Cameroon Upper Extremity Rehabilitation Project

section 2

Splinting
Anatomical Landmarks for Splinting

**Ulnar**

= Little finger side of the hand

**Radial**

= Thumb side of the hand
Arches of the hand

Purpose: to allow the hand to conform around objects in a functional grasp

**Proximal transverse arch** = arch at the level of the carpometacarpal joints; the capitate (carpal bone) is the keystone of the proximal transverse arch. This is a fairly fixed arch which remains curved even when the hand is open.

**Distal transverse arch** = arch at the level of the metacarpophalageal joints; the 2<sup>nd</sup> and 3<sup>rd</sup> metacarpals are the keystone of the distal transverse arch. The 1<sup>st</sup>, 4<sup>th</sup> and 5<sup>th</sup> metacarpals rotate around the 2<sup>nd</sup> and 3<sup>rd</sup> metacarpals to either flatten or increase the arch.

**Longitudinal arch** = arch best observed by following the length of the 3<sup>rd</sup> finger. The longitudinal arch increases/deepens with finger flexion and flattens somewhat with finger extension.
The general purpose of a hand splint is to **mobilize** or **immobilize** injured tissues.

**Reasons for using an immobilization splint:**

1. To REST tissues after an acute injury to reduce inflammation (but not so long that stiffness develops). Examples: after a traumatic injury or a flare-up of inflammatory arthritis.

2. To provide external SUPPORT in a way that increases function. Examples: an unstable joint after a traumatic injury or increase function in an arthritic hand.

3. When a nerve injury disrupts normal MUSCLE BALANCE. Example: after a radial nerve injury, finger and wrist extensor muscles cannot work against the flexor muscles.

4. To PREPARE for SURGERY or make a surgical decision. Example: to immobilize a joint so that the patient knows what it will feel like to have that joint surgically fused or to prevent pain by immobilizing the joint until surgery can take place.
Reasons for using a mobilization splint:

1. To PROTECT healing structures and limit tissue stress while still allowing some movement.
   Example: after a flexor tendon injury, a splint could be worn that allows controlled movement, in this case, some active flexion is allowed but full extension is limited.

2. To PREVENT CONTRACTURE (contracture = the shortening and hardening of muscles, tendons, or other tissue, often leading to deformity and rigidity of joint)
**Common names:**
- Safety position splint
- Resting pan splint

**Purpose:**
To immobilize the wrist, hand, and fingers, while preventing stiffness and shortening of soft tissues.

**Used for:**
- Traumatic injury/acute condition
- Burns
- Inflammatory joint disease
- Crush injury
- Prevent contracture
- Boxer fracture (# of 5th and/or 5th metacarpal bones)
- Reduce pain & inflammation

**Key points while splinting:**
- Wrist position = 30° extension
- MCP position = 70° flexion
- IP position = full extension
  - Only allow IP flexion for pain relief or if hand very contracted; the goal is always full extension
- Thumb position = full abduction

Or any condition causing significant swelling, as this can cause “clawing” (MCP extension & IP flexion)
Pattern Drawing

1. Trace the outline of the hand and forearm on a piece of paper, paper towel or clear plastic bag.
   *Make sure the forearm is in line with shaft of the 3rd metacarpal &
   the thumb is extended/radially abducted.

2. On the pattern, mark and label:
   a. Wrist crease (both sides of hand)
   b. First web space
   c. Second web space
   d. Distance of 2/3 the length of the forearm (this will be the final
      length of the splint)
3. On the pattern (hand removed), fill in:
   a. Draw a straight line down between the index and middle finger, through the dot at the second web space (down as far as the base of the thumb)
   b. Draw a horizontal line through the dot at the first web space, far enough across to intersect with the line from the second web space
   c. Make a star (★) where the vertical and horizontal lines cross
   d. From the star (★), draw a line down towards the wrist crease and then curve out to connect with the new outline of the splint
e. Trace a new outline around the sides of the pattern so that there is enough material to extend half way up the sides of the hand and forearm (approximately 1 finger width at the fingers, 2 finger widths at the wrist, and 3 finger widths at the forearm)
f. Cut out the pattern and if possible, try it on the patient’s hand
Fabrication – Plaster of Paris

1. Trace the pattern onto a stack of 8 layers of plaster of Paris (POP) and cut the material.

2. If your patient has lots of arm hair, bandages, or open wounds, put a protective layer between their skin and the splinting material (ex. plastic bag for wounds or bandages, sock or thin stockinette for hairy arms).

