Principles of Casting

Trauma Management with Cast Application

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Introduction

- **Basic Principles of Fracture Treatment**
  - **Reduction**
  - **Immobilization**
    - **Temporarily**
    - **Definitive**

    } Plaster Cast
  - **Rehabilitation**

Different Types of Casting Materials

- Plaster of Paris (POP)
- Synthetic resin

Plaster of Paris (POP)

- Gypsum
  - Early use in *Paris* to make building plaster and cement
  - Chemical formula: calcium sulphate dihydrate *($CaSO_4.2H_20$)*
- Produced by heating gypsum to about 150°C
  - $CaSO_4 \cdot 2H_2O$ + *heat* → $CaSO_4 \cdot 0.5H_2O + 1.5H_2O$ (released as steam)
  - When the dry plaster powder mixed with water, it reforms into gypsum → *exothermic reaction*

Plaster of Paris (POP)

- Setting time
  - Starts about 10 minutes after mixing and is complete in about 45 minutes
  - Not fully set for 72 hours
- Impregnating fabric materials with gypsum to make **plaster bandage**
  - Gyspona: on leno cloth
  - Orthoflex: on rubber elastic fabric

Synthetic Resin

- Polyureathane resin
  - Formed by a di-isocyanate and a polyol in the presence of a catalyst
  - Formula of isocyanate: $C_6H_5.NCO$
- Activation for the resin polymerization
  - Usually water
- Synthetic resin bandages (Fabric + resins)
  - eg. **Dynacast**: glass fiber fabric + polyurethane resin

Ideal Casting Material

- Easily applicable
- Conforming to the injured limb
- Able to set rapidly
- Adequate strength to hold reduction
- Radiolucent
- Light
- Water resistant
- Good ventilation

Advantages



POP	Synthetic Resin
Inexpensive	Shorter setting time
Good molding capacity	More radiolucent
Long storage time	Lighter
Easy to handle	Stronger
	Water resistant
	Better ventilation

Resin Bandage is not a superior material

CR + POP

- **What does it mean ?**

CR *(Close reduction)*

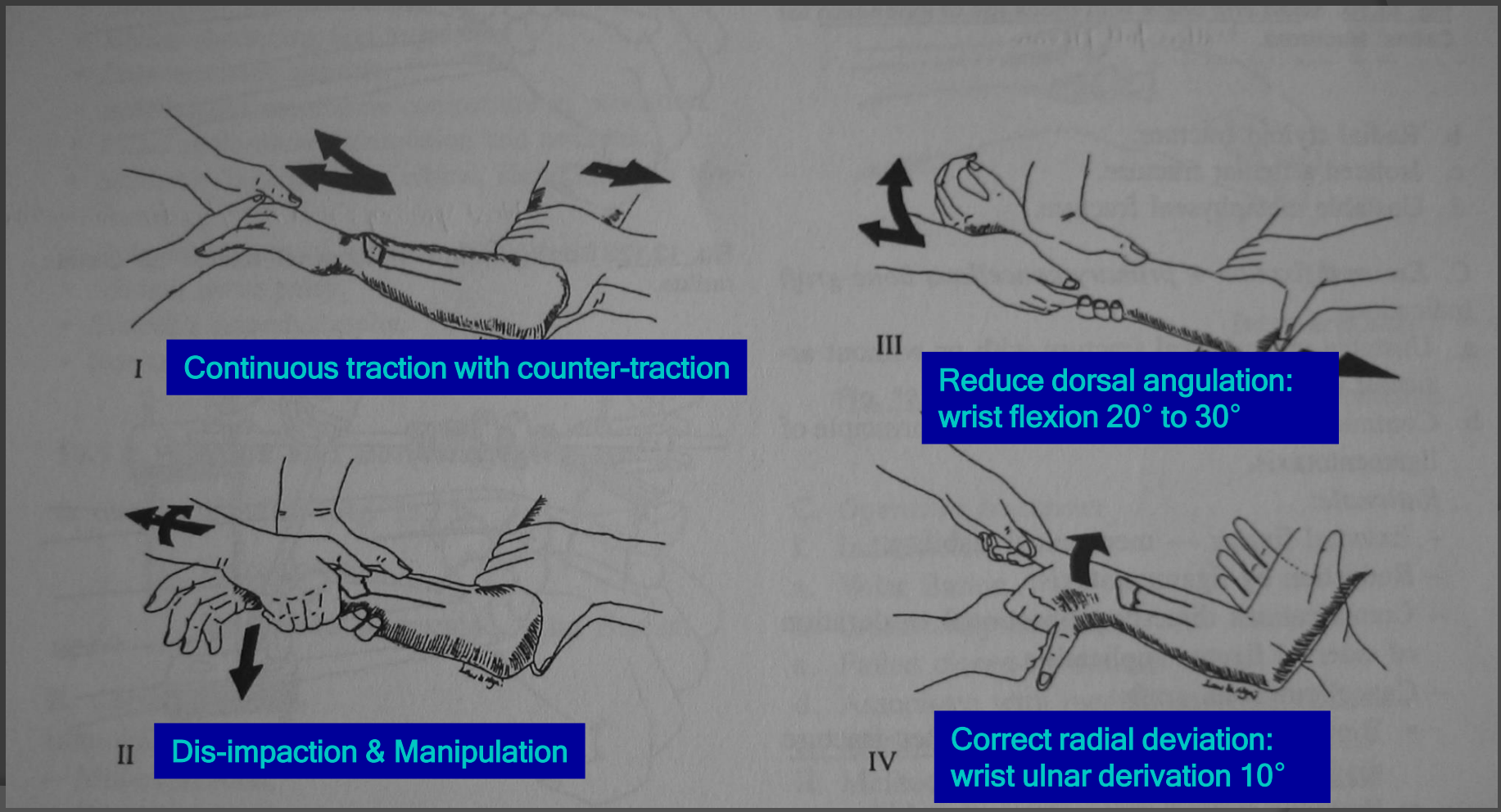
- Manipulation of the fracture to improve the position of the fragments
- As soon as possible
- Under appropriate anaesthesia/muscle relaxant/sedation

