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REDiMED HULU Guidelines for Hand and Upper-limb Injury Management

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# Soft Tissue Injury

**Distal phalanx fractures and nail bed repairs**

**Description**Fractures of the distal phalanx are commonly associated with crush and nail bed injuries. They are generally classified as either tuft, longitudinal or transverse. Avulsion fractures involve the flexor or extensor tendon insertion.

Distal phalanx fractures are commonly associated with hypersensitivity and pain of the finger tip.

**Treatment**Stability of phalangeal fractures primarily depends on fracture orientation.

**TUFT FRACTURES**Tuft fractures are usually comminuted and involve the nail bed. Distal tuft fractures and longitudinal fractures are inherently stable and require splinting only for comfort.

**Week 1-3**

* Mallet style splint for comfort during activity/work for up to 3 weeks leaving PIPJ free.
* AROM of the DIP commenced immediately
* Desensitization activities commenced immediately
* Oedema management

**Week 4-6**

* Gradual strengthening / work hardening

**TRANSVERSE & LONGITUDINAL FRACTURES OF PROXIMAL HALF**

Transverse non-displaced fractures are treated with splint immobilisation. Displaced fractures are associated with subluxation of the nail base and require fixation (kwire).

**Week 1-4**

* Immobilize DIP in mallet style splint with PIP free
* AROM of unaffected joints
* Oedema management

**Week 4-6 (post wire removal)**

* Commence hourly active exercises, using splint between for activity
* Desensitization as required

**Week 6**

* Strengthening / work hardening

**NAIL BED INJURY**

**Week 1-2**

* Protective splint leaving PIPJ free
* AROM all joints, including DIP

**Week 2-4**

* Scar management
* Desensitization
* Gentle passive ROM as required
* Strengthening

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| Hand Therapy schedule | 1X per week first four weeks  1 X per week/fortnight until full strength and ROM achieved (approx. 8 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Final at approx. 16 weeks post injury (assess nail regrowth and sensation) |
| Return to work schedule | One handed/light/office duties first 2 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 4 weeks post injury  Heavy lifting/contact sports week 6 weeks post injury depending on fracture healing |

## Skin Grafts and Flaps

**Description**

Skin grafts and flaps are used in Plastic Surgery to cover a soft tissue defect or when loss of tissue will be unable to heal or heal inadequately without surgical intervention.

Common grafts used following trauma include split thickness skin grafts (STSG) and full thickness skin grafts (FTSG). The thicker the graft the more dermal appendages the graft contains. For meshed or expanded STSGs, skin cells may be cultured in a lab and applied for more coverage. For larger defects over exposed tendons or bone, a muscle flap and subsequent skin graft may be required e.g. gracilis free flap.

**Treatment**

The graft or flap applied over the defect is required to be stable prior to commencing range of motion. Generally a graft is stable 4 days post-operatively, however the treating surgeon may request a longer immobilisation period until the graft has taken. Flaps are typically protected for up 7-10 days, particularly if across a joint.

**Therapy Considerations**

* Important questions to ask the treating surgeon:
  + When mobilisation of the graft/flap can occur?
  + Can compression of the graft/flap commence (and when)?
  + Is a splint required?
  + What was intra-operative ROM?
* Education of the client is particularly important especially with regard to wound care, scar management, desensitisation, range of movement, compression and psychological issues.

**Day 4 - Week 1**

* Dressing change
* Commence active range of motion exercises
* Fabricate protective splint if required
* Apply compression if surgeon approves, the patient can also be measured for a custom pressure garment if required.