3. Run the sheets of POP through a tub of warm water and squeeze out any extra water.

4. Position the POP over the volar surface of the patient’s arm and start to smooth the plaster against the skin; make sure the splint is lined up with the forearm.

5. Before the POP begins to harden, flare the proximal end of the splint (against the forearm) so that it does not dig into the patient’s arm.
6. Continue smoothing the POP against the patient’s hand, while keeping the patient’s wrist and hand in the correct position:
   - Wrist position = 30° extension
   - MCP position = 70° flexion
   - IP position = full extension
   - Thumb position = full abduction

7. Once the POP has hardened, remove the splint and finish the edges with small strips of scrap POP. You can also trim down the POP. Example: you may want to build up some material to support the thenar eminence.

8. Allow the POP to harden for 24 hours and then finish with paint or resin to make it water resistant and stronger.

9. Apply straps across the proximal phalanx, distal forearm (before/proximal to the wrist and ulnar & radial styloid processes), and the proximal forearm (end of the splint).
Fabrication – Thermoplastic

The pattern drawing process for splinting with thermoplastic is the same as described above, with the following exceptions:

- Thermoplastic stretches so the pattern does not need to be as big; when tracing a new outline around the sides of the pattern (enough material to extend half way up the sides of the hand and forearm), you only need to add about 1 cm at the fingers, 2 cm at the wrist & 3 cm at the forearm.

Use thermoplastic that is 1.8 mm or 2.4 mm thick

Fabrication:

1. Trace the pattern onto the piece of thermoplastic.

2. If your patient has lots of arm hair, bandages, or open wounds, put a protective layer between their skin and the splinting material (ex. plastic bag for wounds or bandages, sock or thin stockinette for hairy arms).

3. Warm the piece of thermoplastic in a warm water bath (60 – 70°C) to make it easier to cut; cut out the pattern before the thermoplastic cools.
4. Put the thermoplastic back in the water bath and warm it until fully flexible.

5. Remove the thermoplastic from the water and quickly pat off any extra water against a towel or cloth; test the temperature of the thermoplastic against your own skin before putting it on your patient.

6. Position the thermoplastic over the volar surface of the patient's hand and arm, folding the thumb material around while keeping the thumb in a fully opposed position.

7. Using gentle strokes with both of your hands, smooth the thermoplastic around the patient's arm, using gravity to assist.

8. Before the thermoplastic begins to harden, flare the proximal end of the splint (against the forearm) so that it does not dig into the patient’s arm.

9. Continue smoothing the thermoplastic against the patient’s hand, while keeping the patient’s wrist and hand in the correct position:
   - Wrist position = 30° extension
   - MCP position = 70° flexion
   - IP position = full extension
   - Thumb position = full abduction
10. Apply straps across the proximal phalanx, distal forearm, and the proximal forearm (end of the splint):
Wrist Splint

Common names:
- Cock-up splint
- Forearm-based wrist extension splint
- Volar-based wrist splint
- Dorsal-based wrist splint

Purpose:
To immobilize parts of the hand/wrist, while allowing functional grasp with the fingers and thumb.

Used for:
- Carpal tunnel syndrome
- Distal radius fracture (post-surgery & conservative treatment)
- Tendonitis
- Ganglion removal
- Fracture of carpal bones (conservative treatment)

Key points while splinting:
- Wrist position should be 15-20° extension & slight ulnar deviation
- Distal palmar crease should be free
- No pinching in first web space
- No restriction of movement of thumb (no pinching with thumb opposition)
Pattern Drawing

1. Trace the outline of the hand and forearm on a piece of paper, paper towel or clear plastic bag.
2. On the pattern, mark and label:
   a. wrist crease (both sides of hand)
   b. distal palmar crease (both sides of hand)
   c. thumb MCP joint
   d. draw a straight line down from the middle of the web space between the index and middle fingers
   e. distance of 2/3 the length of the forearm (this will be the final length of the splint)
3. On the pattern (hand removed), fill in:
   a. The line of the distal palmar crease.