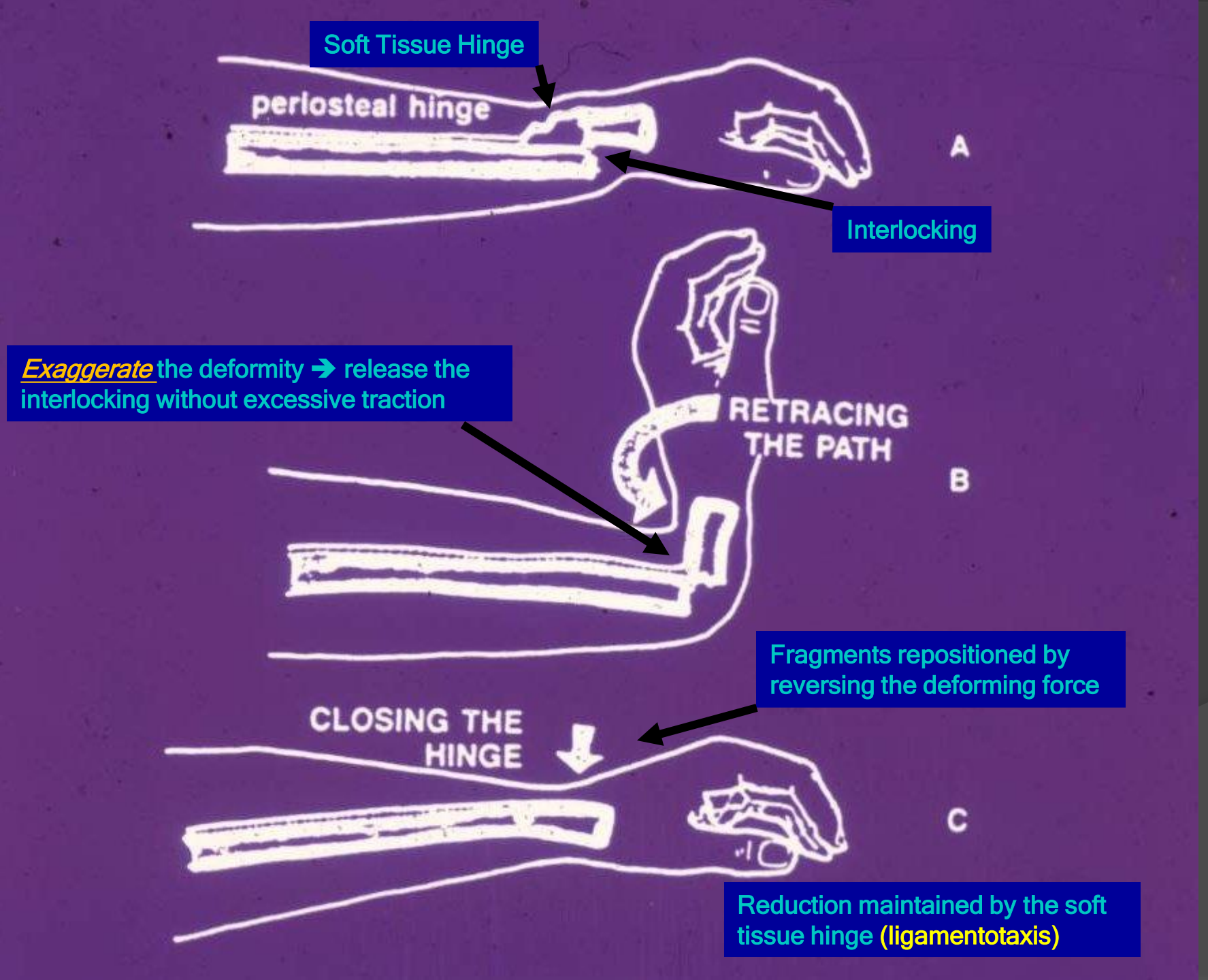
- Manoeuvre :
  - Traction
    - Distal part of the limb is pulled in line of the bone
  - Counter-traction
  - Manipulation
    - As the fragments disengaged, they are repositioned (by reversing the original direction of forces)
  - May need to exaggerate the deformity first