**Week 2 – 4**

* Continue with active range of motion exercises, can commence passive if graft has taken well
* The patient can be educated on how to complete their own dressing changes and wound care independently i.e. washing
* Commence scar massage and desensitisation
* Address any functional issues the patient may be having

**Week 4-6**

* Further scar management can be provided i.e. contact media
* Static progressive or dynamic splinting can be utilised for joint contractures or reduced range of motion across a joint
* Commence strengthening activities

**Week 6 onwards**

* Ensure that ROM is maintain or continuing to improve
* Continue with aggressive scar management techniques
* Continue with desensitisation
* Continue patient education regarding ongoing scar care i.e. risk of sun damage, itch, hypertrophic scarring and options for scar revision

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| Hand Therapy schedule | 2x per week for weeks 1-4  1x per week/fortnight until full strength and ROM achieved (approx. 8 weeks)  1x per month to continue with scar management advice |
| Doctor schedule | Initial assessment or post op assessment  Weekly for up to 4 weeks  Monthly until a full return to work is achieved  Final at approx. 6 months post injury |
| Return to work schedule | One handed/light/office duties first 2-4 weeks dependent on other associated injuries  Increasing duties as tolerated next 4-8 weeks  Full duties at approx. 6-8 weeks post injury  Heavy lifting/contact sports week 8 weeks depending on other associated injuries |

## Amputations and De-tipping

**Description**

Amputations of the digits are generally associated with a traumatic injury involving machines, crushes and lacerations. There is often involvement of the other digits with either superficial wounds or tendon injury. De-tipping refers to loss of a partial segment of the distal pulp or phalanx.

**Therapy Considerations**

As amputations are often a result of a traumatic injury can patients can therefore have issues in dealing the loss of the digit or segment, this is particularly evident in Asian or Middle Eastern cultures. Another prominent issue is hypersensitivity of the finger and scar and/or phantom pains.

Early range of motion of unaffected joints, effective wound care, scar management and functional retraining are essential for successful treatment of these injuries.

**Post-Surgical Management**

**Week 1**

* Change of dressing and wound check
* A bulky dressing or is place on the digit for protection with a bashgaurd for pt’s returning to work.
* Desensitisation can be initiated from week 1
* Both active and passive ROM exercises

**Week 2**

* Removal of sutures 14 days post operation
* Scar massage/oedema management can commence
* Continue with desensitization
* Encourage patient to utilize bash-guard at work or in at risk situations only

**Week 3-6**

* Continue with AROM and PROM, scar management, oedema management and gradual strengthening of the hand and fingers.
* If hypersensitivity is occurring the Downey sensitivity test should be administered.
* Gradual return to work dependent on duties required to be performed.

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| Hand Therapy schedule | 2X per week first 3 weeks  1X per week/fortnight until full strength and ROM achieved (approx. 8 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Final at approx. 16 weeks post injury (assess nail regrowth and sensation) |
| Return to work schedule | One handed/light/office duties first 2 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 4 weeks post injury  Heavy lifting/contact sports week 6 weeks post injury |

# Joint Injuries and Dislocations

**Volar Plate Injury**

**Description**

The volar plate is a fibrous thickening of the joint capsule on the volar surface of the PIP joint. It provides volar stability and prevents hyperextension of the PIP joint. PIP and DIP joint stiffness and flexion contractures of the PIP joint are common after this injury. If left untreated instability of the PIP joint results.

**Causes**

The volar plate can become injured or ruptured when the PIP joint is dorsally dislocated or hyperextended. Often the volar plate and at least one collateral ligament are torn. Dorsal dislocations of the PIP joint can involve an avulsion fracture from the volar aspect of the base of the middle phalanx.

**Treatment Aims**

* Protect healing structures (i.e. volar plate) and prevent recurrence of dislocation.
* Restore full ROM to affected digit.
* Minimize scarring and prevent PIP flexion contracture.
* Manage oedema
* Restore/maintain ROM unaffected joints.

**Treatment**

X-ray indicated to determine degree of injury.

**CONSERVATIVE – SIMPLE INJURY – *Joint stable with no ligament laxity***

* Buddy strap to adjacent finger for 4 to 6 weeks.
* Oedema management
* Allow full AROM exercises as indicated.
* PROM flexion exercises if flexion impaired.
* Monitor flexion contracture and initiate passive extension at week 6. Dynamic and static progressive splinting if contracture is substantial (15-45 degrees) or with hard end range at 6 – 8 weeks.
* Continue with buddy taping for sport for 3 months.

