Workshop W10M

Basic Orthopaedics

Speaker: Nettie Stoddart
<table>
<thead>
<tr>
<th>Size</th>
<th>Slab type</th>
<th>Suggested use</th>
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</table>
| 1 inch 2.5cm | Single finger splints  
Thub splints  
Neonatal/Paediatric splints | *Finger fractures  
*To support finger nerve / tendon repairs  
*Immobilization of finger soft tissue injuries |
| 2 inch 5cm   | Paediatric arm & leg splints  
Two finger splints | *Arm & leg injuries in small children / babies  
*Finger or thumb injuries / fractures  
*To support finger nerve / tendon repairs  
*Immobilization of finger soft tissue injuries |
| 3 inch 7.5cm | Small adult ankle stirrups  
Small adult Volar/Dorsal forearm splints  
Child leg and arm back slabs  
Radial /thumb spica splints  
Small adult forearm ‘sugar tongs’ | *Ankle soft tissue injuries  
*Wrist and forearm injuries & stable fractures  
*Scaphoid / Bennetts & thumb fractures  
*Child leg & arm injuries & stable fractures  
*Wrist & hand resting shells  
*To support hand /wrist nerve / tendon repairs  
*IV arm board |
| 4 inch 10cm | Small adult below knee back slab  
Adult ankle stirrups  
Adult Volar / Dorsal forearm splints  
Adult forearm ‘sugar tongs’  
Ulnar / Radial gutter splints  
Large adult thumb spica  
‘Boxer’ Metacarpal splints  
Humeral ‘U’ slab / ‘sugar tongs’ | *Ankle & forefoot soft tissue injuries or stable fractures  
*Stable Fibular fractures  
*Wrist and forearm injuries & stable fractures  
*Metacarpal / Boxer & Metatarsal fractures  
*Elbow / forearm and humeral fractures or injuries  
*To support arm or leg muscle / nerve / tendon repairs  
*Scaphoid / Bennetts, & thumb fractures  
Whole hand injuries  
*IV arm board |
| 5 inch 12.5cm | Adult leg back slabs  
Large adult arm splints  
Humeral ‘U’ slab / ‘sugar tongs’ | *Lower leg & knee injuries & stable fractures  
*Proximal forearm and humeral injuries & fractures  
*Elbow injuries |
| 6 inch 15cm | Large adult leg slabs  
Extra large adult arm splints  
Humeral ‘U’ slab / ‘sugar tongs’ | *Lower leg & knee injuries & stable fractures  
*Proximal forearm and humeral injuries & fractures  
*Elbow injuries |
PRE-PADDED SYNTHETIC SLAB
APPLICATION TECHNIQUES & TIPS TO BETTER SPLINTING

A SLAB; sometimes referred to as a SPLINT; is a hard supporting bandage encircling ¾ of the limb, applied over padding as a temporary or short term treatment method to support and prevent movement, as opposed to a CAST, which is fully circumferential and used in definitive / longer term treatment to fully support, immobilise and maintain the position of an injury or a reduced fracture.

Advantages of using Slabs
- Quick & easy to apply (requiring only water, padded splinting material & a bandage)
- Requires minimal expertise to apply
- Accommodates post injury oedema
- Decreases pain by stabilising the injury site
- Removable & reusable for dressing changes, medical examinations, X rays, etc

General synthetic slab application techniques
1. Select the appropriate width slab for the limb. Choose a width that will ¾ encircle the limb. (The larger the limb circumference and the greater the area to be covered – the wider the slab should be & vice versa)
2. Always measure the limb and then cut the slab to that measurement.
3. Push remaining slab back into foil sleeve packaging, express the air out and immediately close the sleeve opening with the sealing clip
4. Use scissors to trim and shape slab (apply gloves if you are going to touch this inner material)
5. Pull padding open at ends and trim inner cast layer according to desired template, leaving padding intact to extend beyond the cast edge
6. Stretch white padding layer to cover edges, folding it over towards the outside layer
7. Using clean, cold water, spray / wet hydrophilic (outer) side (do not over saturate)
8. If water spills onto white side – dab off with a towel before applying slab to limb.
9. Place the limb & joints in required position (Always splint in the position of stability and where possible, functionality)
10. Place padded hydrophobic (white) side to patient’s skin, folding or overlapping edges to accommodate acute joint angles.
11. Ensure no synthetic material is exposed and touching skin – stretch padding to cover any cut edges
12. Smooth and mould the slab around the limb contours using palms & not fingertips
13. Check that there is no encroachment onto non involved joints
14. Secure slab to the limb with conforming bandage – rolled on without undue tension
15. At acute angles apply a figure 8 turn of the bandage while wrapping; subsequently covering with circular turns.
16. Leave finger / toe tips exposed to enable neurological & circulatory checks
17. Mould and hold / support the limb position while the slab cures
18. Do not rest the curing cast on a hard surface till it has completely set as the splint may flatten at the point of contact – often this is over an area of minimal flesh coverage (e.g. heel, elbow, ulna border etc)
19. Slabs are non-weight bearing
The following templates can be used as POP slab templates
BUT padding must be applied between the limb and the POP

- Apply a layer of undercast wool around the limb before applying the wet POP slab.
- Alternately lay a few layers of undercast wool down on the work surface slightly wider & longer than the slab, place the wet POP slab onto this sheet of wool, lift the entire (POP & woo) slab and apply with the padding side to the limb.
- Secure the slab to the limb with a cotton conforming bandage (wet crepe bandages tend to stretch causing the slab becomes loose (they will absorb the moisture from the wet POP)

