near and far’**

B

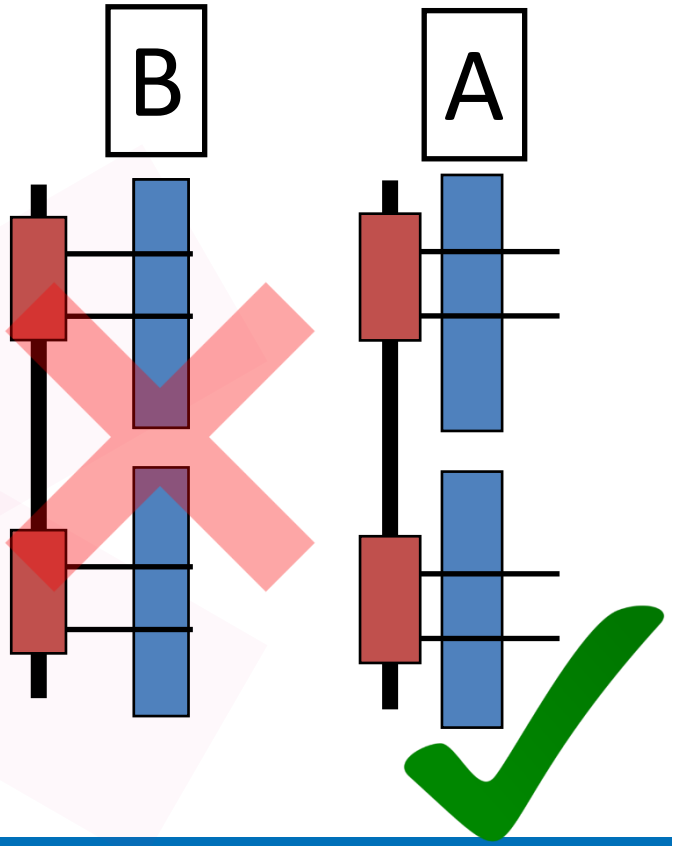
Close together, pins behave like one single pin



Correct pin placement

A Place frame close to the bone

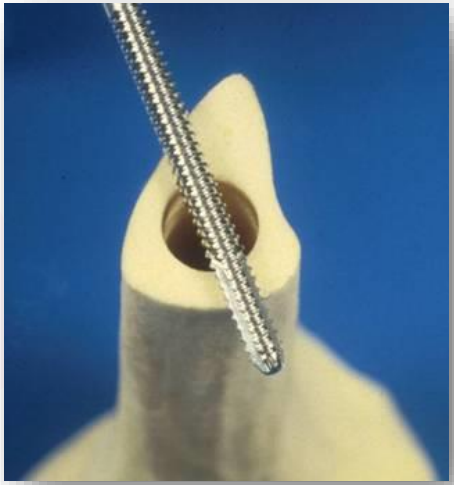
B A shorter lever arm reduces the momentum at the pin entry site

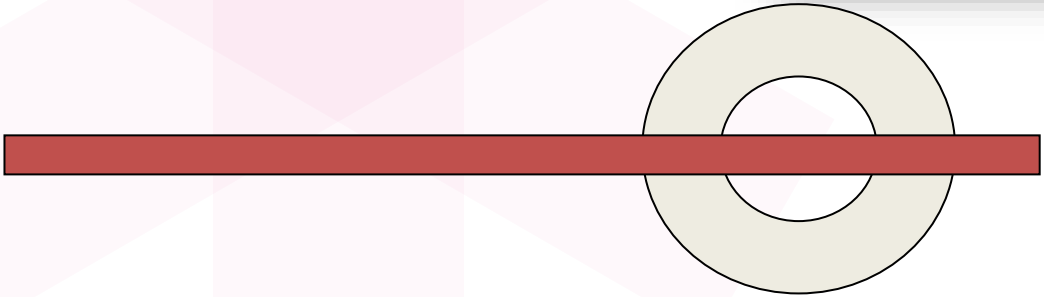


Pin placement

Penetrate the bone in the middle

Best grip in the bone





Pin placement

- ✓ Travel the longest distance possible through the bone
- ✓ Bi-cortical purchase
- ✓ Avoid soft tissue damage as much as possible
- ✓ Think of patient comfort