**CONSERVATIVE – *Severe dislocation with unstable joint*** (small fracture component up to 30%, joint enlocated)

**Week 1**

* Splint: Dorsal blocking PIP extension at comfortable extension (20-30) (i.e. without pain on volar PIPJ) degrees. Splint should allow full flexion and can be digital or hand based dependent on individual patient factors.
* Exercises: AROM in splint allowing full flexion and extension to splint. PROM flexion only. Attention should be given to the DIP joint to prevent ORL tightness (passive flexion stretches and lateral band glides). Restore ROM all unaffected joints.
* Oedema management.
* Surgeon may request repeat x-ray day 7-14

**Week 2**

* Splint: adjusted to decrease PIP extension block to 10-20 degrees
* Exercises as above
* Oedema management

**Week 3**

* Splint: adjusted to decrease PIP extension block to 0-10 degrees.
* Exercises as above.
* Oedema management

**If significant flexion contracture (>20 degrees) of PIP joint, consider digital volar night resting splint in position of maximum active PIP extension.**

**Week 4**

* Assess stability – cease day splinting in exchange for continuous buddy strap for stable joints.
* Continue splint until week 6 with PIP extension blocked at 0 degrees for unstable joints or if volar plate tender on palpation.
* Light ADL permitted within splint or with strap.

*If significant flexion contracture (>20 degrees) of PIP joint, consult senior therapist or surgeon to consider suitability for;*

* Cease day splint in exchange for buddy strap
* Serial static night extension splinting
* PIP extension stretches

**Week 6 onwards**

* Discontinue day splint.
* Gradual increase in functional use of hand. Buddy strap to adjacent finger to provide additional support as required.
* Gradual increase in resistive exercises.
* For persistent PIP flexion contractures, consider;
* Dynamic PIP extension splinting
* Serial static night extension splinting

**Week 8**

If flexion contracture remains at PIP joint and not responding to static splinting, request surgeon review with check x-ray

**Week 10-12**Return to heavy activity and sport with buddy tape for up to 3 months.

**Post-operative management**

Unstable joints managed with open reduction and volar plate arthroplasty, often have the PIP joint immobilized with a Kirschner (K-wire) for 2 – 3 weeks.

**Weeks 0-3 (or until K-wire removed, can be up to 5 weeks)**

* Protective splint to protect digit - hand or finger based dependent on patient factors.
* Oedema management
* Restore / regain ROM of unaffected joints especially DIP joint.
* Wound management
* Attention should be given to the DIP joint to prevent ORL tightness (passive flexion stretches and lateral band glides).

**Weeks 3-5 onwards**

* Following removal of K-wire, commence extension block splint in neutral or slight flexion.
* Commence gentle AROM within limits of splint.
* Commence gentle passive flexion within splint.
* Oedema management

**Week 4**

* Continue day splinting with PIP extension block at 0 degrees.

If significant flexion contracture of PIP joint, consider digital serial static extension splint at night aiming for 0 degrees PIP joint extension.

* Light ADL. Buddy strap can be used to provide additional support with activity as indicated.

**Week 6 onwards**

* Discontinue day splint.
* Gradual increase in functional use of hand. Buddy strap to adjacent finger can be used to provide additional support as required.
* Gradual increase in resistive exercises.
* *For persistent PIP flexion contractures, consider;*
* Dynamic PIP extension splinting
* Serial static night extension splinting

**Week 10**

* Discontinue buddy strap / splint
* *For persistent PIP flexion contracture with hard end range, consider;*
* Serial casting

**Week 15**

* Return to heavy activity and sport.

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| Hand Therapy schedule | 1-2X per week first 6 weeks  1X per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8 weeks post injury  Heavy lifting/contact sports week 8 weeks post injury, buddy strap until 12 weeks post injury |

## Gamekeepers/Skiers Thumb

**Description**

Gamekeepers or skiers thumb refers to an injury involving the ulnar collateral ligament (UCL) of the metacarpal joint of the thumb. Gamekeepers thumb relates to chronic instability due to attenuation of the UCL following repetitive movements while skier’s thumb is an acute injury often associated with detachment of the UCL from its insertion on the proximal phalanx. It is particularly common in skiers and ball-handling athletes as is caused by a sudden, forceful abduction and extension of the thumb. An avulsion fracture of the base of the proximal phalanx is often associated with this injury. Injuries are classified as follows:

* **Grade I** – Microscopic tears in the UCL with no loss of ligament integrity.
* **Grade II** – A portion of the ligament is completely torn, with overall ligament integrity still intact.
* **Grade III** – The ligament is completely ruptured (Steners Lesion) with instability exceeding 35°.