POP

- Application of cast
- Maintain the position with a “3-point fixation” Casting

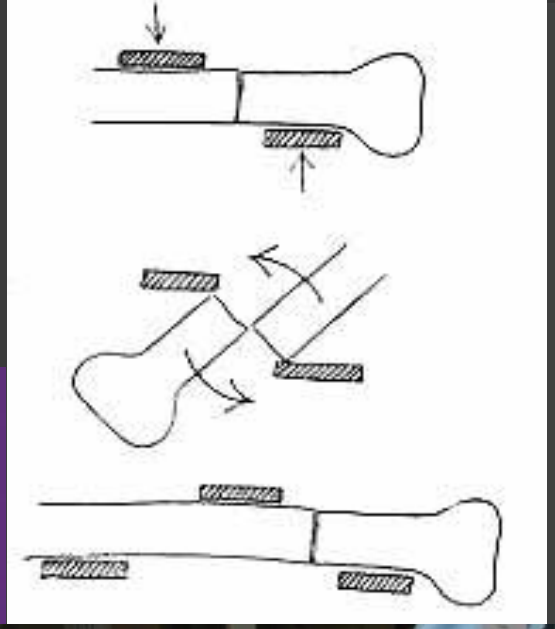
Closed Reduction of Colles' Fracture

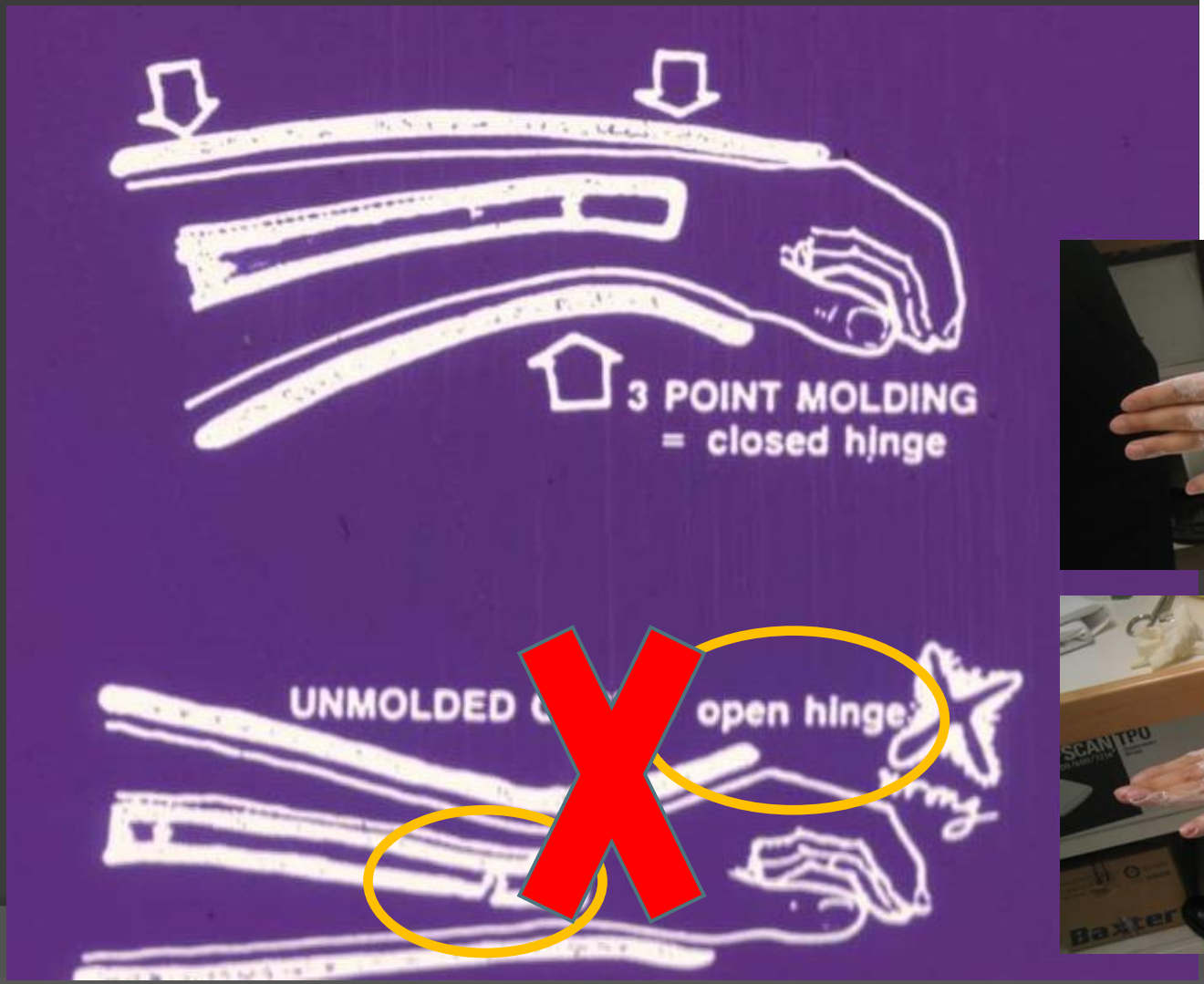



Soft Tissue Hinge
periosteal hinge
A
Interlocking
Exaggerate the deformity ➔ release the interlocking without excessive traction
RETRACING THE PATH
B
Fragments repositioned by reversing the deforming force
CLOSING THE HINGE
C
Reduction maintained by the soft tissue hinge (ligamentotaxis)

Molding ➔ 3-Points Fixation:

- A third force to neutralise the couples and the system becomes stable
- It takes a ***curved cast to produce a straight bone***





Poor Manipulation & Reduction

- Insufficient relaxation
- Inadequate reduction
- Poor understanding of fracture mechanics
- Fail to hold the alignment after reduction

Preparation before casting

- Determine the aim: Temporarily Vs Definitive
- Choose the appropriate casting material
- Use the appropriate size bandage
  - e.g. 4” hand & forearm, 6” leg, 8” thigh
- Pain control for close reduction
- Get an assistant

Basic Steps for Plaster Application

- **Reduction of fracture**
- **Padding**
  - **Tubegauze / stockinette**
  - **Velban application**
- **Activate plaster bandage**
- **Plaster bandage application**
- **Molding**
- **Trimming & reinforcement**
- **Follow up monitoring and care**
- **Removal**

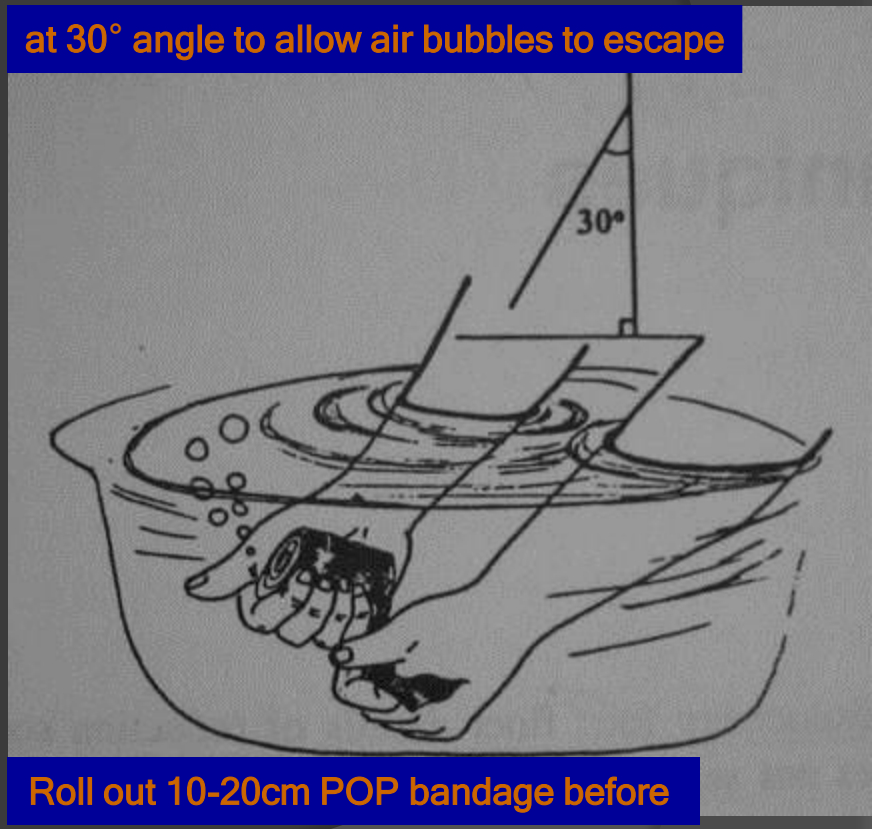
- Stockinette first
- Extending to the joint above and longer than the limb for easy handling of the extremity

Padding – Velban

- Smooth and even
- Overlapping 50% of the preceeding turn
- Thin layer is enough, otherwise would affect the fittness & strength of the cast
- ***Thicker at bony prominences***
- Control swelling

Plaster Bandage Activation

- Lifted with dry hands
- Thorough immersion in ***water at room temperature***
- Gently squeezed out water until no more bubbles
- Remove from water and further squeeze out excessive water



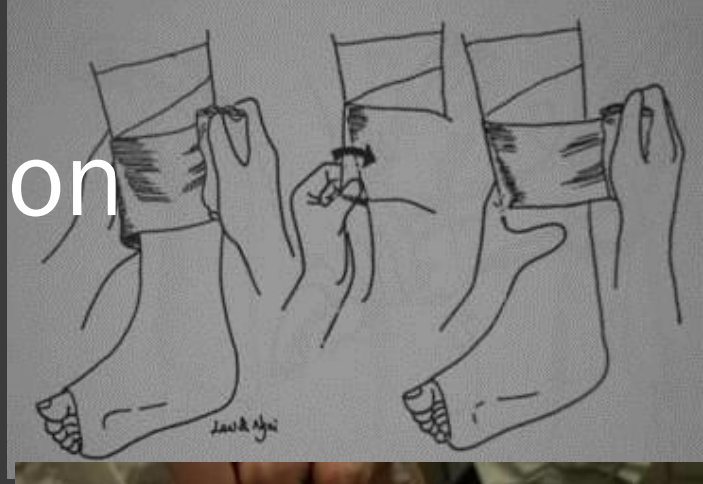
- Water at room temperature
  - Cold water: retards setting and reduce cast strength
  - Hot water: may cause burn injury