**UNIVERSAL BELOW ELBOW VOLAR or DORSAL SLAB (template 1)**
(average 3 – 4 inch width slab)
Measure from the base of the index finger crease (MPJ) to 5cm from the cubital fossa (elbow crease). Leave padding intact while trimming slab according to template

**Volar Slab**
- Measure, cut, trim / shape as per template.
- Place the slab blue side up and ensure you cut the correct side (left or right)
- Stretch padding to cover cut edges and wet slab
- Place slab onto anterior aspect of forearm and hand with cut out ‘D’ shape around thumb and through web space with angled top edge along proximal palmar crease.
- Check that there is no sharp edge through the thumb web space
- Check that there is no encroachment into the cubital fossa.
- Secure to the hand and arm with a bandage.
- Mould into the prescribed position.

**Dorsal Slab**
- Measure, cut, trim / shape as per template
- Place the slab blue side up and ensure you cut the correct side (left or right)
- Stretch padding to cover cut edges and wet slab
- Place slab onto back of hand & forearm with cut out ‘D’ shape around thumb and through web space with angled top edge along knuckle line.
- Check that there is no sharp edge through the thumb web space.
- Check that there is no encroachment when extending the elbow.

- Secure to the hand and arm with a bandage.
- Mould into the prescribed position.
VOLAR and DORSAL SLAB (template 2)
(average 3 - 4 inch width slab)
Measure from the base of the index finger crease (MPJ) to 5cm from the cubital fossa and double this measurement

- Trim / slab according to template. Fold the slab in half (blue side out) and make a small initial cut along the fold. Pull a short strip of the padding apart along the sealed sides adjacent to the cut – Slide the scissors between the inner & outer padding layers and cut through the cast material to the opposite side and remove a flat triangular piece from the volar edge as shown in template. Close the opening, lay the slab flat, stretch the slab so that the padding is stretched at centre point; now cut through this area of the padding to within an inch of the opposite edge
  - Stretch padding to cover cut edges and wet the slab
  - Place slab onto anterior aspect of forearm with the trimmed edge along proximal palmar crease and the other cut edge along knuckle line with the uncut hinge through the thumb web space.
  - Check that there is no encroachment into the cubital fossa.
  - Secure to the hand and arm with a bandage.
  - Mould into the prescribed position.

FOREARM SUGAR TONGS
(average 3 - 4 inch width slab)
Measure from proximal palmar crease down around elbow to knuckle line.
- Trim top edge as per universal Volar / Dorsal slab to follow palmar crease with ‘D’ cut out
- Place slab into palm with cut out ‘D’ shape around thumb and through web space with angled top edge along proximal palmar crease, continue the placement down anterior aspect of forearm, around the 90° flexed elbow and back up the dorsal forearm to knuckle line – the slab forming a ‘U’ around the elbow
- Don’t forget to stretch padding to cover cut edges before wetting the slab

FOREARM REVERSE SUGAR TONGS
(average 3 - 4 inch width slab)
Measure the length from the finger tips, down the forearm, around the flexed elbow and back up the forearm to the fingertips.
- Use the above template and apply as above but the excess needs to be folded over at the elbow – position one side of the excess material around / under the elbow and overlap the other end over that. Secure the slab and lock in place at the elbow with couple of figure 8 turns.
VOLAR and DORSAL SLAB (template 3)

(average 5 - 6 inch width slab)

Measure, cut, trim / shape as per template

For the central triangle cut out
Fold the slab in ½ lengthways with outer (blue) layer facing out, and 1 inch down from top edge, cut a 1½ inch slot through the folded edge. Slide the scissors under the cut and remove a triangle out of the cast material and outer (blue) layer with the apex pointing down (see template) leaving the inner white padding intact. Make a small cut in the inner white padded layer at right angles to the original cut down toward the apex of the triangle. Stretch the padding at the original cut to fold over and cover that cut edge

- Stretch padding to cover cut edges and wet slab.
- Slide the thumb through the cut-out-triangle slot, align the distal edge with the distal palmar crease and fold the slab onto the dorsum and volar aspect of hand & forearm with the slab opening along the Ulnar border.
- Check that there is no sharp edge through the thumb web space
- Check that there is no encroachment when extending the elbow.
- Secure to the hand and arm with a bandage.
- Mould into the prescribed position.
THUMB IMMOBILIZER (template 4)

(average 4-5 inch width slab)
Measure from the middle crease (PIPJ) of the middle finger to 5cm from the cubital fossa (elbow crease).

- Measure, cut, trim / shape as per template.
- Place slab white side down on volar aspect of hand / arm with top edge at PIPJ and one side edge overlapping the base of the thumb. Mark the slab at the thumb web space. Cut down from the centre of the top edge, obliquely to the thumb web mark leaving a ½ - ¾ inch bridge intact. Cut away the portion between top edge and mark at a 10° angle leaving the triangle attached to the bridge. (see template)
- Stretch padding to cover cut edges and wet slab
- Place slab onto volar / anterior aspect of forearm and hand with triangle level with thumb and 10° cut edge along proximal palmar crease.
- Check that there is no sharp edge at the thumb or web space. Starting at the web space, wrap the thumb triangle around the thumb.
- Check that there is no encroachment into the cubital fossa.
- Secure to the thumb, hand and arm with a bandage.
- Mould into the prescribed position.
**THUMB SPICA**
(average 2-3 inch width slab)
Measure from the tip of the thumb to 5cm from the cubital fossa (elbow crease).
- Measure and required length.
- Stretch padding to cover cut edges and wet slab
- Place slab at the tip of the thumb and along the Radial aspect of the forearm.
- Overlap the excess width around the thumb allowing the slab to flare out around the base & web space.
- Check that there is no encroachment into the cubital fossa.
- Secure to the thumb & hand with a couple of figure 8 turns and continue to spiral down the arm with the bandage.
- Mould into the prescribed position.