Pin placement

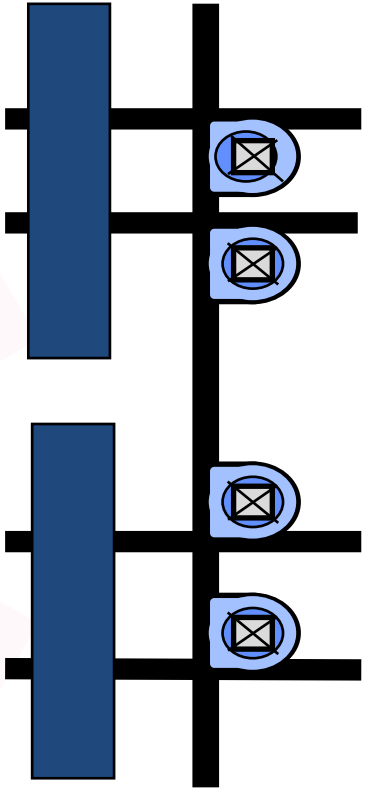
- ✓ Pins should be 2 cm or more away from the fracture
- ✓ Insert the most difficult pins first
- ✓ Pay attention to where you can place pins:
  - joints
  - fracture
  - soft tissues

Elasticity and stability

A frame should be stable and elastic

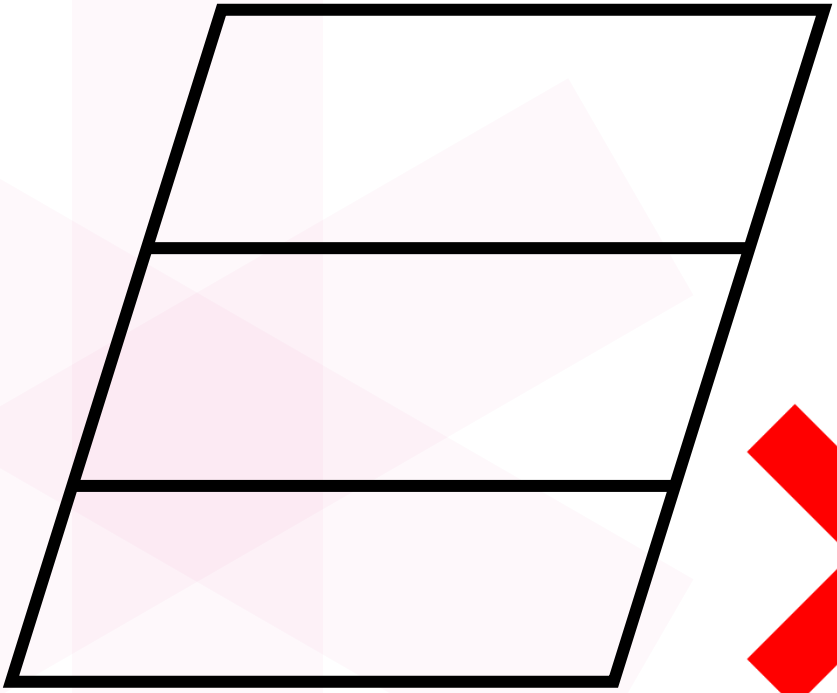
