

# Upper Limb Orthoses

## Upper Limb Orthoses

- They are very common, especially in the cases of the hand.
- The use of the term orthoses or splints are interchangeable.

# Diagnostic Indications

- Fractures •
- Tendon injuries •
- Crush injuries •
- Amputation •
- Arthritis •
- Carpal tunnel release •
- Arthroplasty •
- Tendon transfer •
- Tumor excision •
- Reconstruction of congenital defects •
- Overuse syndromes •
- Cumulative trauma disorders •

# General classifications of splints or orthotics

- **Static orthoses:**

- ❖ They do not permit motion and are referred to as resting or positional splints. ( to position or hold the wrist and hand)
- ❖ They are commonly fabricated from low temperature thermoplastic materials, but if a permanent orthosis is required, high temperature copolymer plastics are used.

- **Dynamic orthoses:**

- ❖ They permit movement, they are splints that provide a dynamic force,
- ❖ They are generally using energy storing materials like rubber bands, spring steel, wound coiled wire, or plastic with memory.

# Hand and wrist orthoses

- Because the complexity of the hand in terms of anatomy, function and associated complications with each injury, hand splinting or orthotic fabrication is clearly a specialty that requires careful examination of each client and in many cases, frequent modifications to the orthosis is required to meet his or her individual needs.



# Hand orthosis (Basic or short opponens)

- It is fabricated from low temperature thermoplastics.
- It is designed to immobilize the first carpometacarpal (CMC) and metacarpophalangeal (MCP) joints and position the thumb in opposition and abduction to maintain the web space and architecture of the hand.
- There is no orthotic wrist control, so strong wrist flexors and extensors are required for functional use.
- Positioning of the hand can be functional for grasp.
- **Indications:**
  - Inflammation or injury of the thumb.
  - Median nerve lesions
  - C6-7 spinal cord lesions.
  - Hemiplegia with loss of thumb opposition.



A: abd, B:add, C: ext, D:flex E:OPP,  
F:reposition



A



B



C



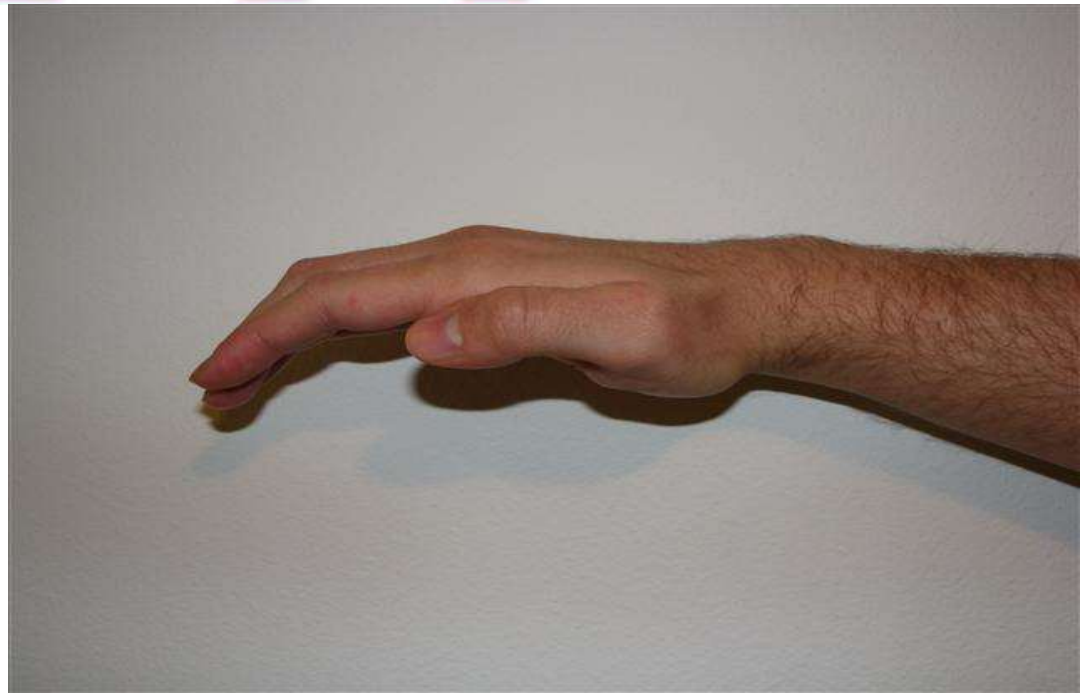
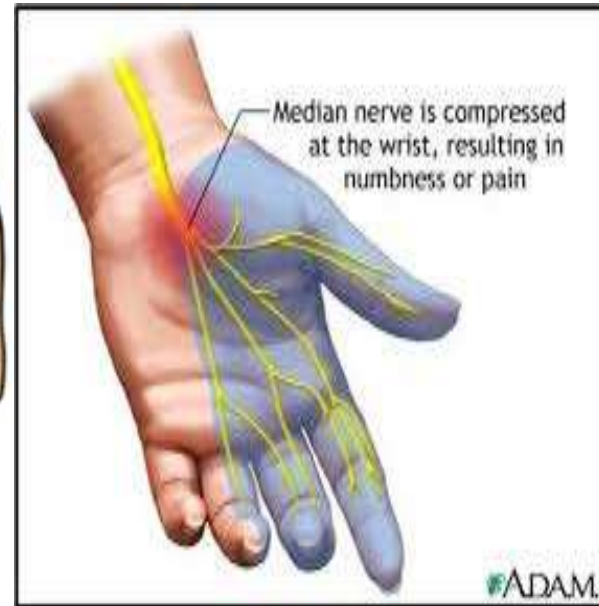
D



E



F



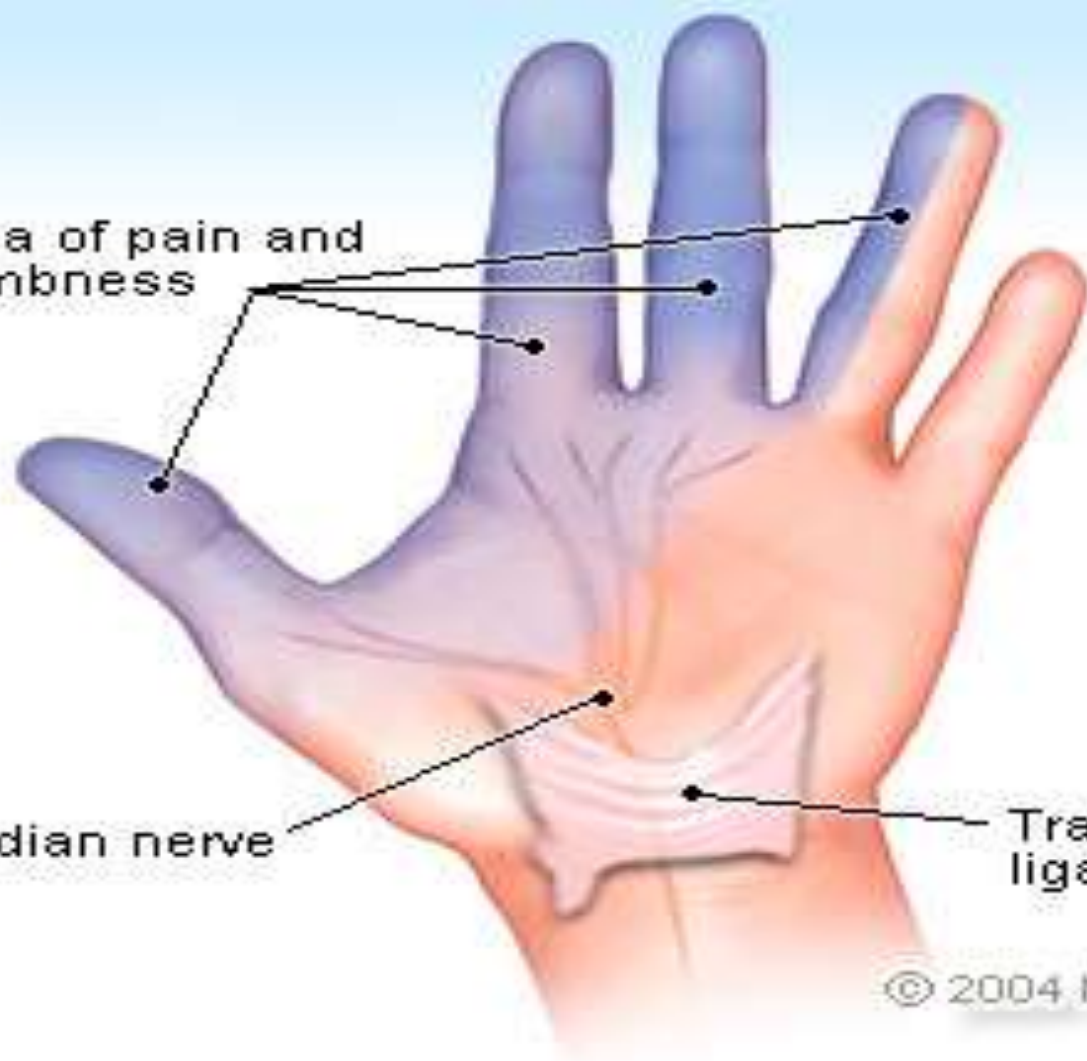
Area of pain and numbness

Median nerve

Transverse carpal ligament

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# Carpal Tunnel Syndrome





## Wrist-hand orthosis

(long opponens splint or volar forearm wrist orthosis)