**FIGURE 8 THUMB SPICA**
(average 1 inch width slab)
Measure from the Ulnar styloid, diagonally across the dorsum of the hand to the Radial side of the thumb, around the thumb through the web space and continuing around to cross the Thenar eminence to the Ulnar border of the wrist
- Measure and required length.
- Stretch padding to cover cut edges and wet slab
- Place the centre on the thumb web space and direct the two ends down towards the wrist, crossing over each other in a figure 8 on the dorsum of the base of the thumb and almost meeting at the Ulnar styloid.
- Secure to the thumb & hand with a couple of figure 8 turns continuing to spiral around hand & wrist with the bandage.
- Mould into the prescribed position.

**THUMB SPICA / SCAPHOID SLAB (template 5)**
(average 5-6 inch width slab)
Measure from the middle crease (IPJ) of the thumb to 5cm from the cubital fossa (elbow crease).
- Measure, cut, trim / shape as per template.
Lay slab down with outer (blue) side uppermost. Roughly divide the width into 3
Starting at the top edge at the outer ½ mark, cut obliquely to the edge removing a triangle (from the left side for the left thumb and the right side for the right thumb). Leave the middle 3rd intact by cutting 1½ inches down along the outer 3rd line and at right angles to remove a rectangle from the opposite corner. (see template)
- Stretch padding to cover cut edges and wet slab
- Centre the slab along the Radial aspect with the middle third at top edge at thumb IPJ and fold the excess closely
around the thumb. Position the outer thirds around the back of the hand and along the proximal palmar crease

- Check that there is no sharp edge at the thumb web space or palm.
- Check that there is no encroachment into the cubital fossa.
- Secure to the thumb, hand and arm with a bandage.
- Mould into the prescribed position.

**ULNAR // DUCKBILL / BOXER’S SLAB (template 6)**

(average 4 - 5 inch width slab)

Measure from the tip of the little (5th) finger to 5cm from the cubital fossa (elbow crease).

- Measure to required length and trim
  Slide the scissors between the outer padding layers approx 1 inch in from the side at the top edge and trim diagonally down approx 2 inches to the side edge removing this triangular piece from both sides (see template).
- Stretch padding to cover cut edges and wet slab
- Place a layer of padding between the Little & Ring (4th & 5th) fingers and ‘buddy strap together.
- Create a gutter by placing the top edge of the slab at the DIPJ of the Little (5th) finger, folding the padding from the triangular cutaway around the strapped fingers, centring the length of the slab down the Ulnar aspect of the forearm.
- Check that there is no encroachment into the cubital fossa.

- Secure the slab to the arm and hand with a bandage, including wrapping around the 4th & 5th fingers.
- Mould into the prescribed position. (looks like a ‘duckbill’ with wrist extended approx 20º and MCPJ flexed 70 - 90º)

**RADIAL / ‘DIAMOND’ or ‘TEARDROP’ SLAB (template 7)**

(average 4 - 5 inch width slab)

Measure from the tip of the middle (3rd) finger to 5cm from the cubital fossa (elbow crease).

- Measure to required length and trim
  Fold the slab in ½ lengthways with outer (blue) layer facing out, and approx 4½ inches down from top edge, cut a 1½ inch slot through the folded edge. Slide the scissors under the cut and remove two flattish triangles out of the cast material and outer (blue) layer with the initial cut forming the base of each triangle to leave a diamond shaped opening (see template) leaving the inner white padding intact. Make a small cut in the inner white padded layer at right angles to the original cut down toward the apex of each triangle. Stretch the padding at the original cut to fold over and cover that cut edge
Stretch padding to cover cut edges and wet slab
Place a layer of padding between all the fingers and ‘buddy strap 2nd & 3rd fingers together.
Slide the thumb through the diamond hole, placing the top edge of the slab at the DIPJ of the index finger, folding the slab around the fingers and hand, centring the length of the slab down the Radial aspect of the forearm, creating a gutter.
Check that there is no encroachment into the cubital fossa.
Secure the slab to the arm and hand with a bandage, including wrapping around the fingers.
Mould into the prescribed position. (looks like a ‘duckbill’ with wrist extended approx 20º and MCPJ flexed 45 - 50º)

ABOVE ELBOW SLAB
(average 5 – 6 inch width slab)
Measure from the base of the little (5th) finger to approx 2 - 3 inches from the axilla)
If the hand is not to be included – measure 1 inch from the Ulnar Styloid to approx 2 - 3 inches from the axilla.
- Measure to required length and trim
- Stretch padding to cover cut edges and wet slab
- Create a gutter by centring the length of the slab down the Ulnar aspect of the forearm with the one edge starting proximal to the distal palmar crease at the little (5th) finger (or 1 inch from the Ulnar styloid), folding around the elbow, continuing up the lateral aspect of the upper arm and finishing short of the axilla.
- Pinch the excess at the elbow into a ‘dart’ and fold to one side – Take care not to push the bulk in towards the elbow and cause a pressure point
- Alternately prior to wetting slab, measure against the arm to determine and mark elbow position. Make a 2 inch cut at right angles from the edge at the elbow mark, pull a short strip of the padding apart along the sealed sides adjacent to the cut – Slide the scissors between the inner & outer padding layers and cut through the cast material removing a triangular piece from each side of the cut and close the padding. Apply as above and overlap the excess at the elbow.
- Check that there is no encroachment into the axilla or pressure over the Brachial Plexis.
- Secure the slab to the arm and hand with a bandage.
Mould into the prescribed position. (functional position normally elbows are flexed to 90° with forearm in neutral rotation)