Stability avoids loss of reduction

Elasticity generates micro-movements
thus callus

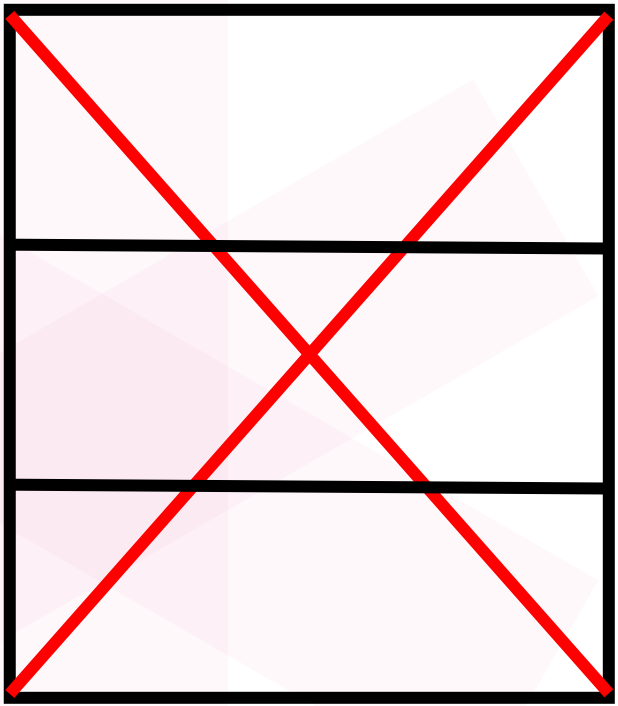


Frame stability - bookcase

Frame stability - Ikea bookcase

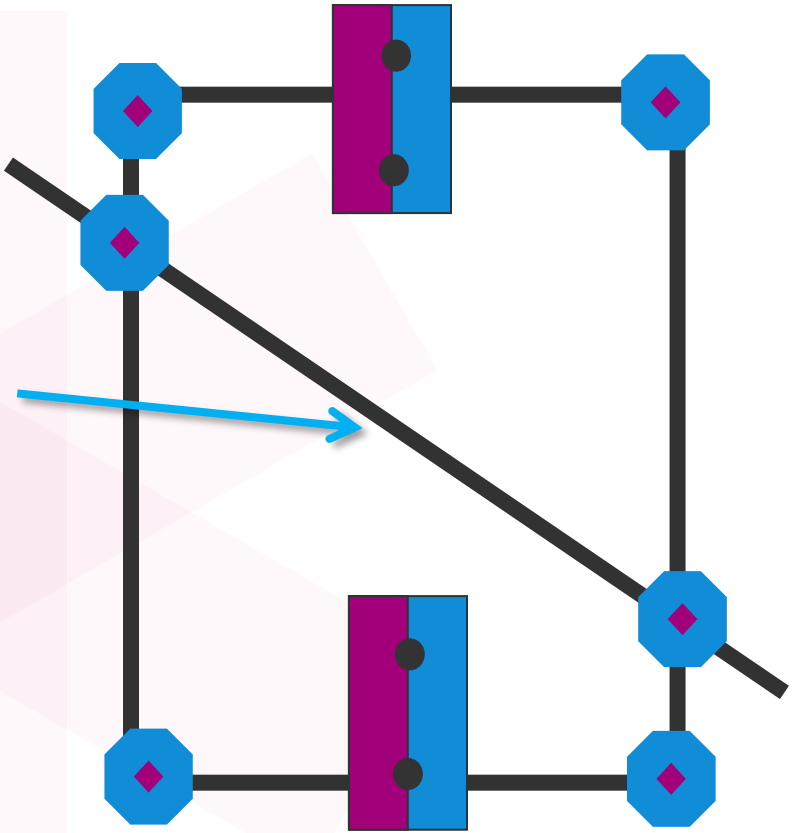


Frame stability - Ikea bookcase



Pin placement

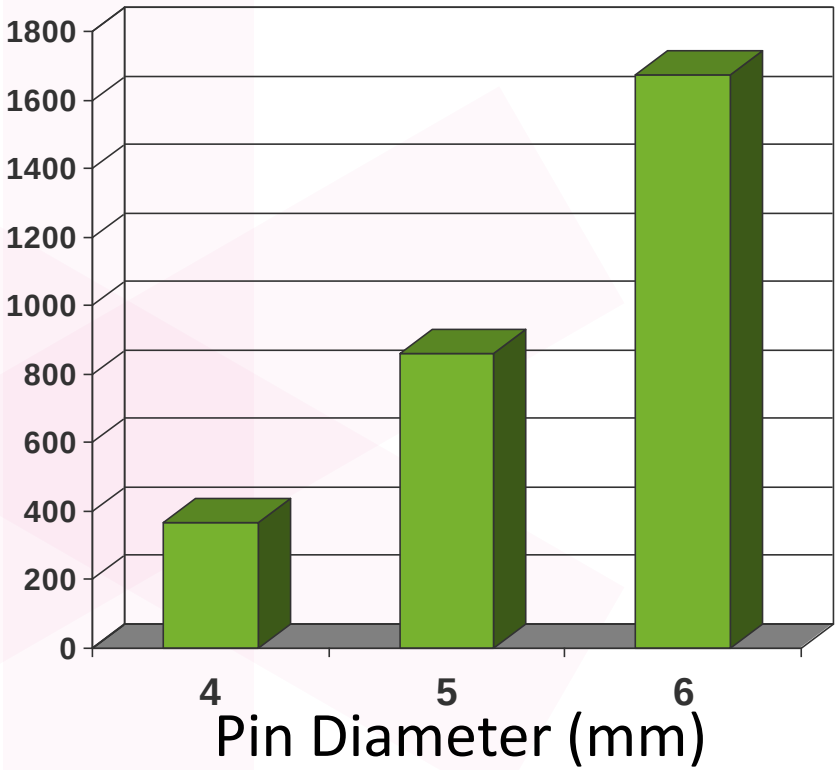
Extra rod increases frame strength and stability