Plaster Bandage Application

- Smoothly and evenly applied
  - Cast may breaks at the junction between thick and thin layers (stress risers)
- Applied with finger tips to ensure that the bandage will not be too tight
- Continuous folds to cover at least half of previous fold
- Smooth out every layer to remove air
- Figure-of-8 when crossing joint, prevent in-folding of plaster causing sore

Plaster Bandage Application

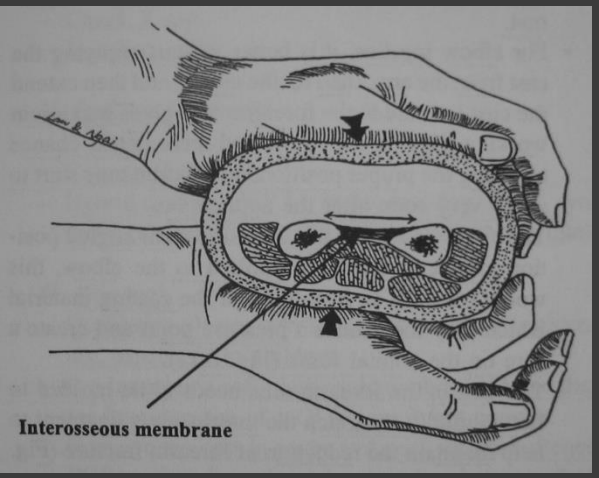
- Cutting out or out-folding the angles of POP slab to avoid pressure point at corner
- Stockinette fold back at the end to make the edge smooth

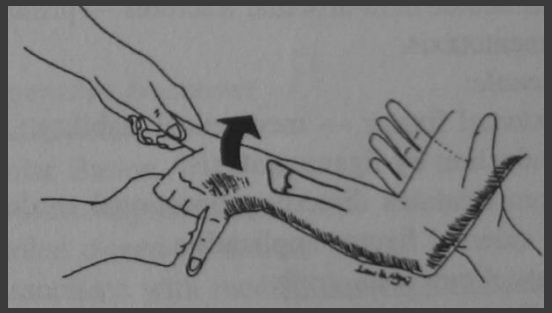


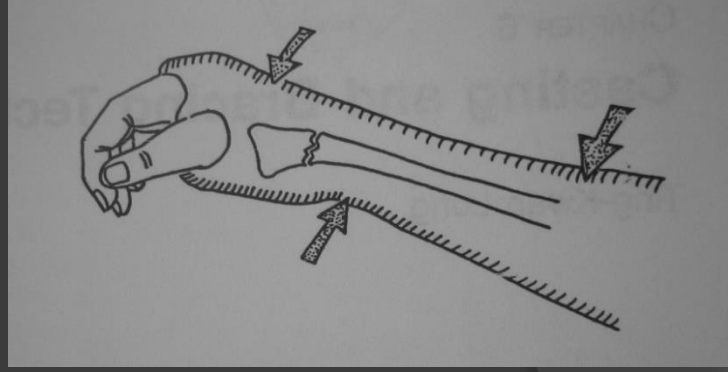
Molding

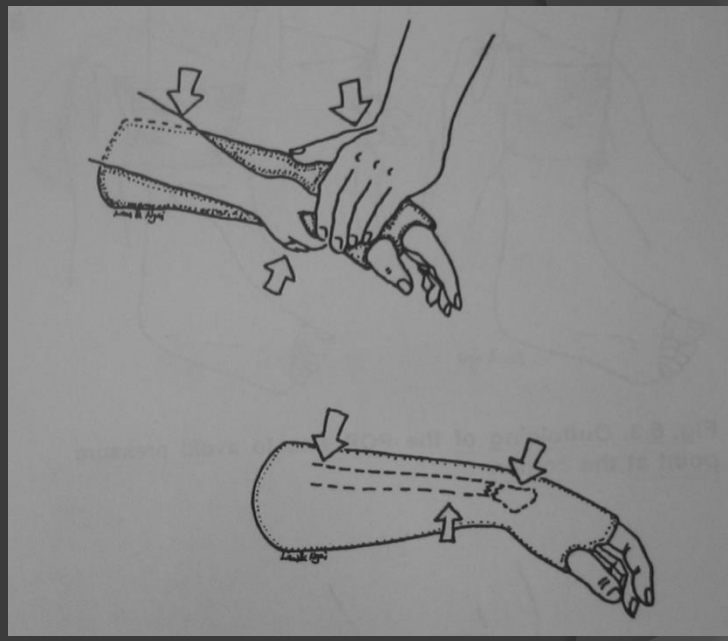
- To fit external anatomy of the limb & create 3-point fixation
- Start during application
- Continuous & Dynamic
- Use palms and thenar eminences **(NOT fingers)**

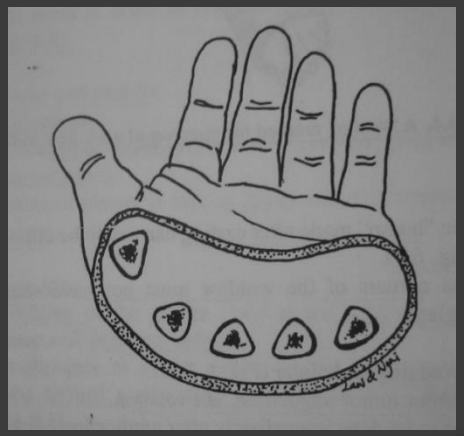
What are they doing ?