Tips

1. Wrapping of bandage
   Start at the wrist, around the forearm up to the elbow and onto the upper arm leaving the elbow unwrapped, continue up towards the axilla. Go back to the unwrapped area at the elbow and adjust / overlap / reposition the excess material at the elbow till it lies nice & flat. Take care not to push the bulk in towards the elbow and cause a pressure point. Now complete the wrapping taking a couple of figure 8 turns around & covering the elbow area.

2. Holding position while slab is curing
   Use tape to wrap a couple of figure 8 turns to hold the elbow in 90° while the slab is curing & setting. Start by attaching ‘strapping tape’ (fabric backed zinc oxide tape is the most effective) at the Ulnar border at the wrist, taking a diagonal strip up towards the axilla area crossing over the front of the elbow, around the back of the slab at the top of the upper arm, back down to the wrist, again crossing over the front of the elbow. Use a wide tape to ensure that a ridge is not formed from the tension / pressure of the tape as it supports the position at the wrist and the top edge of the slab.
   If there has been give in the tape & position needs to be adjusted – twist the tape at the crossover to tighten it and pull the elbow back up to the required position.

BELOW KNEE SLAB
(average 5 – 6 inch width slab)
Measure from 2 inches below the Popliteal area to just beyond the tips of the toes.

- Measure to required length and trim
- Stretch padding to cover cut edges and wet slab
- Create a gutter by centring the length of the slab down the back of the leg from below the poplitical area, folding around the heel, along the plantar aspect / sole of the foot and ending just beyond the tips of the toes. (if there is excess length – fold it over onto itself to provide a double layer to reinforce the toe platform)
- Pinch both sides of the excess formed at the ankle / maleolus into a ‘dart’ and fold down towards the foot – Take care not to push the bulk in towards the ankle and cause a pressure point
- Alternately prior to wetting slab, measure against the leg to determine and mark the ankle position. Make a 2 inch cut at right angles from the edge at the ankle mark, pull a short strip of the padding apart along the sealed sides adjacent to the cut – Slide the scissors between the inner & outer padding layers and cut through the cast material removing a triangular piece from each side of the cut and close the padding. Apply as above and overlap the excess at the ankle.
- Check that there is no encroachment into the Popliteal Fossa or pressure over the Common Peroneal Nerve at the Fibular Neck.
- Secure the slab to the leg with a bandage. Start wrapping at the toes to calf.
- Mould into the prescribed position. (functional position normally with the foot in neutral rotation and 90° at the ankle)

Tips

3. Wrapping of bandage
   Start at the toes, around the forefoot and across to the Achilles area leaving the heel & ankle unwrapped, continue up towards the knee. Go back to the unwrapped area at the ankle and adjust / overlap / reposition the excess material at ankle till it lies nice & flat. Take care not
to push the bulk in towards the ankle and cause a pressure point. Now complete the wrapping taking a couple of figure 8 turns around & covering the ankle area.

4. **Holding position while slab is curing**

Use tape to wrap a couple of figure 8 turns to hold the ankle in 90º while the slab is curing & setting. Start by attaching ‘strapping tape’ (fabric backed zinc oxide tape is the most effective) under the metatarsal heads area, crossing over to the front of the ankle, taking a diagonal strip up to the knee area, around the back of the slab (below the popliteal area) back down to the foot, again crossing over the front of the ankle to the sole of the foot. Use a wide tape to ensure that a ridge is not formed from the tension / pressure of the tape as it supports the position under the metatarsal heads and the top edge of the slab.

If there has been give in the tape & position needs to be adjusted – twist the tape at the crossover to tighten it and pull the foot back up to the required position.

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**Basic Emergency Slabbing**

Immobilization of an injured extremity should ideally begin as soon as possible at the accident site after stabilization of any life threatening injuries. This initial management can be with any available materials from ‘Mum’s broom handle and Dad’s ties’ to the ‘Blow up’ Urias type splints carried by Ambulances.

The initial treatment is invaluable for

1. pain control
2. decrease further soft tissue injury
3. Oedema management.

Generally, most Orthopaedic injuries will be immobilized in a POP SLAB in the Emergency Department; the injury dictating the temporary or definitive nature of the immobilization treatment.

A SLAB (sometimes referred to as a SPLINT) is a hard supporting bandage encircling ¾ of the limb, applied over padding as a temporary or short term treatment method to support & prevent movement, as opposed to a CAST, which is fully circumferential and use in definitive / longer term treatment to fully support, immobilise and maintain the reduced fracture.

There is no absolute contra-indication for applying a Slab to an injured limb other than the relative considerations of soft tissue injuries and embedded foreign objects. In these cases the injury is covered with dressings and appropriately padded to prevent pressure before applying the Slab prior to transport to Hospital or Operating Theatre.