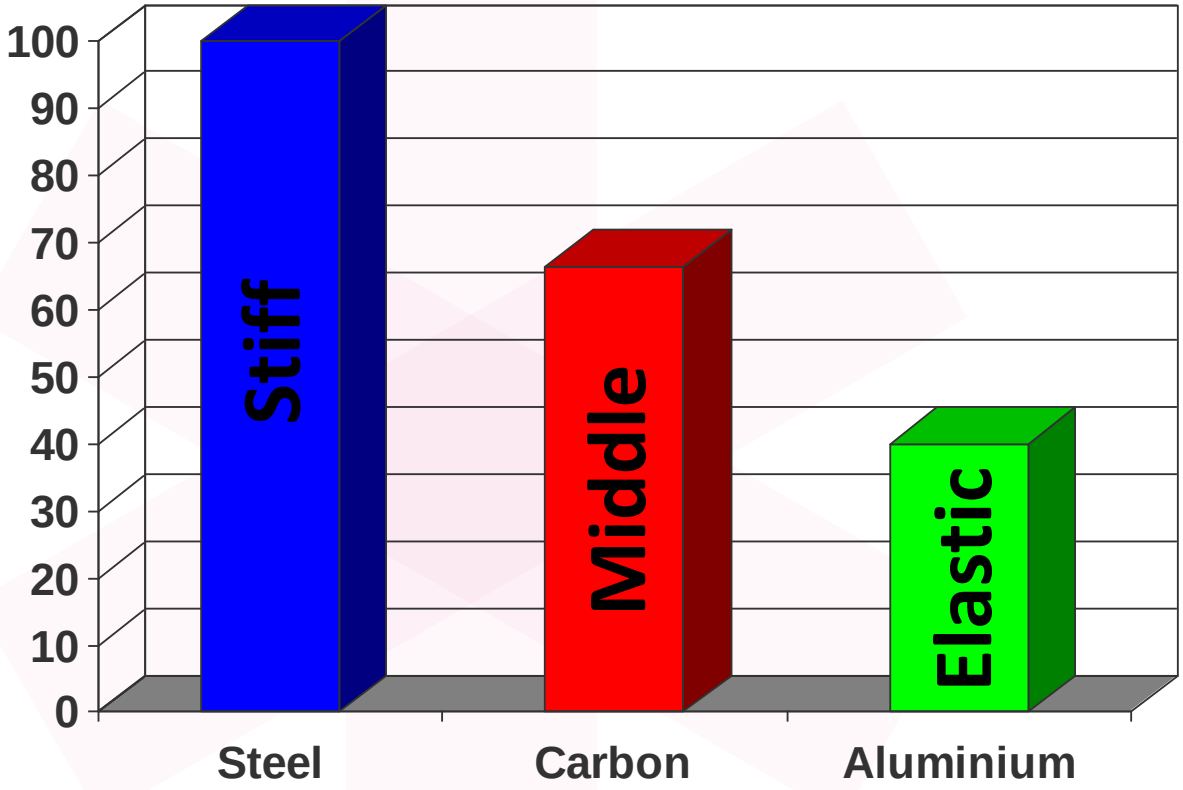
Elasticity and pin diameter

Frame rigidity

(N/mm)



Rod stiffness



Pelvic stabilisation

Emergency stabilisation

Thank you

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