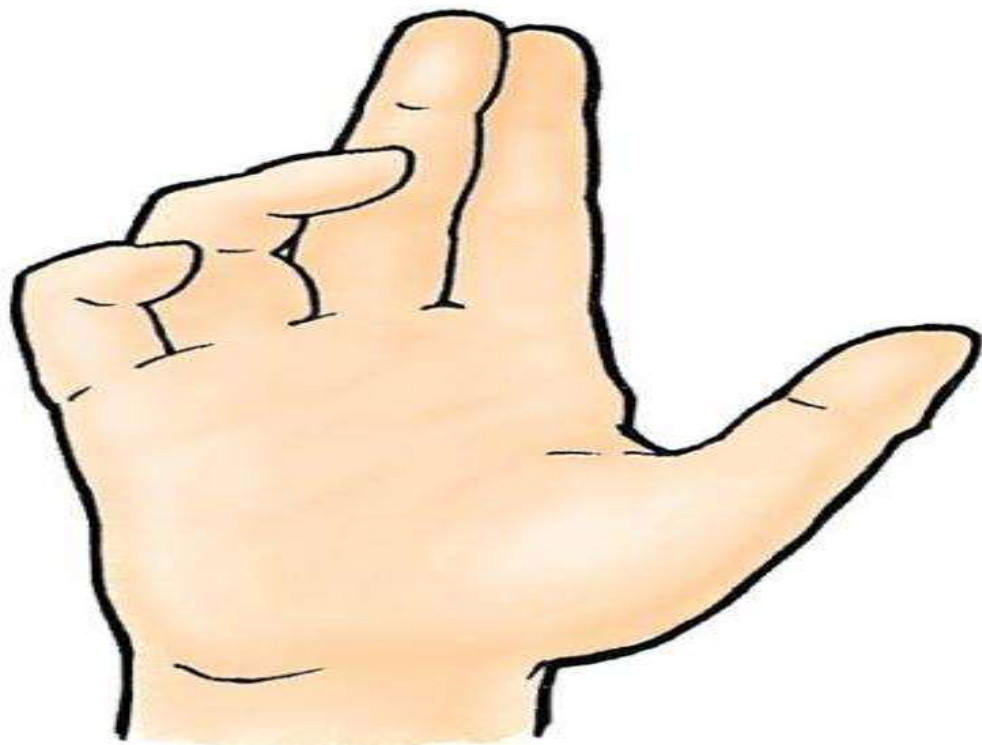
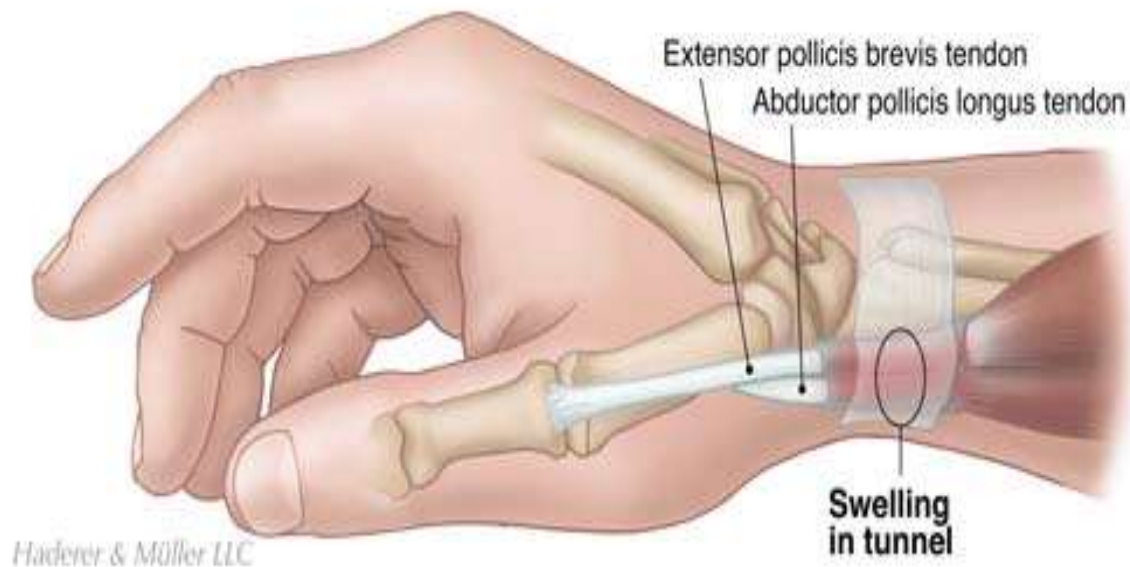
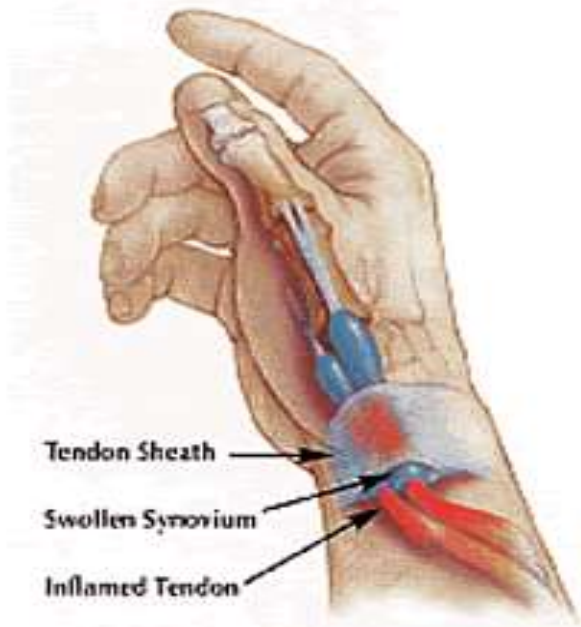
- It is fabricated from low temperature thermoplastics.
- Like the short opponens splint, It is designed to immobilize the first carpometacarpal (CMC) and metacarpophalangeal (MCP) joints and position the thumb in opposition and extension to maintain the web space.
- The addition of wrist immobilization with volar wrist control design. Maintaining neutral or slight extension, offers less tension to the inflamed tendons. With reduction of the thumb movement in general.
- Basically, this splint is short opponens with wrist control.

### • Indications:

- DeQuervains's tenosynovitis.
- Median and ulner nerve lesions
- C5-6 spinal cord lesions
- Wrist or thumb instability
- Degenerative/inflamed wrist thumb jo
- Scaphoid or Bennett's fracture disloc









Erb's palsy / Erb Duchenne Palsy



# Volar forearm static wrist hand orthosis (resting hand splint)

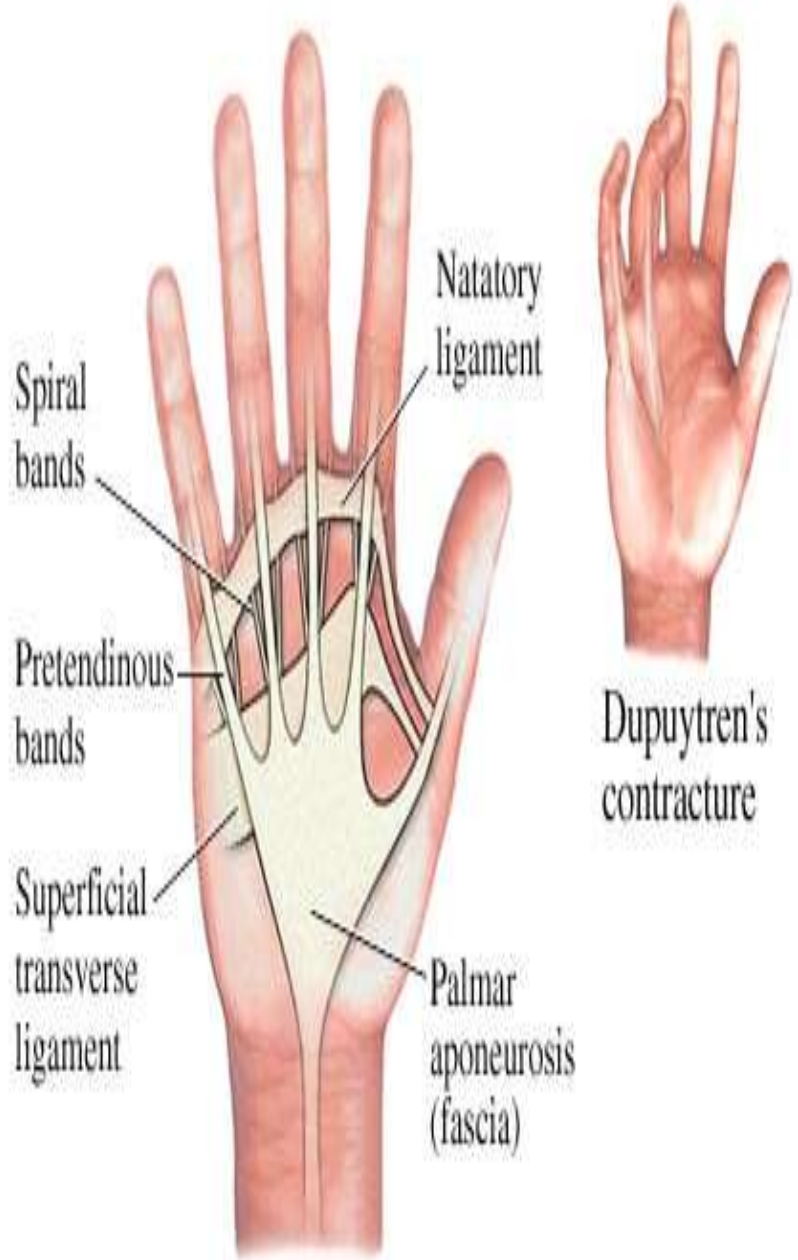
- Commonly referred to as a resting hand splint.
- The objective of this splint is to place the hand and wrist in neutral or functional position, with the MCP joints flexed 60 to 90 degrees and the PIP and DIP joints flexed to 0 to 45 degrees. The wrist is in slight extension to neutral.
- This position maintains the web space, preventing a flat hand or flexion contractures of the hand, it is also used to reduce pain and inflammation.

- **Indications:**

- Flaccid hand due to paralysis.
- Burns or healing skin grafts.
- Degenerative or inflamed joints.
- Volkaman's ischemia.
- Trauma to hand or wrist.