Advantages of using Slabs

• Quick & easy to apply (requiring only water, POP bandages and padding)
• Economical and readily available materials
• Requires little expertise
• Accommodates post injury oedema
• Slightly less rigid / more adjustable than a Cast

The aims for immobilization are

• Decrease pain by stabilising the injury site
• Decrease further soft tissue injury from bony fragments
• Decrease the motion & traction on the vital periosteum
• Protect adjacent neurovascular structures from further damage by the fractured bone ends
• Helps reduce morbidity associated with long bone fractures

Casting in Acute situations
There is a simplicity in emergency casting situations
1. Close inspection of limb and injuries
2. Routine emergency wound cleaning and dressing
3. Apply padding and a Slab
4. Bandage in place
5. Stabilize the limb for transport
6. Documentation

Naturally the injury and subsequent treatment will not be as simple
All skin wounds need to be closely inspected to ensure that an open fracture is not missed – obvious ‘from outside to within’ wounds are relatively easy to recognise but the often subtle skin puncture made by the ‘from within to out’ ‘pin hole’ size wound is easily missed - this oversight is inexcusable and will have serious consequences for the patient with at the very least an increased infection risk of 5%.
Always perform (and document) a neurological and vascular examination prior to and immediately after immobilization.

Casts (i.e. completely encircling) should not be used except with great caution in the acute arena as they limit the space for increasing tissue oedema and thus are associated with an increased risk of Compartment Syndrome. Where used, these casts should be POP and split or Bi-valved before discharge. (OsteogenesisImperfecta)

DO NOT use complete casts in the face of:-
1. Extreme oedema
2. Significant soft tissue injury
3. Inadequate /no reduction

General Casting Considerations
1. Padding
   • Generally padding is applied from distal to proximal – from the smallest circumference to the larger spiralling around the limb with 30 - 50% overlap
   • Apply padding thick enough to provide protection (1-2 layers with 2-3 layers over bony prominences and proximal / distal ends). If the padding is too thick it will compress down causing the cast to become loose and compromise the effectiveness to maintain fracture reduction
   • Apply with slight tension so it lies down smoothly without wrinkles or creases.
   • Check bony prominences and apply 1-3 small torn off patches of padding directly where needed – do not build up circumferentially around the limb

2. Pressure Points
   • Ensure that no ridges, creases, wrinkles or finger indentations are in the finished cast
   • Do not rest the fresh cast on a hard surface (bed rails etc) till it has completely set as the cast may flatten at the point of contact – often this is over an area of minimal flesh coverage (e.g. heel, elbow, ulna border etc)

3. Application tension
   • Do not apply any tension on bandages when applying a cast

NETTIE STODDART
ORTHO CARE PTY LIMITED
UPDATED 04/12
Toll Free Number 1800 226 445
• When applying a cast, do not lift the roll off the limb or pull on bandage to change direction
  • In POP take tucks in the one edge to change direction of wrapping while with the Synthetic casts – ease the material slightly into the desired direction.

4 Application Tips
• Only experience can teach the quantities (number and size of bandages) required for each particular cast. This will be determined by various factors: - the extent of the cast, size of the limb, age, sex & personality of the client (i.e. what they will do while in the cast) even the type of casting material used.
• The larger the limb circumference and the greater the area to be covered – the wider the bandage can be. Vice-a-versa.
• For larger casts e.g. above knee casts, apply the cast in sections – i.e. covering & immobilizing one joint at a time starting with the crucial joint first. When 50-75% of each section has been applied, rub / smooth / mould the cast firmly to ensure optimum lamination occurs and allow the material to set before continuing onto the next joint. When extending the cast to the next section / joint, overlap uncured casting tape half way to the previously immobilized joint.
• When applying the cast in sections – do not overlap the padding onto existing cast or interpose dressings, bandages or any materials between layers of the casting material.
• Always splint in the position of stability and where possible, functionality – functional positioning is vitally important in the longer term definitive casts but not so critical in the initial short term trauma slab.
• Ensure that you have assistance to apply the slab /cast.
• After care is aimed at reducing oedema and patient education

5 Moulding
• Casts are applied & smoothed to conform to the shape of the limb
• Casts / splint rely on 3 point pressure moulding to maintain position and reduction.
• Charnley – 1 point of contact centred under the convex side of the fracture with the other 2 aimed in the opposite direction, proximal & distal on the concave side
• The conforming and moulding of the cast also cause the soft tissues to exert a degree of hydraulic force onto the fracture which helps maintain length and alignment by preventing axial loading.

Trauma Physiology as relating to Casting

Circulatory & Neurological impairment
Causes
1. Directly related to the injury e.g. Humeral # particularly the Halstein Lewis # (junction middle and distal 1/3 with a lateral spike) has a high association with radial nerve injury
2. Cast (or undercast padding) applied too tightly
3. Uneven tension on bandage during application
4. Insufficient padding to allow for increasing oedema of limb
5. Local pressure on areas where the nerves / blood vessels are close to the surface
6. Changing joint position after casting material is applied and before it is cured

Observations
Increasing oedema
• Venous pressure causes the extremities of the limb to appear engorged and excessively red/purple. This is usually associated with increased pain and swelling.
• Arterial pressure causes the extremities to appear white/blanched and cold. On pressure to the toe/finger nails, they will remain white with no indication of blood circulation. Muscle can last 6-8 hours but the ischaemic muscle has no potential for regeneration and will result in fibrous scarring and Volkmann's Ischemic Contractures. If not relieved the extremities will gradually turn blue and then black and the resulting ischaemic damage to the tissues is irreversible.
• Neurological pressure initially manifests as altered sensations, followed by pins & needles and then parasthesia. As the stages progress there is a corresponding increase in pain and decrease in movement. Intractable pain may indicate incipient ischaemia. Nerves will function for about 2-4 hours and following loss of function, peripheral nerves have the potential to recover.