   b. Trace a new outline around the sides of the pattern so that there is enough material to extend half way up the sides of the hand and forearm (approximately 2.5cm at the fingers, 2.5 cm at the wrist & 3 cm at the forearm); *Note: because plaster of Paris does not stretch (and can be cut down before wetting), make your pattern slightly larger than you think you need and cut it down to size after trying it on the patient.*

   c. A curved line connecting the radial (thumb) side of the distal palmar crease with the mark for the wrist crease. This will outline the thenar crease. The outline of the pattern should run through the marking for the thumb MCP joint.

   d. Draw a hole about the size of the base of the patient’s thumb; the hole should be about 2 cm from the radial (thumb) side of the pattern and not quite half way down from the distal palmar crease to the wrist crease; extend the hole to the outline of the thenar crease.
4. Cut out the pattern and if possible, try it on the patient’s hand. Make note of any areas that need to be smaller or larger. *Example: this pattern does not allow enough space around the thenar eminence and the splint would block thumb opposition.*

a. Modify the pattern as needed.  
   *Example: making a larger hole to allow thumb opposition*
**Fabrication – Plaster of Paris**

1. Trace the pattern onto a stack of 8 layers of plaster of Paris (POP) and cut the material.

2. If your patient has lots of arm hair, bandages, or open wounds, put a protective layer between their skin and the splinting material (ex. plastic bag for wounds or bandages, sock or thin stockinette for hairy arms).

3. Run the sheets of POP through a tub of warm water and squeeze out any extra water.

4. Position the POP over the volar surface of the patient’s arm and start to smooth the plaster against the skin; make sure the splint is lined up with the forearm.
5. Before the POP begins to harden, fold down the top of the material to clear the distal palmar crease. Do the same around the thenar crease.

6. Continue smoothing the POP against the patient’s hand, while keeping the patient’s wrist in the correct position: Functional grasp requires **15-20° extension and slight ulnar deviation.**

7. Once the POP has hardened, remove the splint and finish the edges with small strips of scrap POP. You may want to reinforce points of stress such as the wrist by adding extra strips of POP.

8. Allow the POP to harden for 24 hours and then finish with paint or resin to make it water resistant and stronger.

9. Apply straps across the dorsum of the hand (near the distal end of the splint), distal forearm (before/proximal to the wrist and ulnar & radial styloid processes), and the proximal forearm (end of the splint).
Fabrication – Thermoplastic

The pattern drawing process for splinting with thermoplastic is the same as described above, with the following exceptions:

- Thermoplastic stretches so the pattern does not need to be as big; when tracing a new outline around the sides of the pattern (enough material to extend half way up the sides of the hand and forearm), you only need to add about 1 cm at the fingers, 2 cm at the wrist & 3 cm at the forearm.

- The thumb hole will also stretch so it only needs to be about 2 cm; draw the thumb hole in the middle of the thenar region.

Use thermoplastic that is 1.8 mm or 2.4 mm thick; if using 1.8 mm thermoplastic you will need to roll down the distal edge of the splint and around the thenar eminence to strengthen the splint.

Fabrication:

1. Trace the pattern onto the piece of thermoplastic.
2. If your patient has lots of arm hair, bandages, or open wounds, put a protective layer between their skin and the splinting material (ex. plastic bag for wounds or bandages, sock or thin stockinette for hairy arms).
3. Warm the piece of thermoplastic in a warm water bath (60 – 70°C) to make it easier to cut; cut out the pattern before the thermoplastic cools.

4. Put the thermoplastic back in the water bath and warm it until fully flexible.

5. Remove the thermoplastic from the water and quickly pat off any extra water against a towel or cloth; test the temperature of the thermoplastic against your own skin before putting in on your patient.

6. Position the thermoplastic over the volar surface of the patient’s hand and arm, placing the thumb through the hole in the thermoplastic.

7. Using gentle strokes with both of your hands, smooth the thermoplastic around the patient’s arm, using gravity to assist. Pull gently to stretch the thermoplastic to clear the patient’s thumb and make the thumb hole slightly larger.

8. Continue smoothing the thermoplastic against the patient’s hand, while keeping the patient’s wrist in the correct position: Functional grasp requires 15-20° extension and slight ulnar deviation.
9. Before the thermoplastic begins to harden, fold down the top of the material to clear the distal palmar crease. Do the same around the thenar crease.

10. Apply straps across the dorsum of the hand (near the distal end of the splint), distal forearm (before/proximal to the wrist and ulnar & radial styloid processes), and the proximal forearm (end of the splint).