Dupuytren's contracture



A

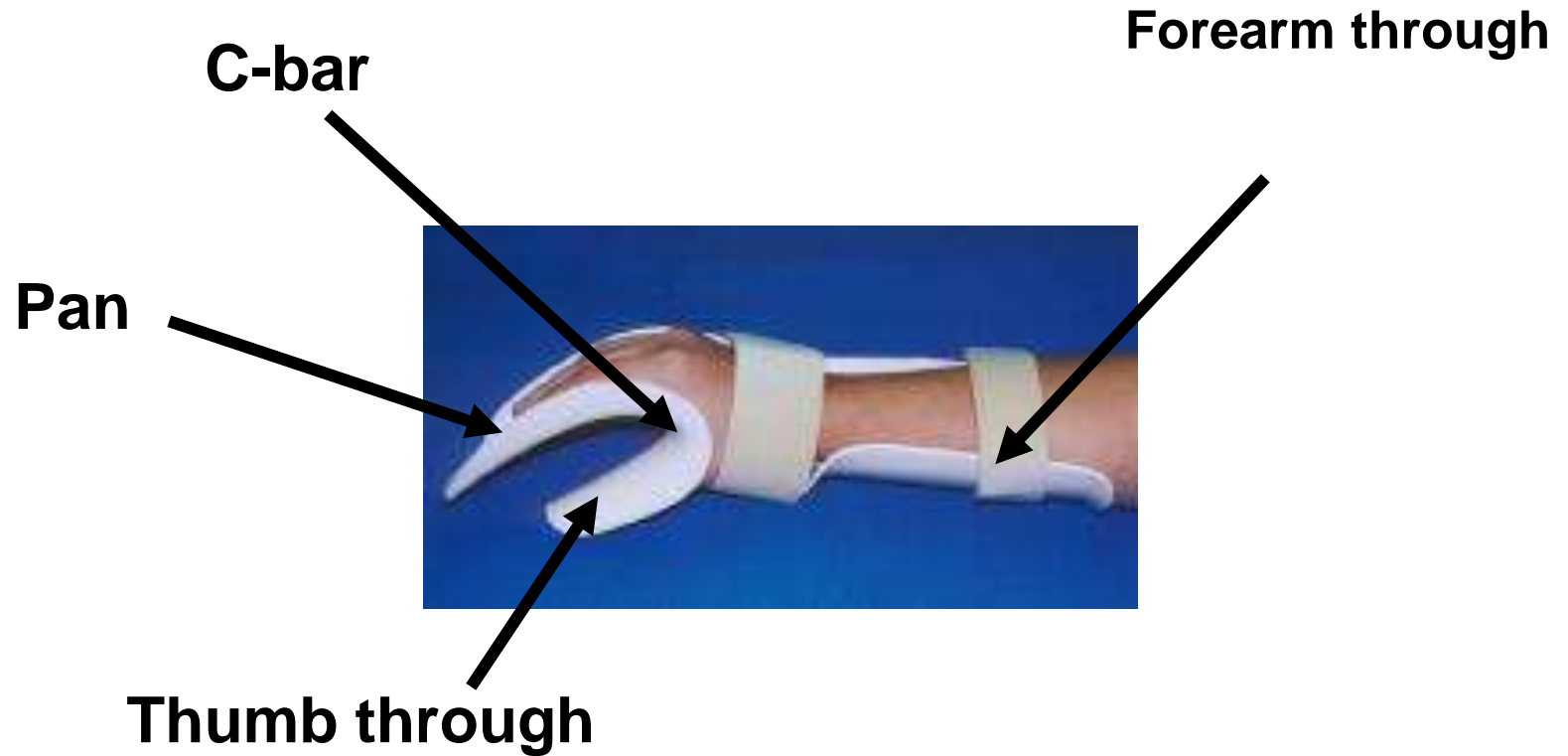


B



C

# Resting Hand Splints (WHO)



# Wrist driven prehension orthosis (tenodesis orthosis)

- Several designs with a variety of materials from low-temperature thermoplastics to light weight metals are used to fabricate these orthoses.
- Designed for clients with spinal cord injury at **C6-7 level** and who have 3-/5 to 3+/5 extensor carpi radialis muscle strength, to facilitate the passive flexion of the thumb, index and middle fingers, or protect the hand for functional tenodesis.



# Utensil holders

## (ADL , UNIVERSAL SPLINT)

- A custom or prefabricated splint, fabricated from leather and flexible metal. A small sleeve or pouch is located within the palmar aspect, permitting the placement of eating utensils, grooming aids and writing implements.
- Active shoulder motions and elbow flexion are required to maintain the objects placed in the splint.
- **Indications:**
- **Hemiplegia.**





# Externally powered prehension unit (EPPU)

- The battery driven externally powered prehension unit (EPPU) allows client with paralysis or sever weakness to have hand function with the use of **WHO (wrist hand orthosis)**.
- The rechargeable battery source drives the mechanical closing and opening of the hand.
- Gross movement of the upper extremity operate the electrical switch, producing pronation to produce prehension and supination to open the hand.

# **Tone – reducing orthosis /wrist cockup splint**

**Tone – reducing orthosis** or **antispsticity splints** are prescribed when hyper tonicity is present. Used in wrist drop deformity of hand and wrist(radial nerve injury.

- The primary objective is to reduce flexor tone, reduce the incidence of contractures, and maintain the arches of the hand by placing the hand and fingers in an extended and abducted position. Creating firm pressure to the palmer surface of the hand.





**Figure 7-16**  
Drop-wrist deformity.



Hand Condition/	Suggested Wearing Schedule	Position
<p>NERVE COMPRESSION Carpal Tunnel Syndrome (median nerve compression)</p>	<p>Acute flare up stage: 4 to 6 weeks continuously worn except for cleaning/hygiene and ROM exercises</p> <p>Gradually decreases in duration with some doctors recommending nighttime wear only</p>	<p>Volar, dorsal, or ulnar gutter splint with the wrist in a neutral position</p>
<p>Carpal Tunnel Release Surgery</p>	<p>1 week post-surgery, that applies during sleep. Strenuous activities, and for support throughout the healing phase</p>	<p>Volar splint with the wrist in a neutral or slightly extended position</p>
<p>Radial Nerve Palsy</p>	<p>Wrist kept in functional position and the splint should substitute for the loss of the radial nerve by placing the wrist in extension</p>	<p>Volar or dorsal with wrist in 0 to 30 degrees in extension</p>
<p>Wrist extensor tendinitis</p>	<p>Continuous wearing followed by gradual weaning of the splint</p>	<p>Volar with 20-30 degrees of wrist extension</p>

Hand Condition	Suggested Wearing Schedule	Position
<p><b>FRACTURES</b> Colle's fracture (closed reduction)</p>	<p>Indicated following removal of the cast and healing of fracture Discontinue use as soon as possible to allow functional hand movement</p>	<p>Volar with maximum passive extension that the patient can tolerate- usually up to 30 degrees</p>
<p><b>RHEUMATOID ARTHRITIS</b> Periods of swelling and joint inflammation</p>	<p>Worn continuously with established periods for ROM exercises between splint wearing schedule</p>	<p>Volar, in extension up to 30 degrees based on patient tolerance</p>
<p><b>OTHER</b> Reflex Sympathetic Dystrophy  Wrist joint synovitis or tenosynovitis</p>	<p>Nighttime wearing  Worn during acute flare ups</p>	<p>Volar, in extension as tolerated by patient  Volar, 0 to 15 degrees in extension</p>

# Elbow orthosis

- **A) Static orthosis**, fabricated from low-temperature thermoplastic,
  - It is formed over the volar surface of the elbow for the purpose of restricting motion and promoting tissue healing.
  - They can be removed for treatment and hygiene. as range of motion returns the angle of the splint can be adjusted by reforming the plastic shell, a process similar to that of serial casting
- **Indications** for the static splints include burns, fractures, tendon, nerve, vascular repair, and cubital tunnel syndrome

- **B) Dynamic splints**

- When range of motion of the elbow is lost, dynamic splint is provide a low load with prolonged stretch of the soft tissues and skin over time.

- **Indications:**

- Burns and contractures.





# Shoulder orthoses

- Arm Sling:
- Figure of eight sling.
- Cuff sling.
- Orthopedic sling.
- Flail arm sling.
- They are used to immobilize and promote healing of tissue after burn & trauma.
- **Hemi arm sling** is use to prevent subluxation of the shoulder while the arm is flaccid.

# Arm sling, cuff sling(fig 2,3)



Figure 8  
brace



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# Flail sling(1,2), hemi-arm sling



# Shoulder-elbow- wrist orthoses

- They are called **airplane splints**./used in erb's palsy
- They are used to protect soft tissue of the shoulder and prevent contractures.
- Prefabricated kits are available,
- The shoulder is abducted 70 to 90 degrees, and can be adjusted as healing progress.