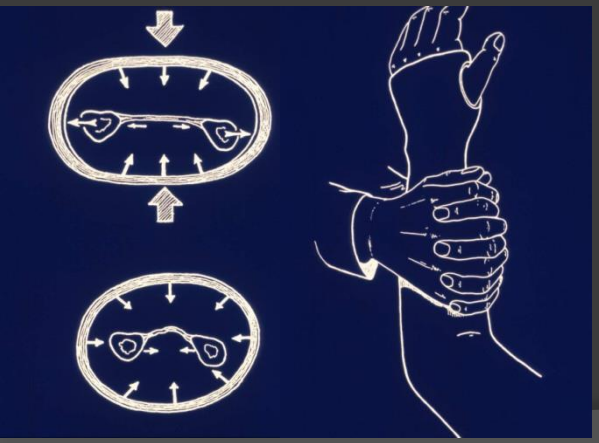




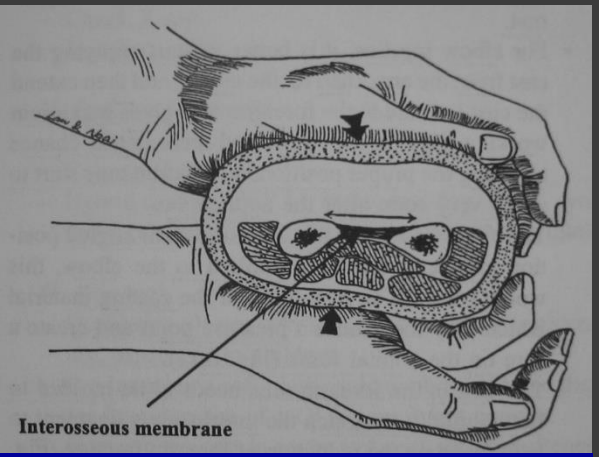




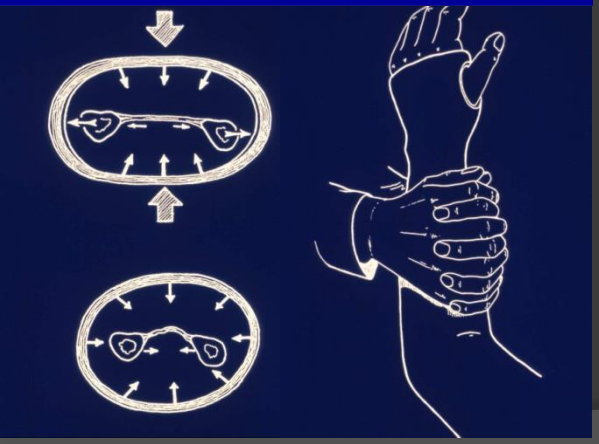




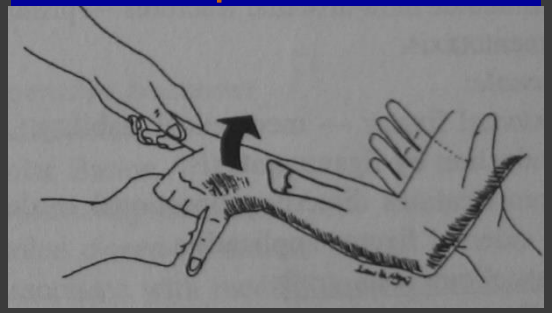
Molding

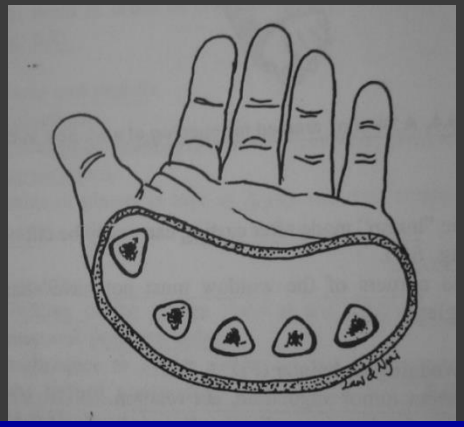


Molding of forearm to stretch interosseous membrane

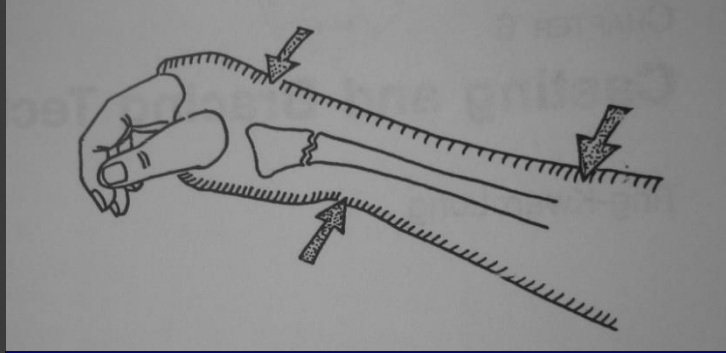


Excluding the 5th finger from the grip to allow the ample accommodation for the transverse palmar arch

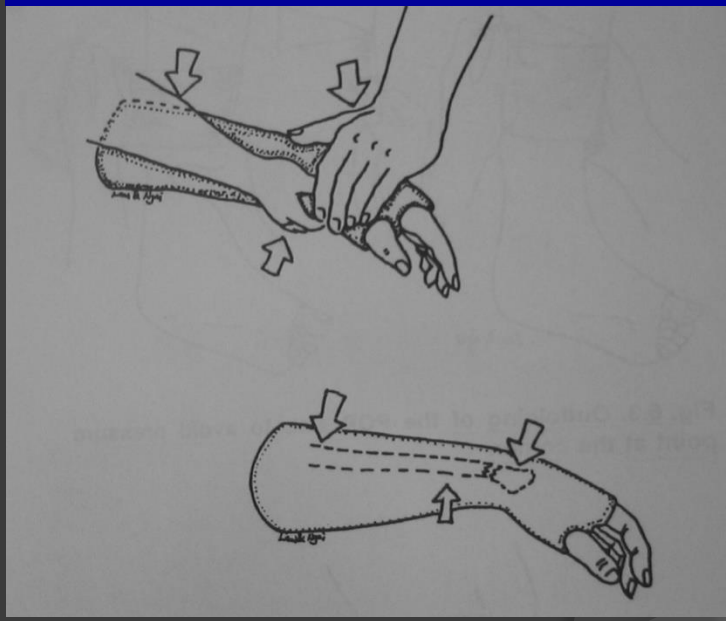




Oblong shape to maintain palmer arch



3-point fixation for distal radius fracture



Trimming

- Allow unobstructed motion for joints that need not to be immobilized
- Prevent impingement sore

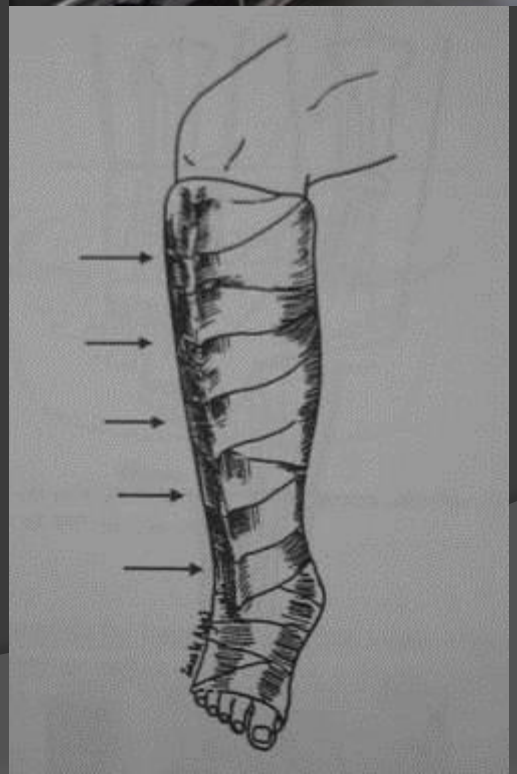
- e.g. Short arm POP for distal radius #
  - Extends from knuckles & palmer crease to below elbow ➔ check free motion of elbow, thumb, little finger, & MCPJs