Compartment Syndrome
A condition in which increased tissue pressure within a limited space compromises the circulation and the function of the contents of that space.
Most common after supra condylar fracture of the Humerus in children, proximal 1/3 Tibial fractures, fractures of the femur
The first and most important symptom of an impending acute compartment syndrome is pain that is greater than expected from the primary problem, such as a fracture or contusion. Excruciating pain on stretching the involved muscles (passive extension of digits) and Parasthesia is nearly always present as each compartment in the arm or leg has at least one major nerve passing through it.

Plaster / Pressure Sores
Early recognition and treatment is important because the skin and underlying tissue will exhibit signs of ischaemic necrosis after only 2 hours of continuous pressure. Pain will disappear as the superficial neurological system is damaged. A necrotic ulcerated area, initially superficial, progressing to full thickness, can result. This may take months to heal and leave permanent scarring and may even require skin grafting or plastic surgery to heal. Take all complaints of pain seriously and split or window cast over trouble area.

Causes
1. Uneven bandaging technique
2. Uneven tension on bandage during application
3. Cast has dents from fingertips or damage while still soft
4. Insufficient padding over bony prominences
5. Too much padding – compressed down to leave a loose cast
6. Changing joint position after casting material is applied and before it is cured
7. Badly finished edges
8. Foreign objects inside the cast
Any foreign object introduced inside a cast will cause localized pressure which can damaged the skin and also cause pressure sores.
Children –small toys e.g. Lego, money, sweets, food etc
Adults scratching inside the cast with knitting needles, biros, rulers, coat hangers etc
Observations
• Burning, ‘gnawing’ or sharp stabbing pain
• ‘Blister’-like pain
• Complaints of pain which has disappeared
• Local heat
• Offensive smell
• Staining seeping through the cast

Treatment
• Determine / clarify the specific localized area
* Run your hand along the length of the cast feeling for a ‘hot spot’
* Get the patient to pinpoint or generalize the area
* Foreign objects, X-rays may be needed to visualize the exact area
• Cut a generous window over the area & inspect skin
• If the skin is compromised – notify medical staff
• To prevent local oedema – replace window with extra padding
• Permanently (plastering it back into cast) or temporarily (strapped back into place with a bandage). Where it is not possible to replace window (fallen apart, destroyed, in 2 or more pieces) make a new ‘lid’ and replace with this.
• Tighten or replace loose cast

Fracture Blisters
There is very little objective data in the literature detailing the characteristics and management of Fracture blisters. These are areas of epidermal necrosis with separation of the stratified squamous cell layer by clear transudate fluid or blood filled. The blood-filled blisters have been shown histologically to have complete separation of the dermis from the epidermis, whereas the clear fluid-filled blisters demonstrate partial separation of the epidermis from the underlying dermis, with a few scattered areas of retained epithelial cells on the dermis. They occur singly or in multiples and may be quite large and arise on markedly swollen skin directly overlying the fracture where there has been an associated torsional injury to the soft tissues - most commonly the tibia, ankle, and elbow. In most instances, they arise within 24-48 hours post acute injury. The present practice is to leave all fracture blisters intact since the fluid remains sterile (once ruptured the blisters are contaminated with skin flora). If the blisters rupture spontaneously, they are deroofed and covered with a non-adherent dressing (re-epithelialisation may take up to 3 weeks).

Allergic Reactions
Allergic reactions are rare with Plaster of Paris. This manifests as a non specific red flush / rash on any skin surfaces that touches the cast – e.g. on the opposite leg.
Skin reactions (itching, rash, skin weeping, etc) are far more common with the application of synthetic underpadding and casting materials. Some people are unable to tolerate being enclosed in a cast (e.g. those who develop ‘prickly heat’ or psoriasis)

Treatment
Where possible – the cast should be changed using another lining material after cleaning the skin thoroughly

Thermal injury
• All casting materials have an exothermic reaction during the curing stage. This temperature will be felt as warm – it should not be hot. ‘Plaster burns’ are most often caused by unskilled and inexperienced application techniques by using too warm or hot water or trapping the heat by resting the cast on plastic covered pillows.
• For this reason it is important to use only lukewarm to cool water when immersing plaster material. Be careful if using water from preset controlled taps).
Problem Solving

Good casting technique is the best way of ensuring that complications do not occur. Remember that prevention is always better than a cure. Strive to perfect your casting techniques and impress on the patient to return immediately and seek help for any untoward problems.

Then watch for the 6 Ps

1. Pain
2. Pallor
3. Pulseless
4. Parasthesia
5. Paralysis
6. Perishing cold

Determine the underlying cause and initiate problem solving mechanisms. And always document initial findings, treatment performed and results. If in doubt – split cast and all underlying materials – including wound dressing, till skin can be seen along the entire length of the cast.

Inspection of Extremities

This is one of the most essential observations required for the first 48 hours after the application of a cast. Fingers & toes should be warm and rosy and should flush quickly with returning blood on release of digital pressure (note that in dark skinned patients this is easier to observe in the nail area than surrounding skin).