# Finger Orthosis ( DIP )



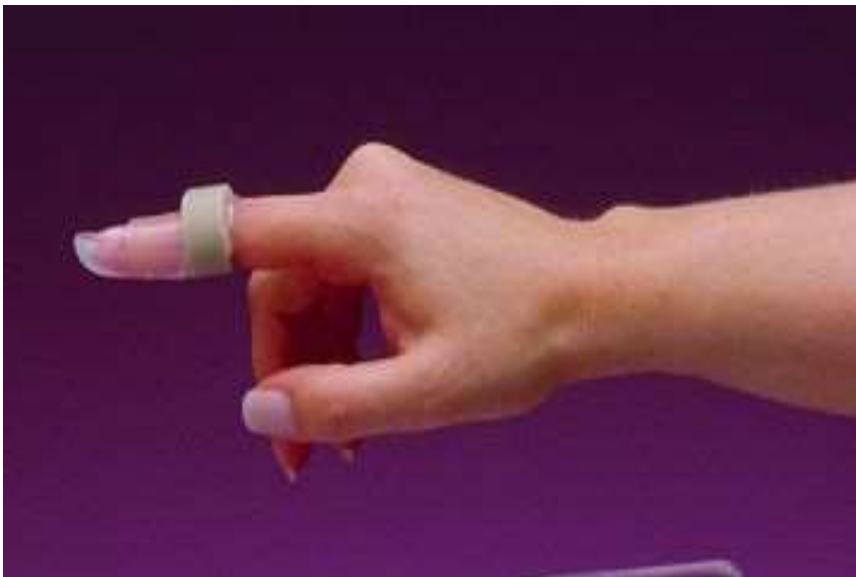
**Type** •

Static or dynamic –

**Region** •

Volar or dorsal –

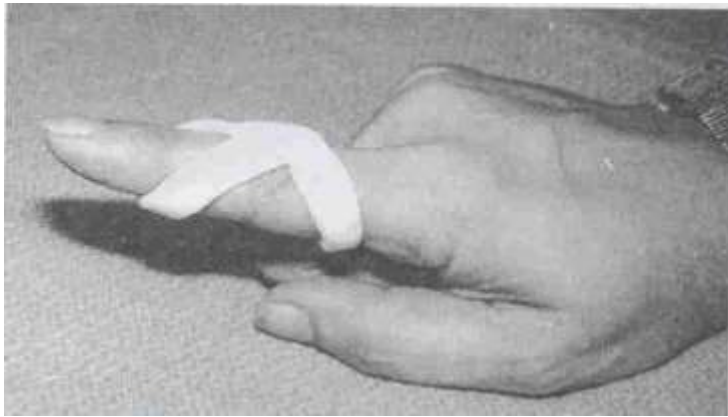
Joint crossed –



Static Volar

DIP Extension Splint

# Finger Orthosis ( PIP )



Static Three point ■  
orthosis for boutonniere  
deformity





*Immobilize*



*Swan Neck*



*Boutonniere*



*Mallet Finger*

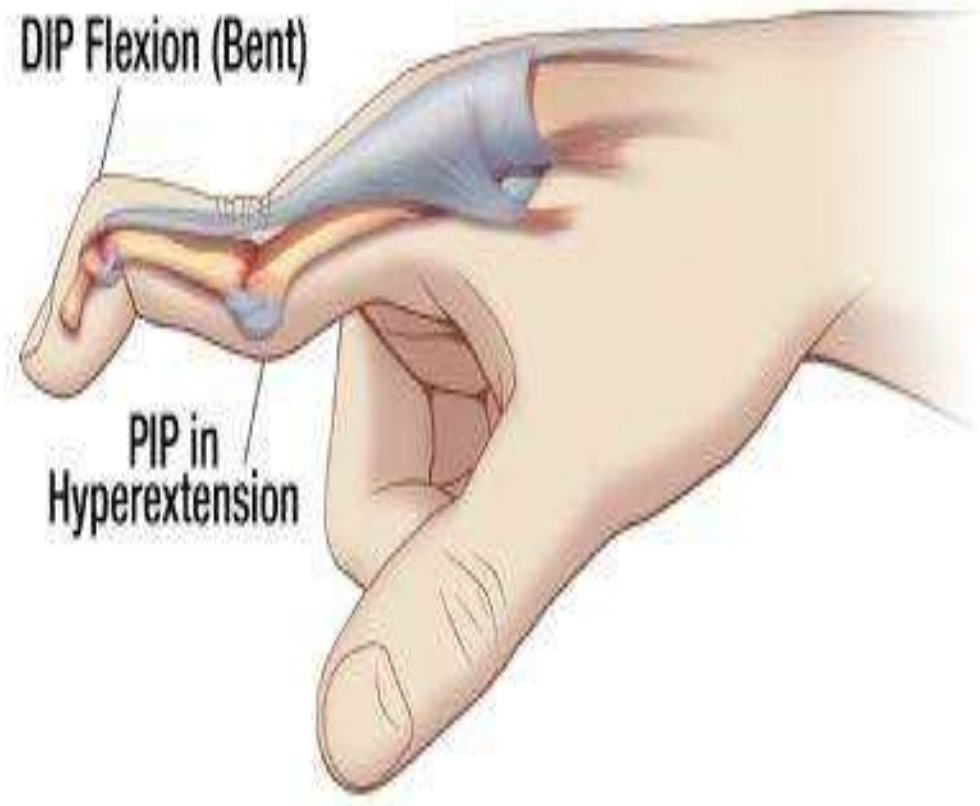


*Lateral Deviation*

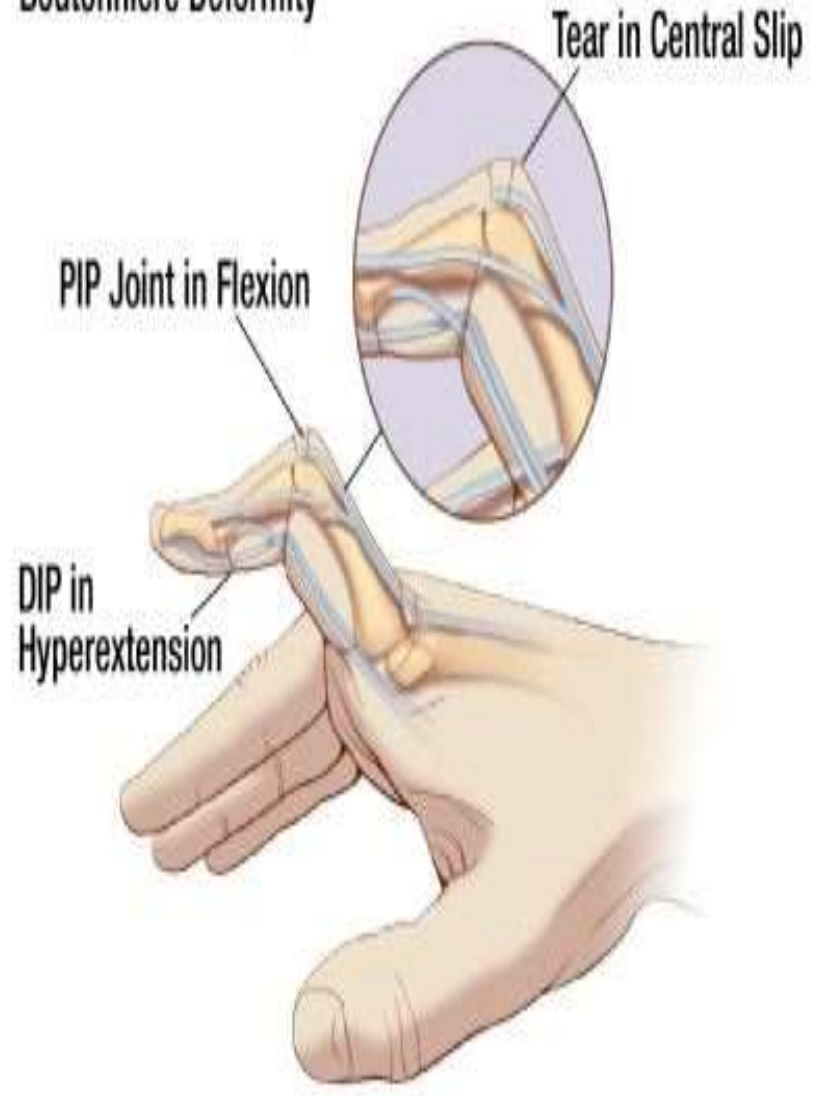


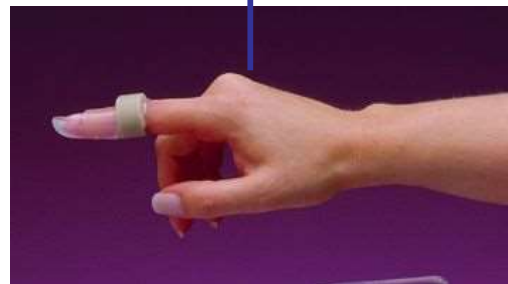
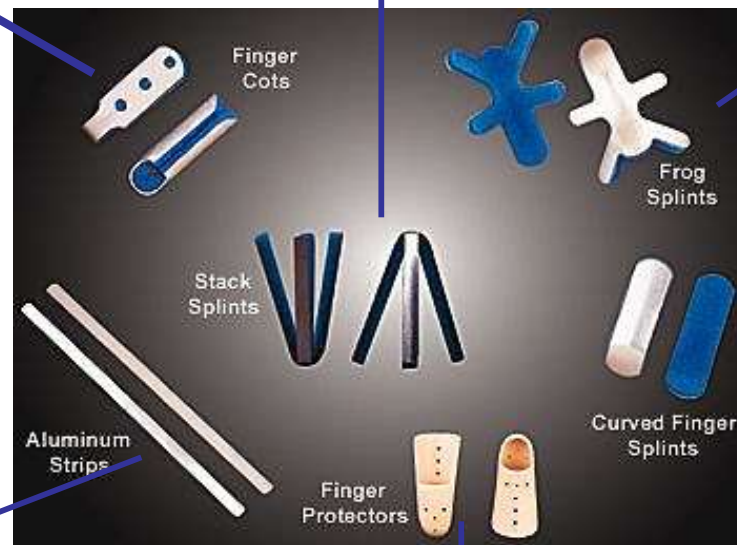
*Trigger Finger*