Check Before Trim

Trimming

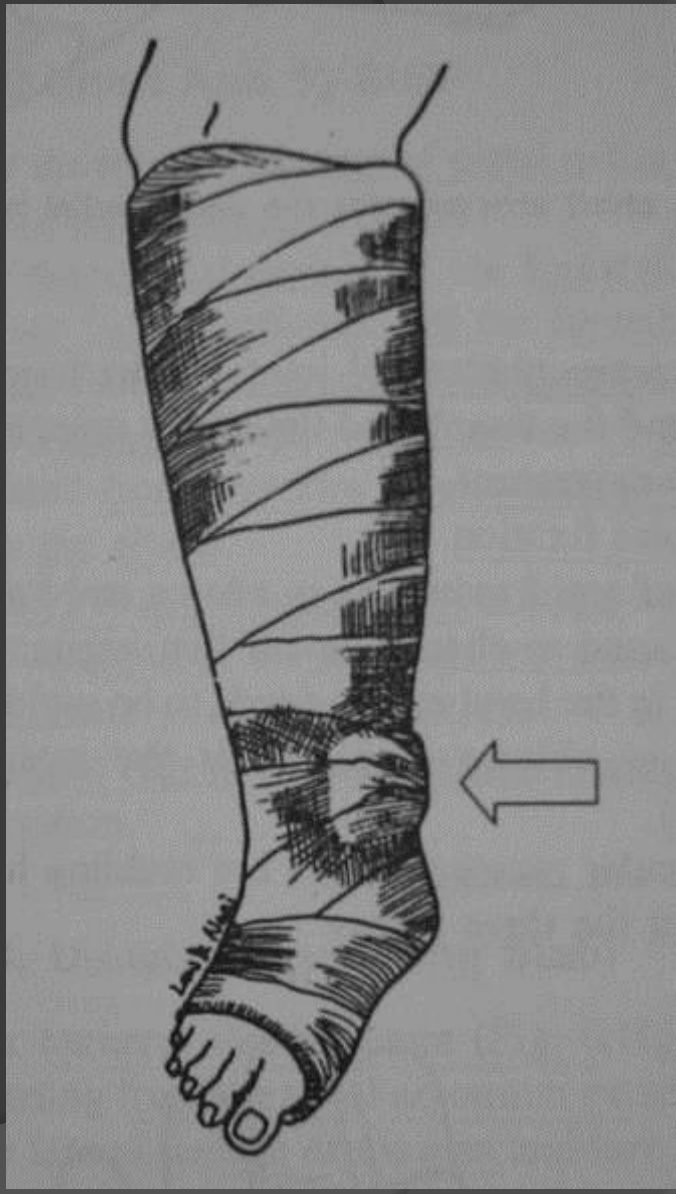
Reinforcement

- **Adding slab**
- **Hybrid casting**
  - **POP for better molding inside, synthetic cast outside for strength & reduced weight**
- **Ridging**

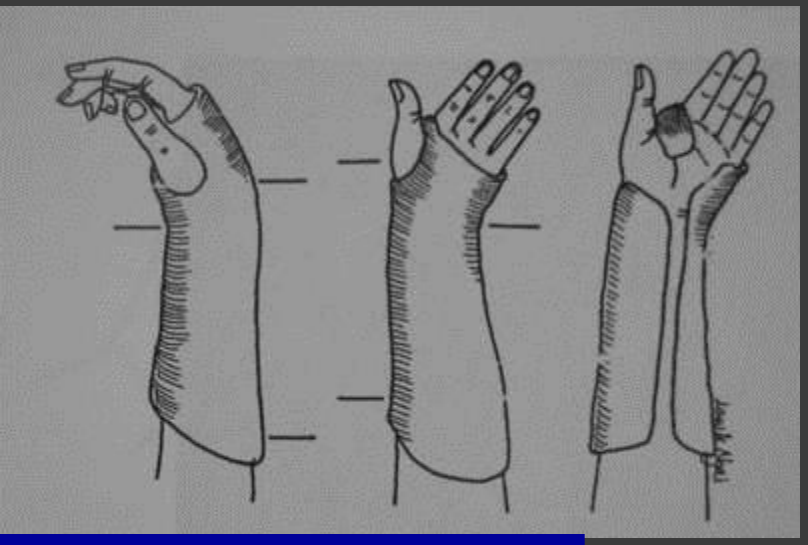


For Wound Inspection

- Making a hump with thick gauze over the wound site for opening of window
- Cut out the hump after POP set