All injured limbs are generally elevated to help control oedema – unfortunately one of the effects of limb elevation is a lowering in local arterial pressure and decreases tissue PO2. If the blood flow is reduced, elevation of the limb or compression within the POP will further reduce the blood flow. Check to see if lowering the limb below the heart level will improve the situation. Newly applied casts feels warm and then becomes relatively cold as the cast dries by evaporation causing a chilling effect to the underlying limb – again check if warming the extremities improves the circulation. If in any doubt as to circulation – split cast or bandages – do not remove!

Treatment

• Medical staff should be notified immediately as any delay may have lasting consequences
• Elevate the limb & keep extremities warm
• Encourage regular full range of motion of the extremities actively or passively
• Window the cast where a local pressure area can be pinpointed
• Split the cast and all underlying padding along the length of the cast; opening the split till skin can be seen along the entire split.
• Documentation.
BASIC CASTING APPLICATION

As all casting materials have a limited working time (average 3-7 minutes), materials needed should be assembled and laid out close to hand before starting to apply the cast. Another helpful preparation is to mentally review the application steps and visualize the cast parameters. Once the casting material is activated (POP dipped / Synthetics packet opened), immediately start applying the cast as quickly as possible.

SET UP
- Choose appropriate size Stockinet and Undercast Padding.
- Lay out the unopened number / size of Casting Tape rolls / slabs.
- Bucket of lukewarm water (20-25°C).
- Gloves & Scissors.
- Accessories (protective strip, cast shoes, bandages, hinges etc).
- Limb support / assistant as required.
- Protective apron/ gown and couch coverings.

STOCKINETTE
- Cut stockinet to required length, plus extra to allow for ‘stretch shrinkage’ and 3-4cm for a turnover at proximal & distal edges of the cast.
- Cut a thumb hole approximate 5-6cm from one end.
- Position the limb in required (functional) position.
- Where thumb is included in the cast, apply tubinette.
- Roll stockinet into a ‘doughnut’, slip over the foot / hand and unroll along the length of the limb (this method will eliminate wrinkles).
- Allow the thumb to protrude through the hole.

UNDERCAST PADDING
- Commence spiral wrapping from distal section of limb.
- Overlap each turn of the padding by 50%.
- Keep wrapping firm with no wrinkles.
- Extend padding approximately 1cm beyond the desired completed cast parameters.
- Apply extra padding over bony prominences, as required.

WATERPROOF UNDERCAST PADDING
- Do not apply any stockinet or any other undercast padding.
- Extend padding approximately 1cm beyond the desired completed cast parameters.
- Only apply extra padding directly over bony prominences if require.
- The projecting material (proximally and distally) can be turned down over the edge and secured onto the cast or left as is.
- Apply a cast removal protective webbing strip (so it is between padding and cast).

CAST REMOVAL PROTECTIVE STRIP
- Measure and cut appropriate lengths of the protective strip.
- Lay this on top of the waterproof undercast padding, sticky side down, along the visualised cutting line for removal of the cast.
- The tape will not lie flat if curved around acute angles, so cut two pieces and place them at right angles to each other, overlapping at the angle.
• Avoid placing the tape directly over bony prominences.
• Apply so that the ends will be visible projecting beyond the edges of the cast.

Alternately – a plastic protective strip can be inserted between the cast and padding or between cast and skin prior to removal of the cast

APPLYING THE CAST

PLASTER OF PARIS
1. Remove the required bandages from the packages, laying them in order of use on your work surface.
2. Position and support the limb. Never attempt to correct / change position once the casting material is applied or by pulling on the bandage during application. Only minor repositioning adjustments are practicable during moulding and prior to cast setting. While applying the cast constantly check that position is maintained.
3. Apply the undercasting materials to the limb.
4. Lay the bandage lengthways across the fingers with the leading edge pointing towards the fingertips and place the little finger under the central core while dipping bandage.
5. Immerse the bandage in fresh, room temperature water (21-24°C), held at a slight angle (approximately 45°) until bubbles stop escaping from the bandage (approximately 5 seconds). Do not squeeze the bandage whilst still immersed. Cool water will slow down the setting rate, while warmer water will accelerate the process (however too high a temperature may result in excessive heat generation while setting).
6. Withdraw the bandage from the water and using both hands grip the ends of the roll between the thumbs and first two fingers and give the roll a ½ twist to gently squeeze the excess water out of the bandage. Do not wring the bandage or re-immere it.
7. Unroll the bandage without tension, keeping the roll in contact with the limb. Wrapping around the pre-padded extremity in a spiral motion, ensuring each turn is overlapped by approximately half a bandage width. Do not stretch or pull the bandage but keep it flat while following the body contours and to change wrapping direction take a tuck at the upper or lower edge of the bandage.
8. Give a quick smoothing rub between layers with your free hand and rub the final layer with smooth, firm strokes to compress the air out between the layers and ensure a solid, well-laminated cast. (It is important that this final rubbing and moulding is done while the material is still workable and before it starts to set.). During rubbing and moulding, care must be taken to ensure that only the palms of the hands are used. Using fingers or thumbs will result in indentations which may cause pressure areas and resulting loss of skin integrity.
9. The setting / curing will occur 3-4 minutes after the bandage is brought into contact with water and the cast will need 24 -72 hours to dry and gain full strength / to become weight bearing.