### Swan Neck Deformity

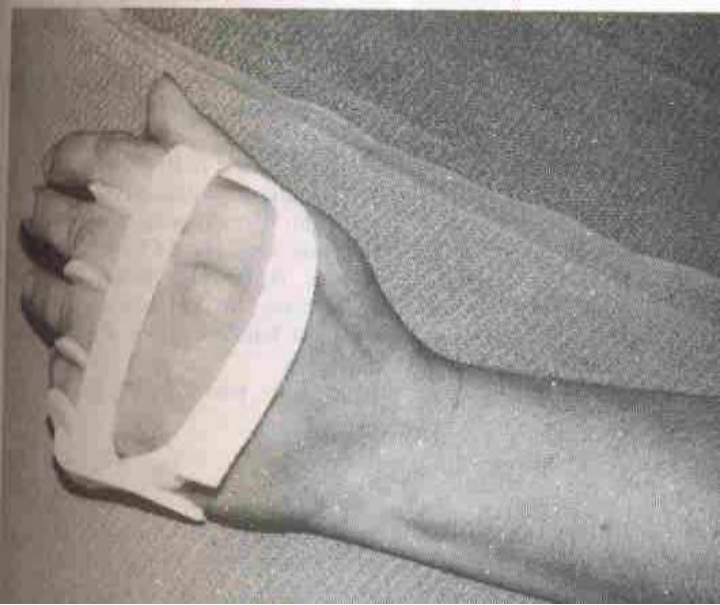


### Boutonniere Deformity





# Hand Orthosis

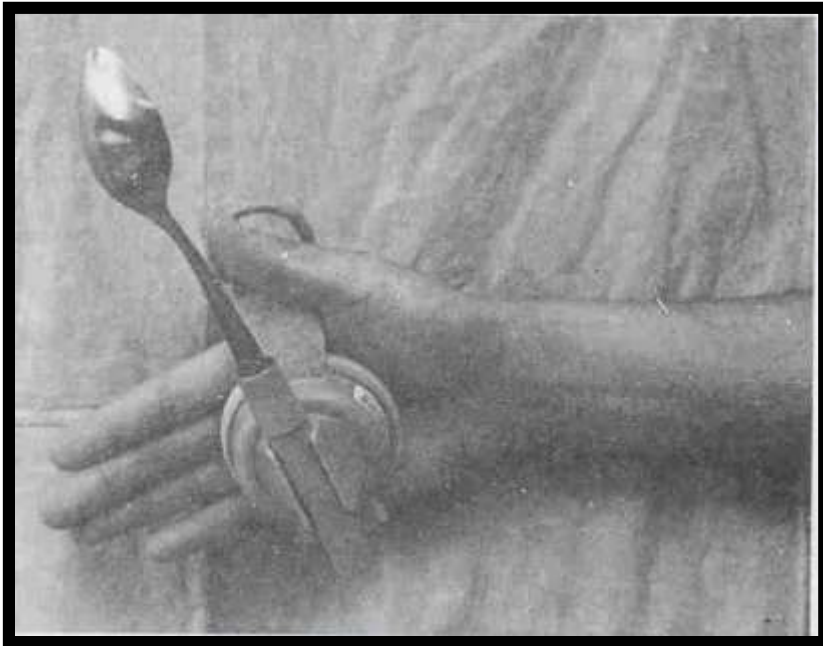


**Ulnar  
Drift**

Static Dorsal  
Hand Orthosis  
With an MP  
Block



# Hand Orthosis



Universal Cuff •



# Purpose of Splinting: DYNAMIC

- To substitute for loss of motor function
- To correct an existing deformity
- Provide controlled directional movement
- Aid in fracture alignment and wound healing



# Physiologic Considerations

## **Too little stretch •**

Atrophy and weaken –

Skin, tendons, ligaments, and joint –  
capsules will shorten in the absence of  
habitual tensile forces

## **Enough stretch •**

Three degrees of gain in ROM per week, with a range –  
of 1-10 deg, is acceptable (Cummings et al 1992 )

High intensity short term stretching actually promotes –  
stiffness

The client should sense tension in the tissues but feel –  
no pain

# Basic Components

Outrigger •

Dynamic Assist •

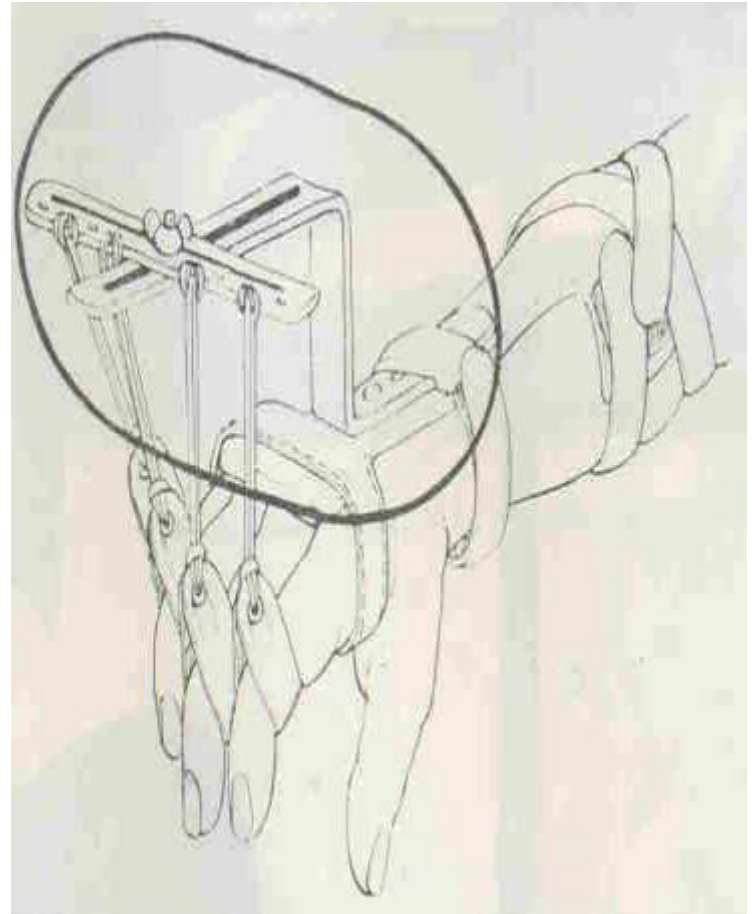
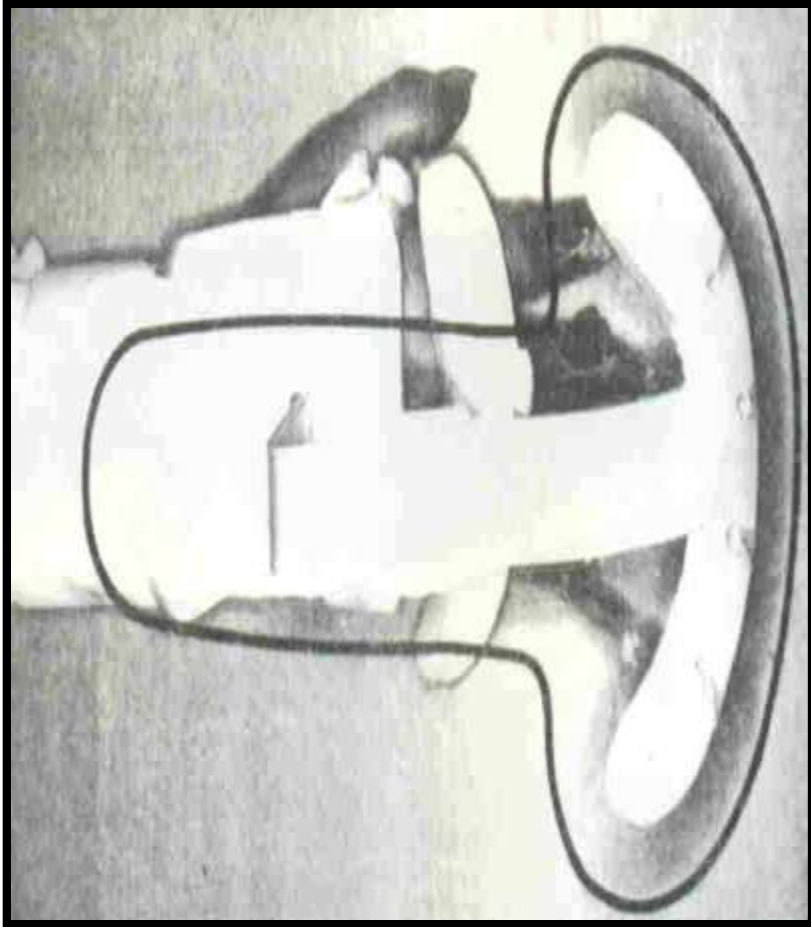
Finger cuff •