**Symptoms**

* MCP joint laxity (see below)
* Volar and dorsal tenderness over the thumb metacarpal phalangeal joint.
* Bruising and swelling evident over ulnar aspect of MCP of thumb.
* Malalignment of thumb compared to contra-lateral thumb.

**Test for Diagnosis**

The goal of these tests is to distinguish between partial and complete tears.

* Palpation - point tenderness along MCP ulnar and volar aspects.
* Stability assessment – critical to assess stability of the thumb MCP joint
* A partially torn ligament usually has a discreet end point even if there is some laxity evident when stress is applied. Partial tears cause more pain than complete tears on stress testing.
* Test with the MP in flexion to eliminate volar plate tightness.
* NB. Patient is often too painful to test within first week of injury.

Consider immobilising in thermoplastic splint for one week then reassess in outpatient clinic.

**Treatment**

Grade I and II injuries (incomplete ligament tears +/- non-displaced bony avulsions can be treated with immobilisation. Complete tears (grade III) +/- displaced bony avulsions usually require surgical repair followed by immobilisation.

**Treatment goals**

* Promote ligament healing
* Maintain full ROM of unaffected joints
* Optimal wound healing
* Reduce oedema
* Maximise MCP joint ROM
* Return to previous level of function
* Prevent re-injury

Obtaining pre-injury range of motion is less important that obtaining a stable pain free joint.

**Grade I and II - Incomplete tears, non-displaced bony avulsions.**

**Week 1-2**

* Splint - thermoplastic short thumb spica –CMC and MCP are immobilised in the splint with the IP joint free. Ensure the MCP is in a neutral deviation position.
* Wear splint full time removing daily only for hand hygiene.
* NOTE – A long arm splint may be requested for high activity patients or to facilitate early return to work. Splint may be prescribed for up to 6 weeks dependent on degree of injury.
* Hand can be used to perform light daily activities with the splint on, to maintain strength and integrity of uninvolved digits.
* Maintain ROM unaffected joints with particular attention to of the thumb IP joint flexion.
* Oedema management.

**Week 2-4**

* If the patient is pain free AROM and AAROM of the MCP joint can be commenced avoiding lateral stress on the MCP joint. If the patient experiences pain then MCP mobilisation will be started in week 4.

**Week 4**

* Continue with splint full time, however can now be removed for gentle active exercises.
* Commence hourly mobilisation of the MCP and CMC taking care to avoid lateral stress on the MCP joint.

**Week 5**

* Continue with splint and AROM
* Commence supervised PROM of MCP if significant stiffness evident.

**Weeks 6 –8**

* Gradual discontinuation of splint. Can perform light activities without splint. Continue using splint for heavy activity until week 10-12.
* Dynamic flexion splinting can be commenced if significant MCP or IP stiffness.
* Gentle lateral pinch strengthening.

**Weeks 10-16**

* Begin unrestricted use. May benefit from protective taping during sports activities for 3-12 months post injury.
* Commence gentle strengthening as necessary (avoid pinch grips that stress ulnar collateral).
* Tip pinch strengthening can commence.

**Post-Operative Management and Grade III injuries**

**Week 1-6**

* Immobilise MCP/CMC in splint
* Wound care.
* Scar management.
* Oedema management
* Hand can be used to perform light daily activities with the splint on, so as to maintain strength and integrity of uninvolved digits.

**Weeks 6 – 12**

* Gentle active mobilisation exercises of the MCP joint can usually begin at week 6. The splint should continue to be worn at all other times.
* Gradual decrease in splint wear. Splint should continue to be worn up to week 12 for heavy activity.
* Strengthening exercises can be commenced at week 8 if necessary, with caution to avoid lateral stress on the MCP joint.