SYNTHETIC MATERIALS
(RIGID)
1. Lay out packages and only open the packet immediately prior to using.
2. Apply the undercasting materials. (Stockinet and padding / waterproof padding with Protective Strip)
3. Wear gloves when handling synthetic casting materials.
4. Open the pouch and dip the bandage in the water.
5. Immerse for 5-10 seconds or squeeze 2-3 times while fully immersed, lift out and apply immediately.
6. Apply by unwinding spirally around the limb without tension.
7. Overlap the previous turn by 50-75%.
8. If needed, trim edges of cast before applying last bandage.
9. Turn stockinet / underpadding over the edge and secure with the last few turns of the casting tape. Waterproof padding & protective strip can be left as is – projecting.
10. Rub the surface of the cast firmly to encourage lamination and mould as required.
11. During rubbing and moulding, care must be taken to ensure that only the palms of the hands are used. Using fingers or thumbs will result in indentations which may cause pressure areas and resulting loss of skin integrity.
12. The setting will occur 3-3.5 minutes after the bandage is removed from the sealed packaging and immersed in the water and the cast will be full strength within 20 minutes

(SEMI RIGID)
1. Select bandages and lay out packages. Only open the packet immediately prior to using.
2. Wear gloves when handling synthetic casting materials
3. Apply a double stockinet layer with no other underpadding.
4. Open the pouch and dip the bandage in the water.
5. Immerse for 10 seconds then squeeze 2-3 times while fully immersed, lift out and apply immediately.
6. Apply by unwinding spirally around the limb without tension.
7. Overlap the previous turn by 50-75%.
8. If needed, trim edges of cast before applying last bandage.
9. Turn stockinet / underpadding over the edge and secure with the last few turns of the casting tape.
10. Rub the surface of the cast firmly to encourage lamination and mould as required.
11. Setting will occur in 3-5 minutes and achieve functional immobilization in approx 15 mins.
12. The number of layers applied will determine the amount of support obtained i.e. the more layers applied, the more rigidity / less spring / greater resistance to joint movement will be achieved.
13. To remove the cast – prise the end of the bandage loose and by exerting traction, the casting material can be stripped off. Alternatively it can be cut with scissors.

TRAUMA SLABBING
PLASTER OF PARIS
1. Select the appropriate size, measure the required length and cut the needed number of strips off the roll.
2. Alternatively manufacture a slab by repeated folding of a Plaster bandage. Tuck the end of the bandage under the top layer to stop the top layer from falling out of alignment when dipped.
3. Lay them in order of use on your work surface.
4. Trim so that it will fit without having to be folded over at edges.
5. Position and support the limb.
6. Apply the undercasting materials to the limb.
7. Grasp the slab firmly at ends and fold / concertina the slab length between the two hands in preparation for dipping.
8. Keeping hold of the ends and the bunched material held between both hands immerse completely, lift out and without changing hold, squeeze the material held between hands to remove excess water.
9. Consolidate the layers: pull hands apart to open up the slab, lay the slab down on a surface and with one quick movement smooth / press the layers together. Alternatively hold the slab at one end and smooth the layers down along the edges between two adducted fingers.

10. Carefully position the slab and smooth / mould it to the contours of the limb without ridges / wrinkles. Apply slab so that gravity assists rather than hinders.

11. Where slabs make an abrupt change of direction either fold the excess flat or make a cut at right angles to the edge and overlap the two flaps.

12. While applying the slab constantly check that position is maintained.

13. In the cast of long and wide areas to be covered with the slabbing (e.g. above knee slab) The cast will need reinforcing at knee and ankle – Do this by layering the slabs – one down the centre back and then place the next two on either side, overlapping onto the first central slab at the top of the thigh and bring them closer as you come towards the popliteal area so that the edges are butted together here, and completely overlap each other when you get to the ankle (if the slab is too wide here, fold the outer edges down to the level of the maleoli. This will give you three layers of slab down the centre back of the leg. If required this slab can then be further reinforced with one more central slab.

14. Bandage use to secure slab should be open weave (cotton or muslin but not crêpe). Thoroughly wet and wring out the bandage, wrap around slab & limb and secure end with a small piece of wet Plaster bandage.

SYNTHETIC SLABBING
1. Position and support the limb.
2. Apply the stockinet or padding to the limb if this is not included as part of the slab.
3. Select the appropriate size slabbing and measure the required length off the roll. (Or select the appropriate precut Slab)
4. Reseal the foil sleeve of the roll.
5. Trim the inner slab material leaving the padding intact to project beyond the edge so that it will fit without having to be folded over at edges.
6. Where slab needs an abrupt change of direction, pull the padding apart at that area and make a cut at right angles to the edge so that the two flaps can be overlapped when applying.
7. Wet / spray the outer side of the slab (blue) and apply the padded side to the limb. Alternatively, dip the slab in water and squeeze excess water out after rolling the slab up in a towel.

APPLICATION TIPS
• Only experience can teach the number and size of bandages required for each particular cast. This will be determined by various factors: - the extent of the cast, size of the limb, age, sex & personality of the client (i.e. what they will do while in the cast) even the type of casting material used.
• The larger the limb circumference and the greater the area to be covered – the wider the bandage can be. Visa-versa.
• For large casts e.g. hip spica, apply the cast in sections – i.e. covering & immobilizing one joint at a time starting with the crucial joint first. When 50-75% of each section has been applied, rub / smooth / mould the cast firmly to ensure optimum lamination occurs and allow the material to set before continuing onto the next joint. When extending the cast to the next section / joint, overlap uncured casting tape half way to the previously immobilized joint.
• When applying the cast in sections – do not overlap the padding onto existing cast. Do not interpose padding, dressings, bandages or any materials between layers of the casting material.