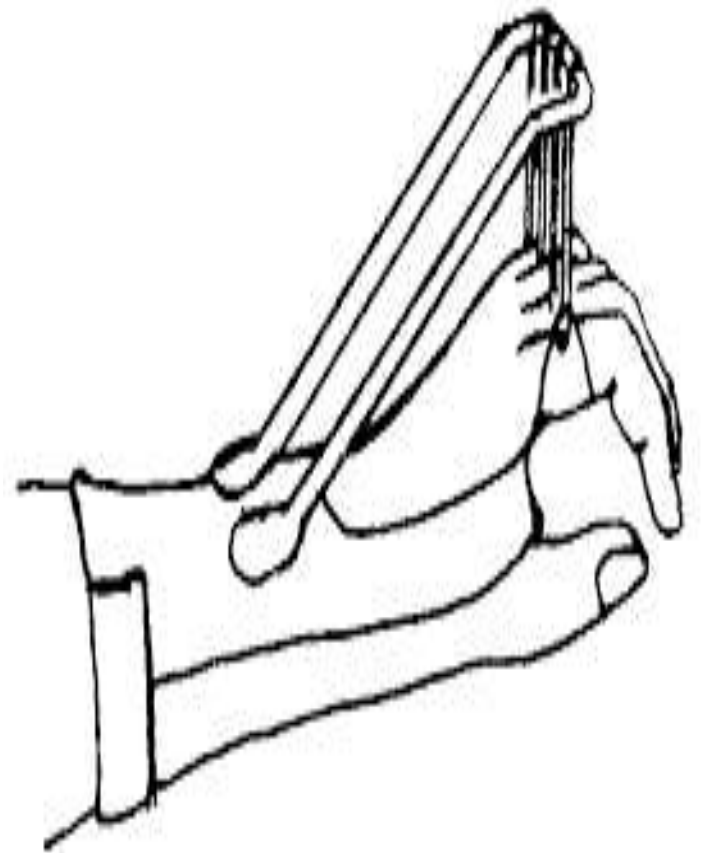
Fingernail attachments •

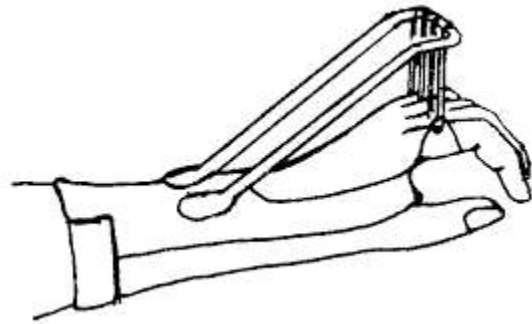
Phalangeal bar/finger pan •



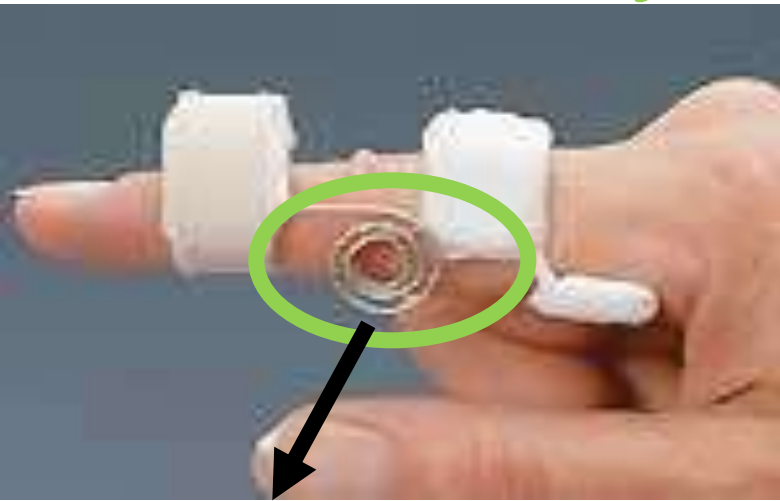
# Basic Components: Outrigger







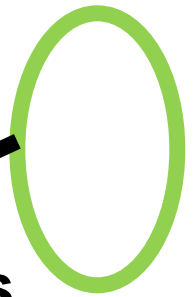
# Basic Components: Dynamic Assist



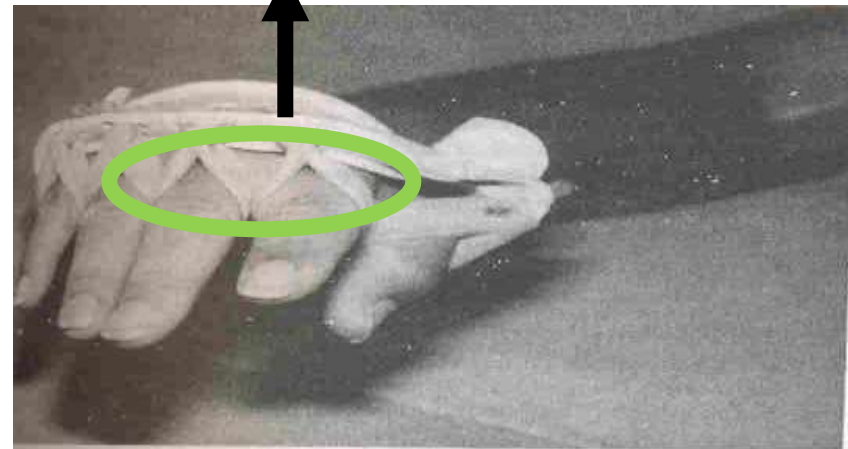
**Springwire finger coils**



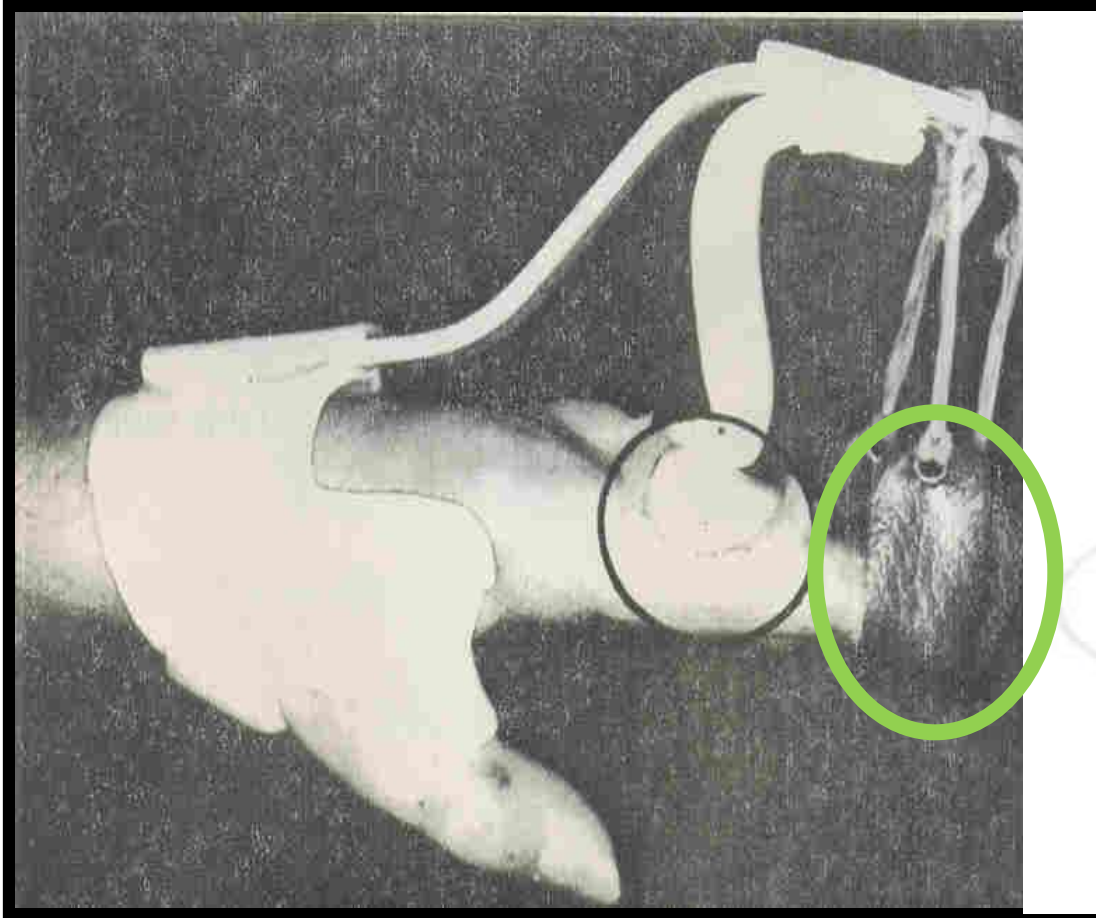
**Elastic bands**



**Springwire knuckle bender**

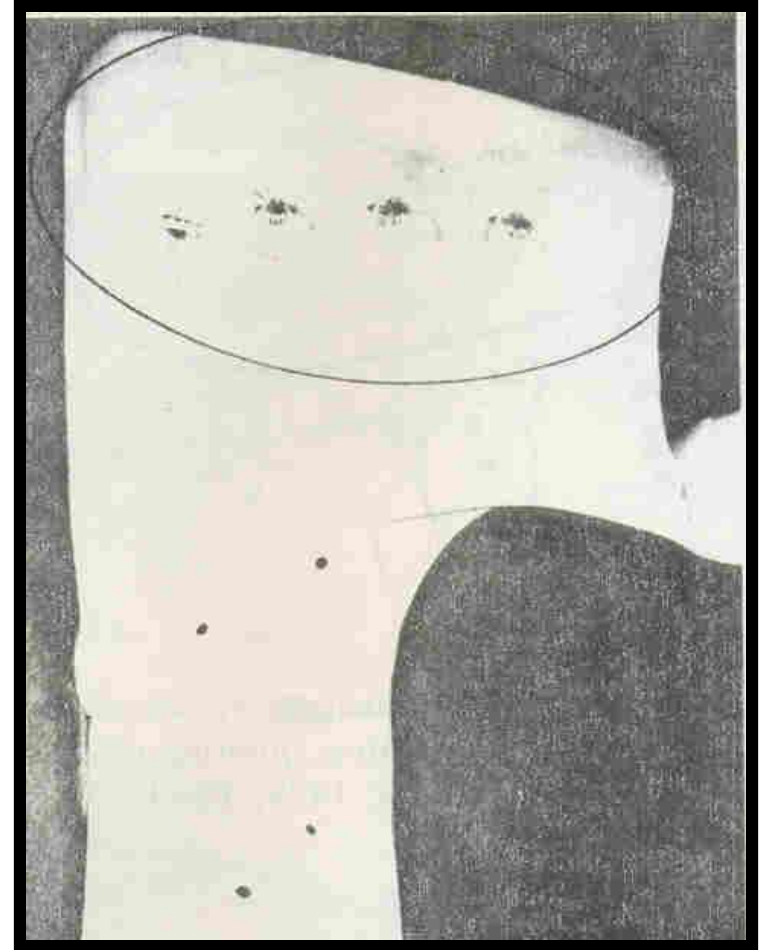
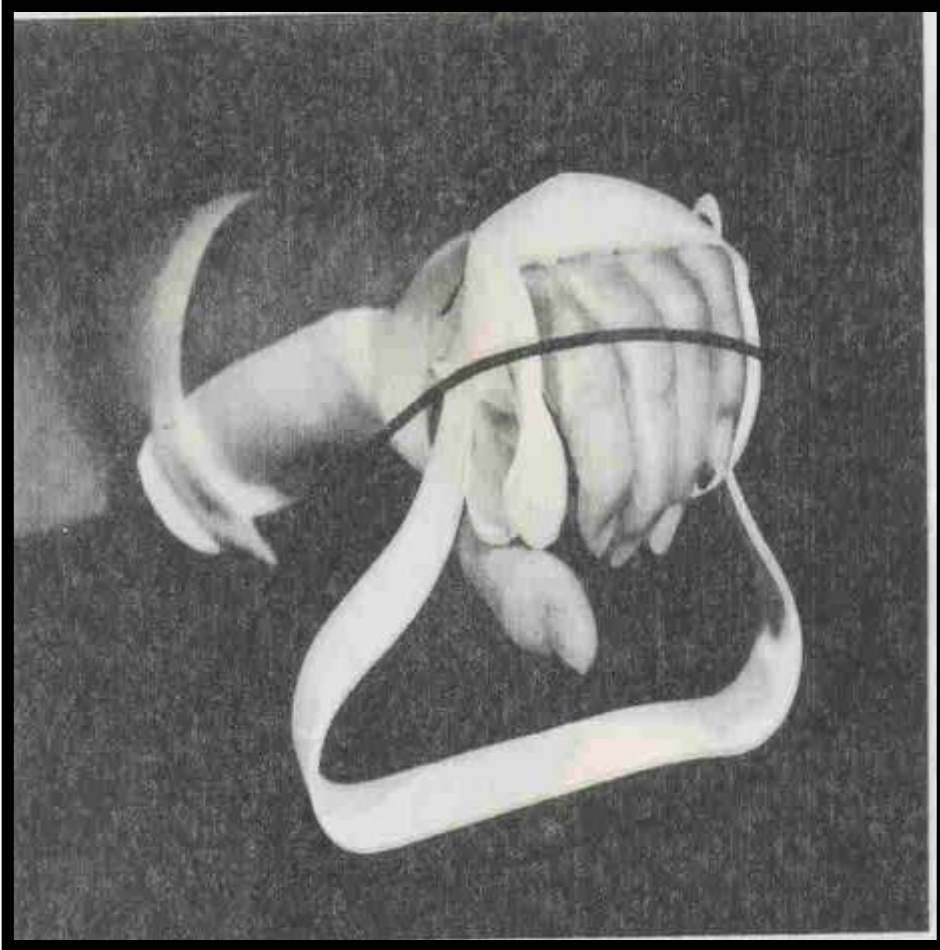