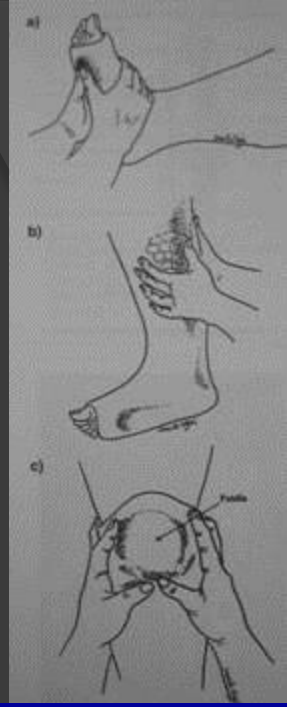


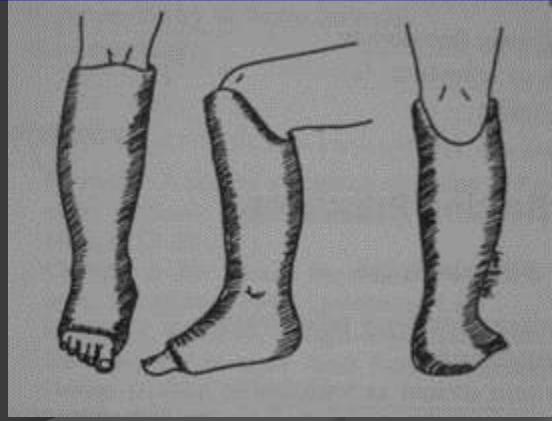
Other Types of Casting



¾ Slab for distal radius

U-slab for humerus





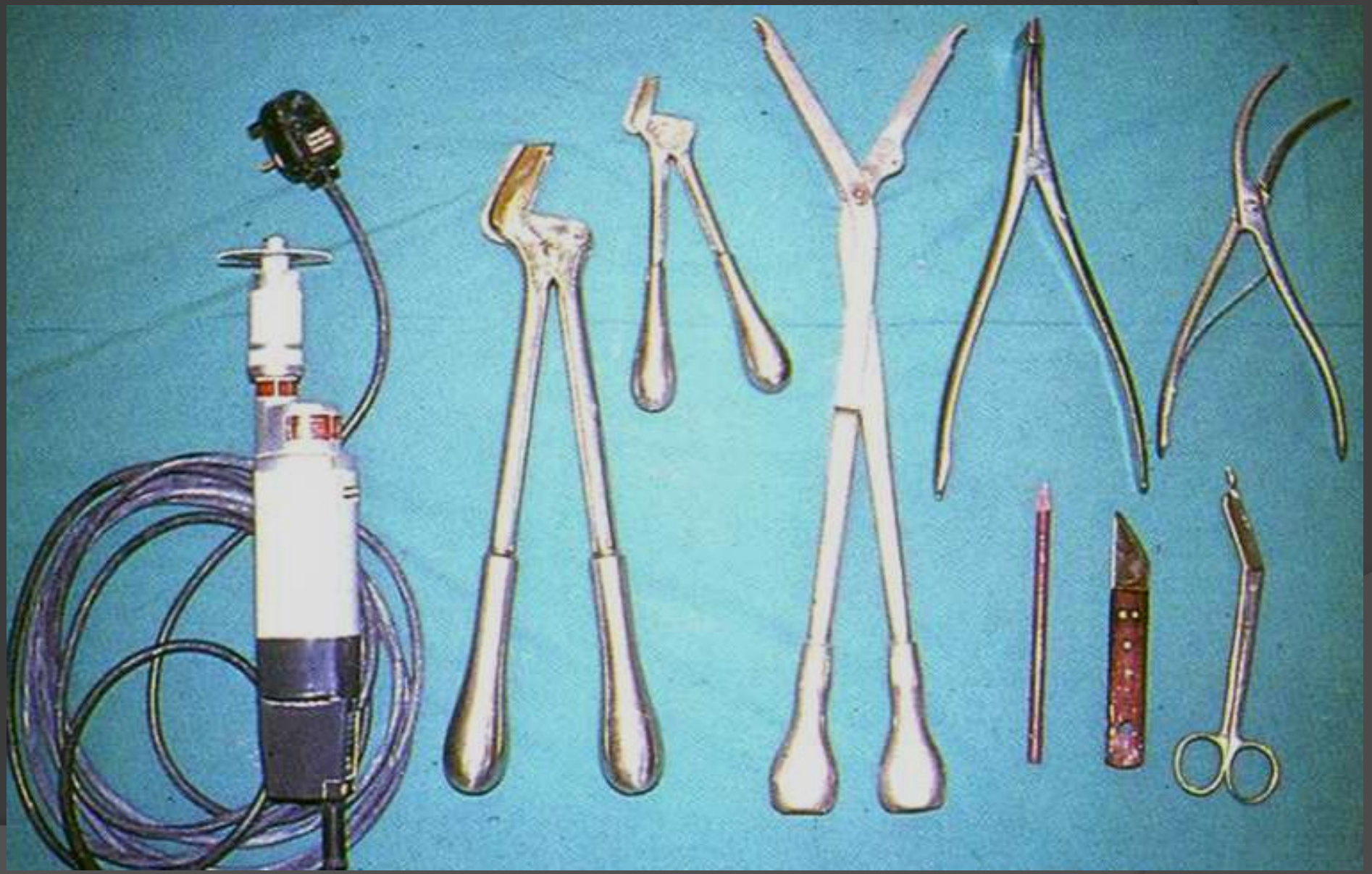
Sarmiento cast for tibia

Cast Removal

- Initial bivalve at diametrically opposite points on the circumference
  - Concave side
- Cutting should not pass bony prominence
- Oscillating electric plaster saw or plaster shears
- Spreader, bender

- Immerse POP in water, peel out after softened

Basic Equipment



Oscillating Electric Saw

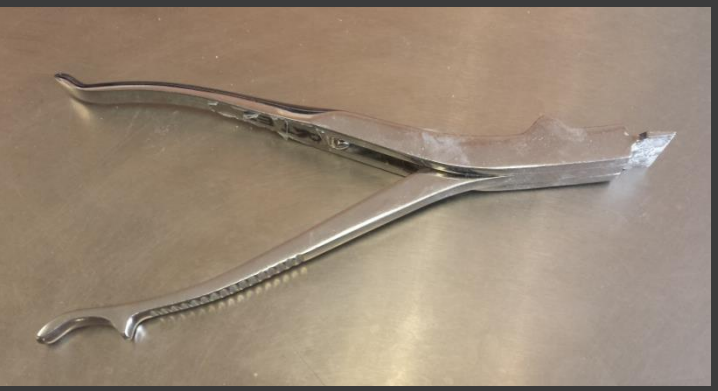
- Vibrates at low amplitude
- Cuts off stiff material but not skin
- Only used on dry and padded plaster
- Stepping without dragging
- The blade can become very hot

Oscillating Electric Saw

Do NOT split plaster on the Convex side

Always split on the ***Concave*** side

Spreader



Plaster Shears

Pitfalls in Plastering

Poor plaster technique will end up with:

- Poor reduction → mal-alignment
- Excessive padding / Edema subsided → loosening
- Too tight → Neurovascular compromise / compartment syndrome
- Too hot → deep burn
- Poor application across joint → joint buckling
- Lamination of plaster → air trapped weaken the cast
- Poor molding → failed immobilization / impingement
- Poor trimming → sharp edges / impingement sore
- Saw injury on removal

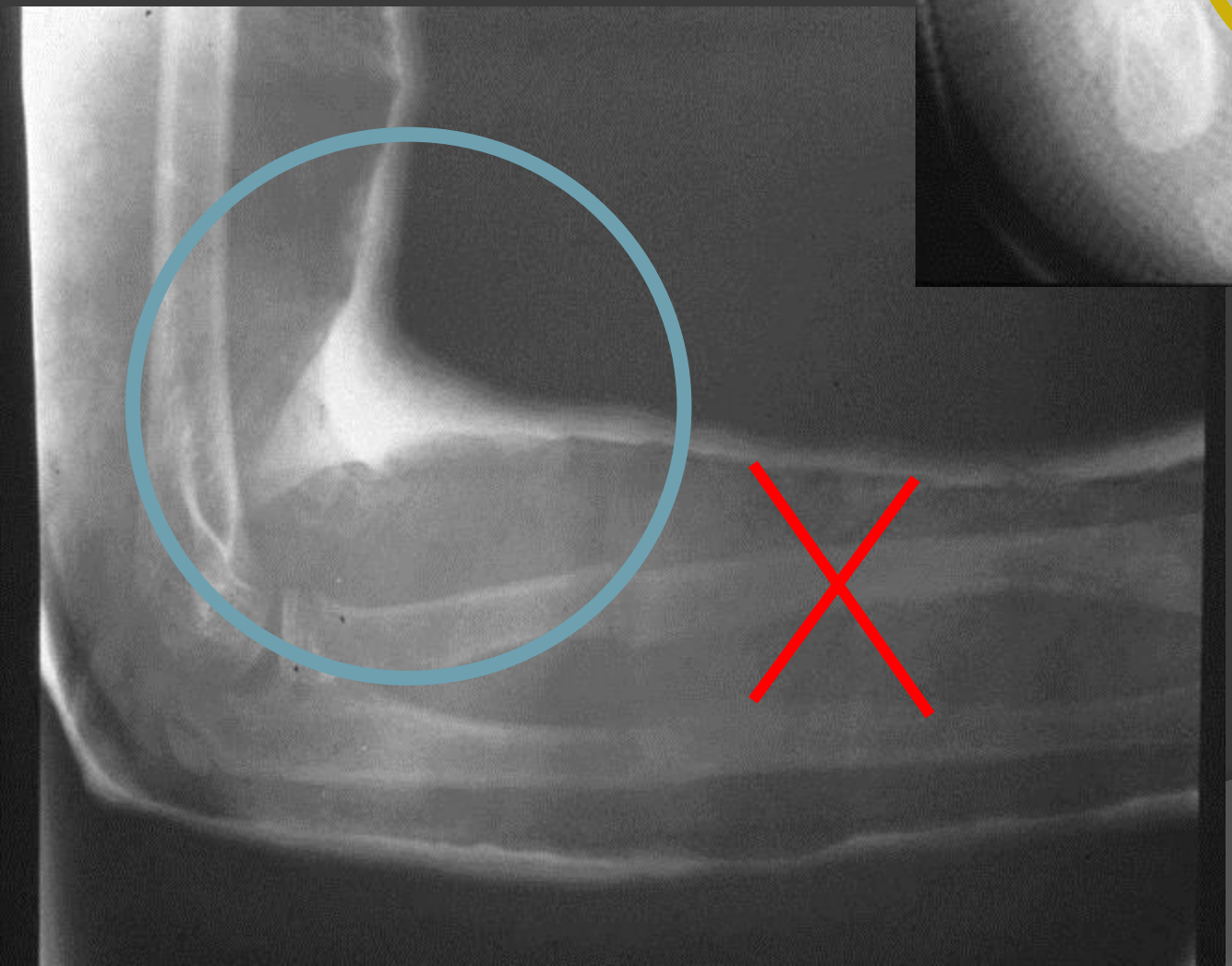
What is the problem?