**Weeks 12-16**

* Begin unrestricted use. May benefit from protective taping during sports activities for 3-12 months post injury.
* Commence gentle strengthening as necessary (avoid pinch grips that stress ulnar collateral).

\* Note - For all grades of injury

* Activities that stress the UCL are avoided for up to 3-4 months.
* A 3 month period of non-strenuous activity following the injury is recommended, to ensure optimal healing
* Return to sporting activities is individualised and each patient is educated regarding the potential risks during the course of healing. Average return to sport is 12 weeks.
* It is not uncommon for patients to experience ongoing pain in the MCP joint for up to 6 months. Consider referral back to surgeon for intra-articular steroid injection.

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| --- | --- |
| Hand Therapy schedule | 1-2x per week first six weeks  1x per week/fortnight until full strength and ROM achieved (approx. 12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 4  Week 6  Week 12  Final at approx. 6 months post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 6 weeks  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 12 post injury |

## Sagittal Band Rupture

**Description**

The sagittal bands support the extensor tendon as it crosses the dorsal aspect of the MP joint. Their fibres arise from the extensor tendon, cover the metacarpal head and insert into the volar plate. Traumatic sagittal band injury typically occur where it is stretched or torn, causing it to slide toward the ulnar side of the MPJ and displacing into the inter-metacarpal space.

**Treatment**

Treatment for an isolated laceration affecting only the sagittal band can be repair surgically and this generally follows the same treatment guidelines of a zone V/VI extensor tendon.

In cases of close traumatic injury to the sagittal band a conservative management approach with early active mobilisation can be implemented.

It is important in the treatment of sagittal band injuries that there is no presentation of a lag of more that 15-20° and that there is no subluxation of the extensor tendon during active range of motion.

**Post-Surgical Treatment**

Commence EAM with a yoke in 15-20 degrees hyper-extension of the injured digit in comparison to neighbouring digits. Continue as per surgeon request

**Week 4-6**

* Commence full active range of motion exercises
* Continue with general therapies e.g. scar and oedema management

**Week 6-8**

* Commence passive range of motion exercises
* Gradual strengthening exercises

**Week 8-12**

* Continue with strengthening and scar management
* The patient can return to work increased duties as tolerated

**Conservative Treatment**

**Week 1**

* Fabricate both a wrist gauntlet in 30° wrist extension and a yoke that holds the affected MCP joint in 10-15° hyperextension compared to the adjacent digit.
* Oedema and pain management
* Patient education
* Active range within the confines of the splint

**Week 2-3**

* Splint check and ensure active range of motion has increased
* Continue with oedema and pain management
* Commence massage of the injured area to reduce scar tissue

**Week 3-5**

* The patient can discontinue the use of the splint at the end of week 3, but is required to continue the use of the yoke
* Commence full active range of motion out of yoke splint at the end of week 5
* Continue with all other therapies to ensure active range of motion continues to improve

**Week 6-8**

* Commence passive range of motion exercises if active range of motion is not fully restored
* Gradual strengthening activities can be introduced following week 6
* The patient can begin a gradual return to full duties at work during this stage

**Week 8-12**

* Continue to monitor for range of motion and grip strength

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| --- | --- |
| Hand Therapy schedule | 2 times per week first 6 weeks  1-2 time per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 5  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-6 weeks  Full duties at approx. 10-12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

# Fractures

**Bennett’s Fracture**

**Pathophysiology**

This injury is a fracture-dislocation of the first metacarpal bone (thumb) at the carpometacarpal joint. The injury occurs when axial force is transmitted through a partially flexed thumb metacarpal. The portion of the metacarpal onto which the volar oblique ligament inserts remains in anatomic position, and the remainder of the articular base subluxes in a dorsal, radial and proximal direction due to the pull of abductor pollicis longus (APL).