# Basic Components: Finger Cuff





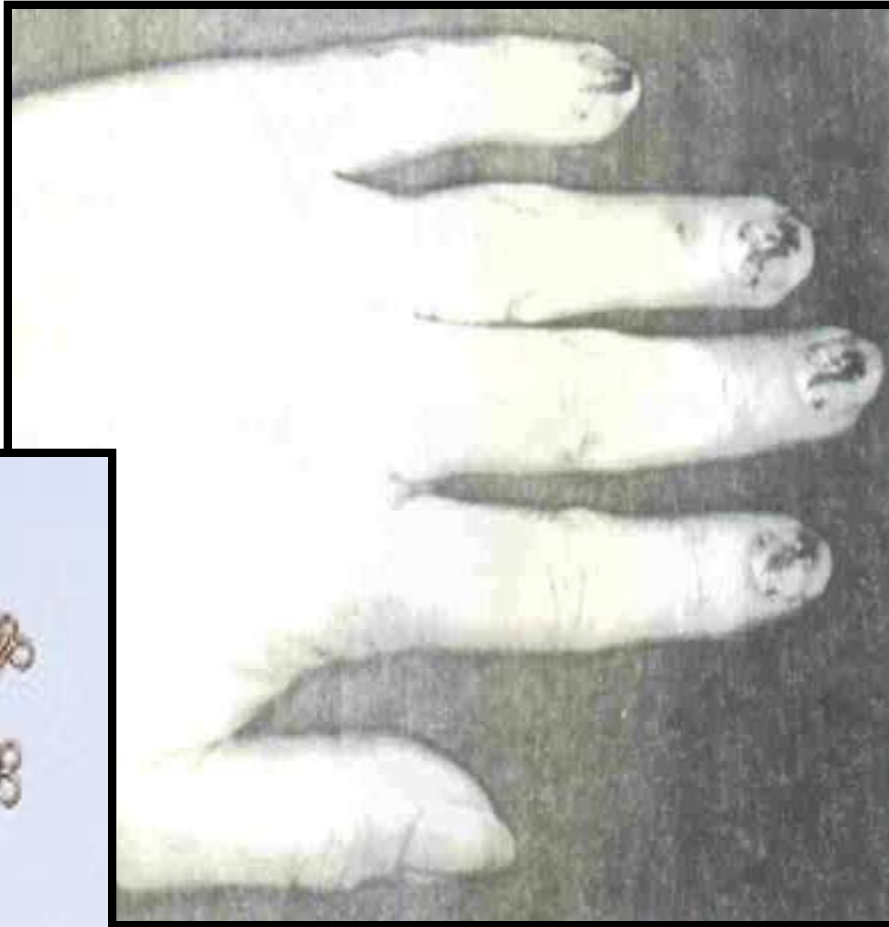
# Basic Components: Phalangeal Bar/Finger Pan





# Basic Components: Fingernail Attachments

**Finger  
hooks**



**Contoured finger  
hooks**

# Dynamic Finger Extension Splint

Dynamic radial nerve splint •

**Objectives:** •

Immobilize the wrist in functional –  
position

Passively extend the MCP –  
unrestricted IP motion

Indications: •

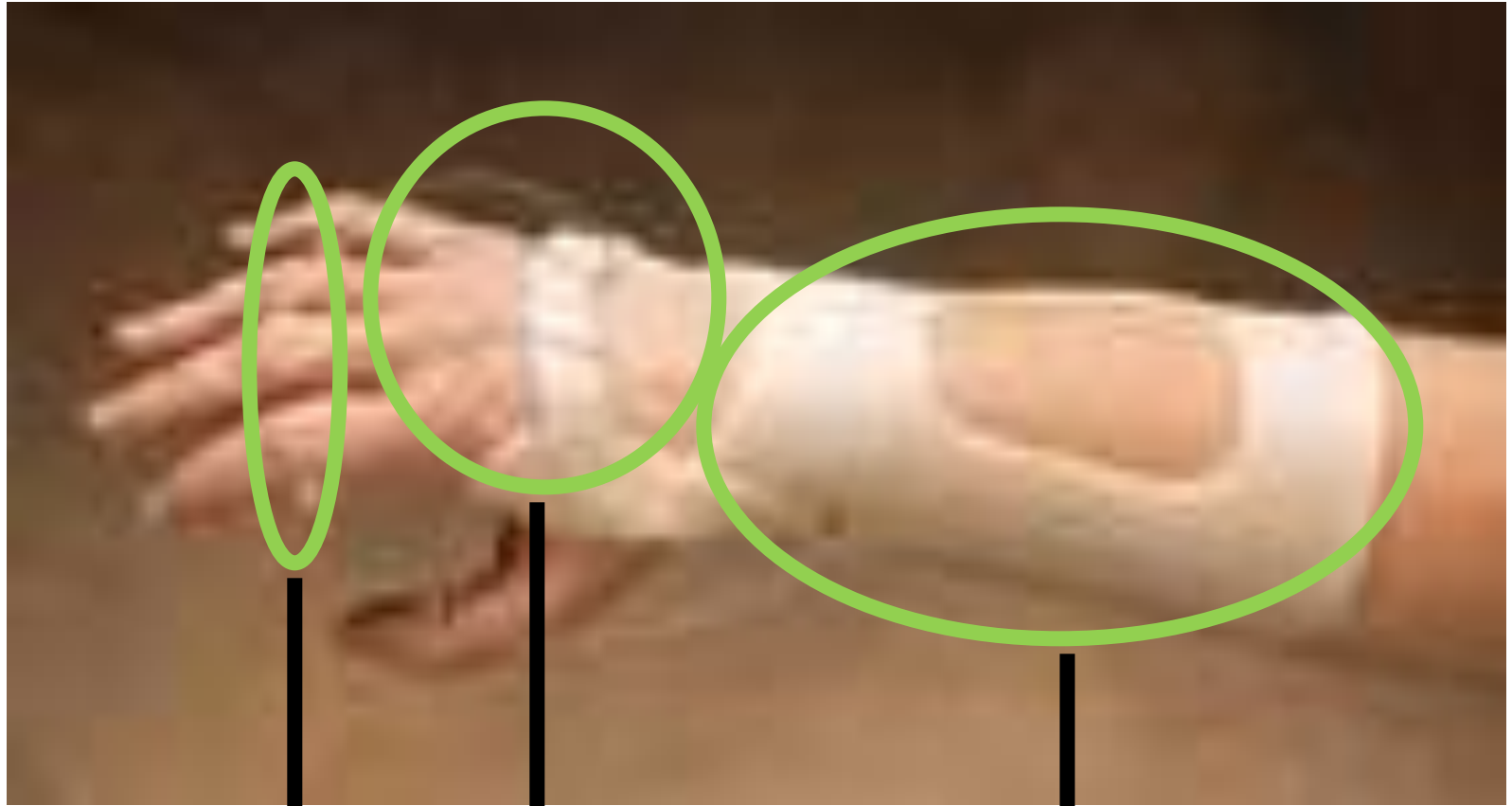
Paralysis of wrist, MCP, Finger –  
extensors