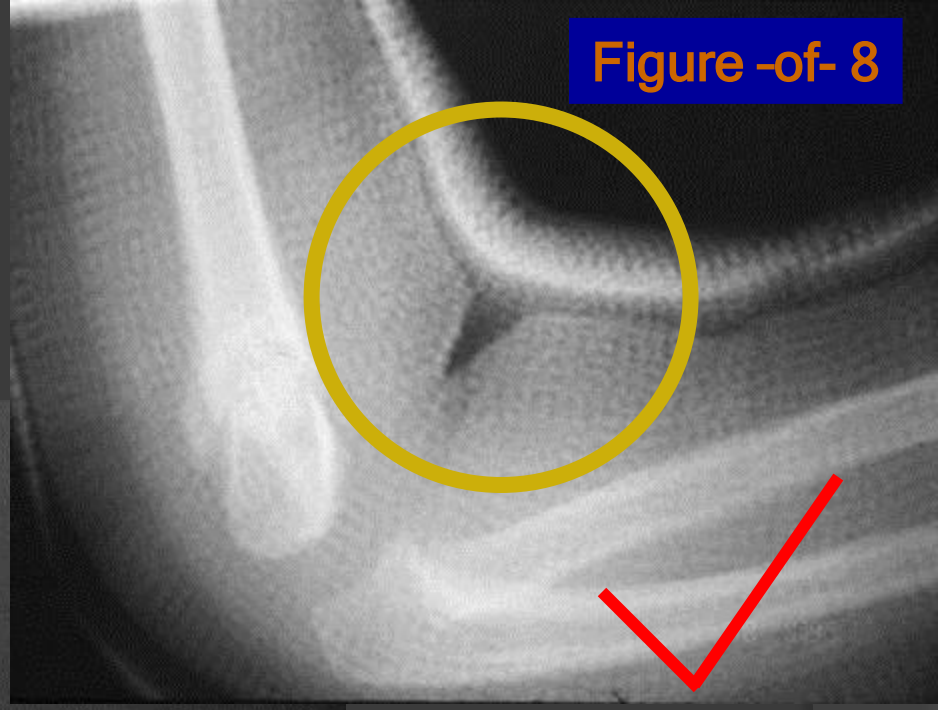
Poor Handling

Don’t “sign” on the cast!

What is the problem?

Buckling





Pressure Sore

Clues of Plaster Sore

- Itching & burning sensation
- Fever, sleep disturbance & fretfulness
- Offensive smell or discharge
- Fluid-stained plaster

Prevention of Pressure Sore

- Good padding
- Proper application of plaster esp over bony prominence & crossing joint
- Out-folding of POP slab to avoid pressure point at corner
- Smooth molding
- Trimming

Plaster Burn

- Heat generated can cause burn, especially if patient is unconscious
- Lower limb long leg POP
  → need more layers for strength
  → more exothermic reaction
- Suggest to use pre-fabricated splint or synthetic cast for LL

Allergy

Follow Up Care

- Check POP fitness
- Detect complications: earlier vs late
- Frequency & timing

What happen & What to do?

16 hrs after POP, develop finger numbness and pain

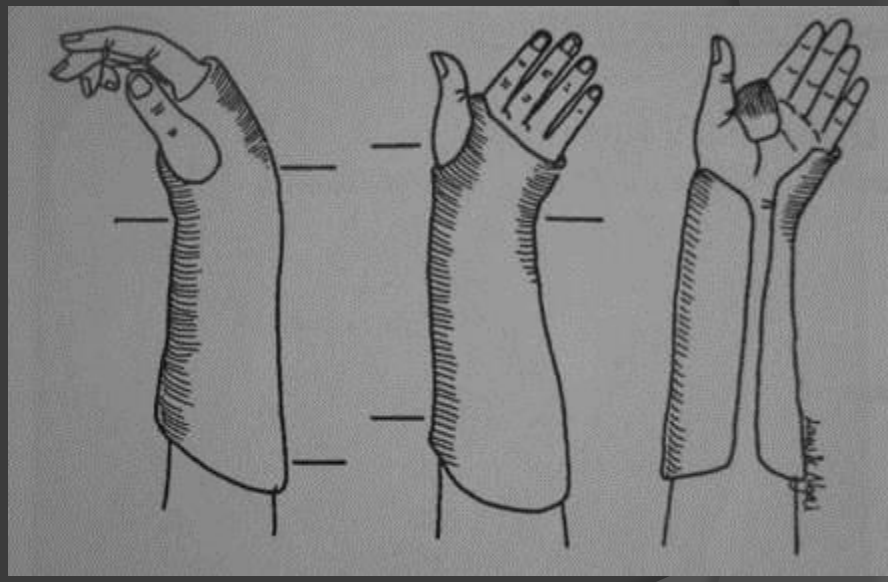
Compartment Syndrome

1. **Split all layers of cast, down to skin, throughout the whole length of cast**
2. **Emergency fasciotomy if clinical suspicious**

Incomplete Slab

- for Acute Cases with Gross Swelling

- Use ¾ dorsal slab for initial treatment of distal radial fracture to prevent over tightening of cast
- Reduce the risk of distal edema / compartment syndrome
-
- Complete cast and then bivalve
  - For better maintainence of reduction



The End

Thank You!