Advantages: •

Relatively has a less obtrusive –  
shape as compared to the  
outrigger design

The hand can be slipped through –  
a loose sleeve with the orthosis  
on





**Finger Cuff**

**Dynamic Springwire Assist**

**Dorsal Forearm Trough**

# Dynamic Wrist Extension Splint

## **Objectives:** •

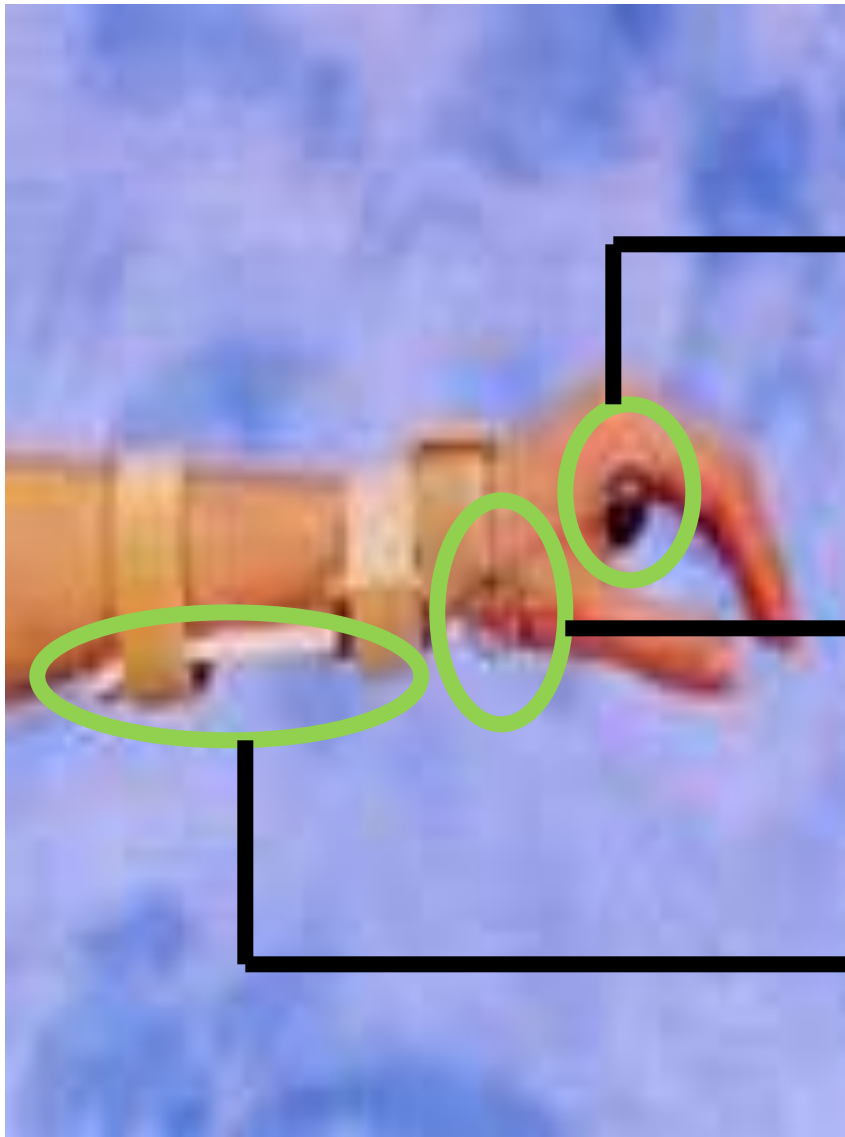
Passively extends the –  
wrist while allowing wrist  
flexion

To prevent contracture –  
of unopposed,  
innervated wrist flexors

## **Indication:** •

Weak or paralyzed wrist –  
extensors

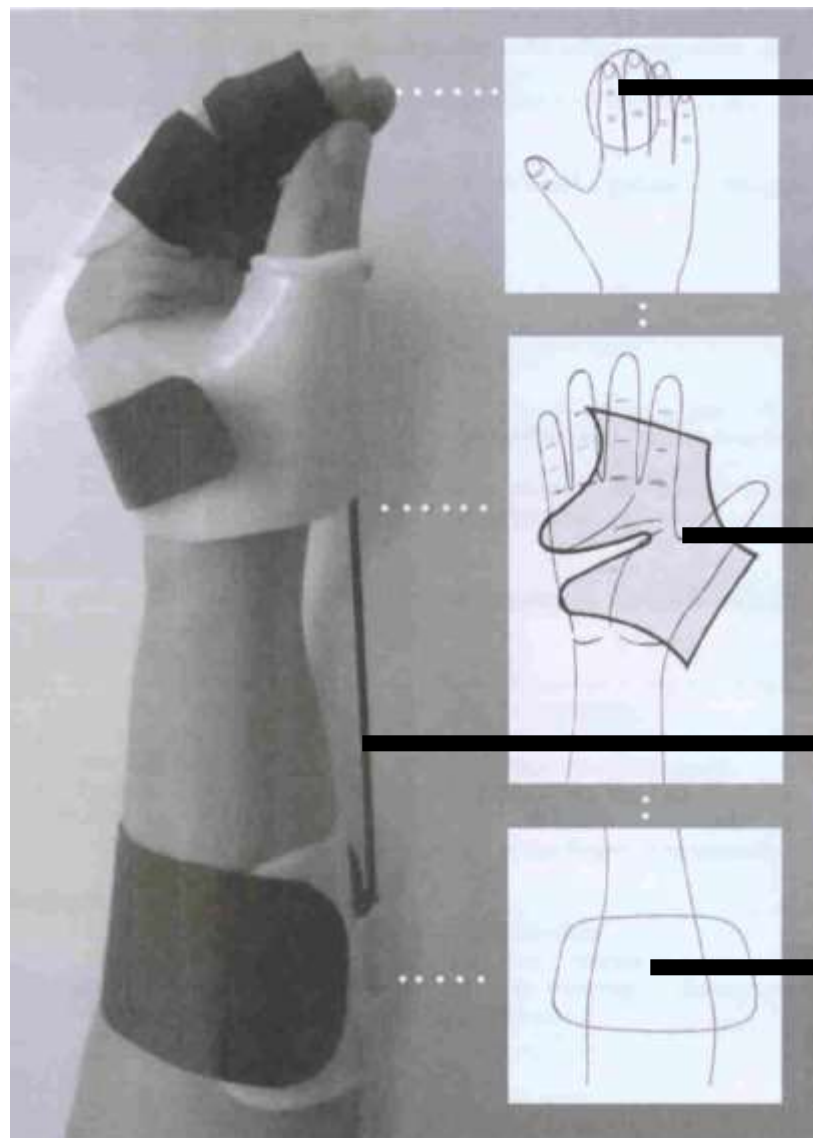




**Metatarsal Bar**

**Dynamic Springwire  
Knuckle bender Assist**

**Volar Forearm  
Trough**



**Finger Cuff**

**Thumb Spica**

**Dynamic Elastic  
Band Assist**

**Forearm Cuff**



# Dynamic Ulnar Nerve Splint

Dynamic anti-claw deformity splint: ■

## **Objectives** ■

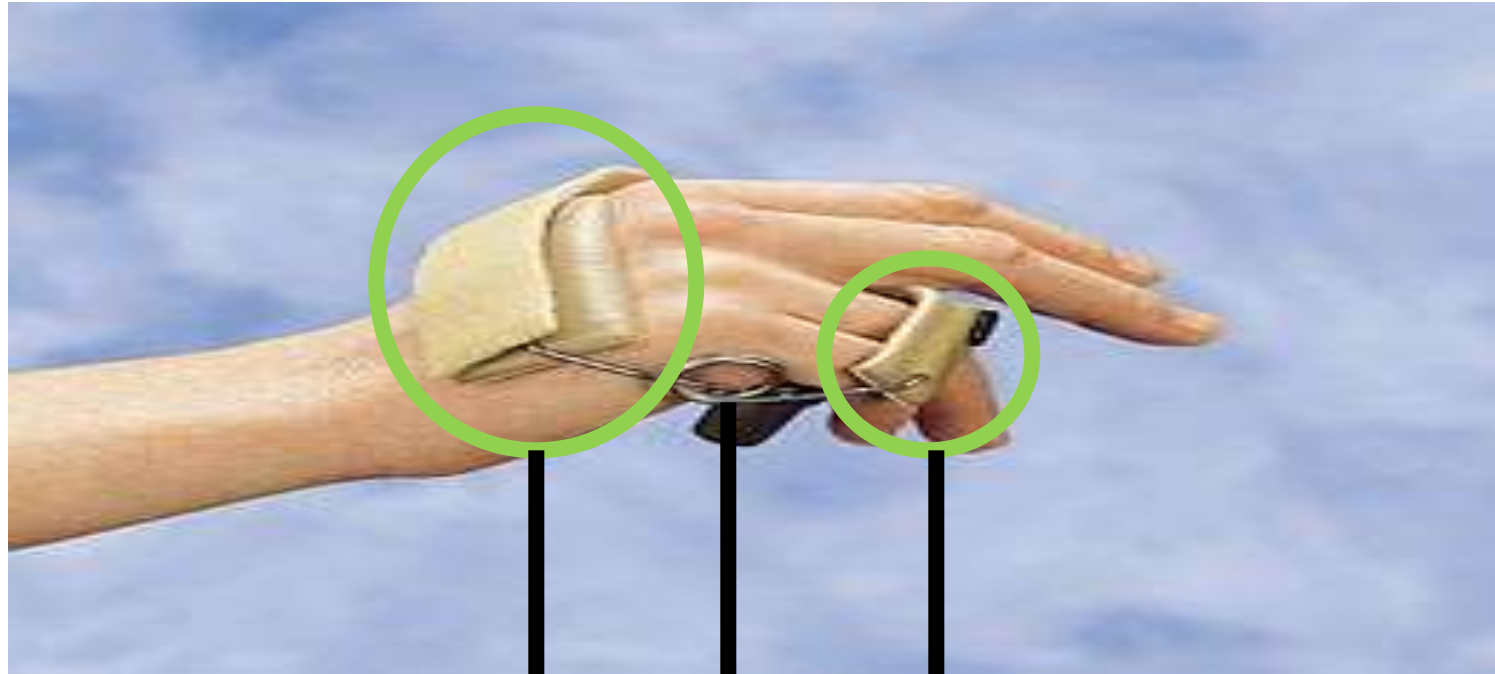
To passively flex the 4th ■  
and 5th MCP's

To prevent shortening of ■  
the MCP Collateral  
ligaments

Indication ■

Ulnar nerve lesion ■





**Metacarpal Bar**

**Lumbrical Bar**

**Dynamic  
Springwire  
Knucklebender  
Assist**

# General Precautions

Be aware of and make adjustments •  
for pressure areas

Check for presence of edema •

Timing •

Compliance •

Skin reactions •

# Upper Extremity Orthosis

Shoulder slings



Humeral Fracture Brace



THANK YOU  
FOR  
LISTENING!!!

**ANY QUESTIONS?**