**Treatment**

Closed reduction and thumb spica cast immobilisation can be effective in the treatment of stable Bennett fractures. Generally, cases characterized by small avulsion fractures and minimal articular incongruity and instability can be managed in this fashion. Open or closed reduction combined with internal fixation is frequently required. More than 1 mm of articular incongruity after closed reduction is an indication for operative intervention. This degree of articular incongruity is associated with an increased rate of articular degeneration in the thumb CMC joint over time.

**Conservative Management  
Week 0-4**

* Splint: Forearm based thumb immobilization splint with the IPJ free
* Exercises: Active thumb IP flexion and extension.
* Oedema management: Coban or tubigrip as indicated

**Week 4-7**

* Splint night and protection
* Exercises: Active wrist and thumb ROM, gentle passive ROM as tolerated
* Avoid heavy lifting encourage functional use of hand

**Week 8**

* Dynamic or serial progressive splinting
* Progressive strengthening

**Week 12**

* Normal activities resumed.

**Post-operative management**

**Week 0-4**

* Splint: Hand based thumb immobilsation splint with IPJ free.
* Exercises: Unaffected joint ROM with splint on
* Oedema management
* Monitor K-wires for infection and change dressings

**Week 4**

* Splint: Remove for exercises only
* Exercises: Thumb ROM
* Oedema management as required
* Scar massage

**Week 6**

* Splint: Cease
* Exercises: Add gentle passive ROM and light strengthening
* Avoid heavy lifting encourage functional use of hand

**Week 8**

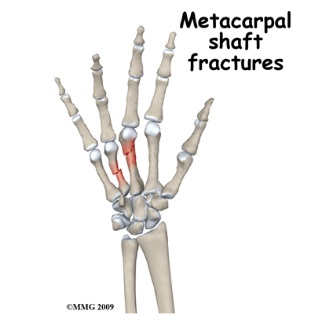
* Dynamic splinting as needed
* Continue strengthening
* Normal activities resumed

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2X per week first four weeks  1X per week/fortnight until full strength and ROM achieved (approx. 8 weeks) |
| Doctor schedule | Weekly first 3-4 weeks  Fortnightly next 4 weeks  Final at approx. 3 months post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 8-12 post injury |

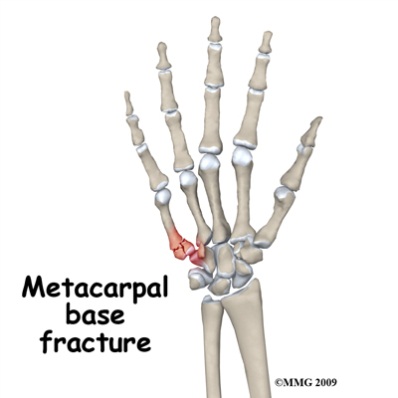
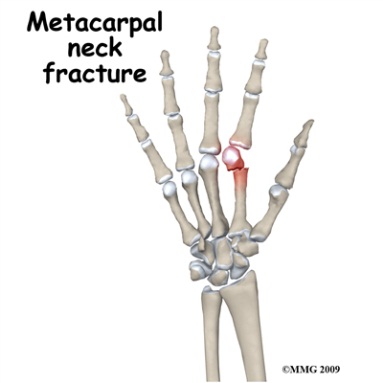
## Metacarpal Fractures

**Pathophysiology**

Injury to the metacarpals is the result of either direct or indirect trauma. These fractures typically result from trauma sustained in sports, motor vehicle accidents, or work related injuries. The nature and direction of the applied force determines the resultant fracture or dislocation.



**Types of fracture**

* Mid Shaft/transverse fracture
* Oblique fracture
* Spiral fracture
* Neck fracture
* Base fracture
* 1st metacarpal fracture

**Anatomical considerations**

* Maintain arches
* Maintain length of collateral ligaments
* Anatomical alignment of fracture
  + Shortened > 3-5mm can produce extrinsic / intrinsic imbalance.
  + Rotation of # can cause finger overlap.
  + For 4th and 5th digits angulation of 20-30 degrees acceptable.
  + For 2nd and 3rd up to 10 degrees acceptable.

**Treatment**

Most metacarpal fractures can be successfully treated with closed management, however certain fractures and dislocations require fixation to ensure optimal restoration of function. Indications for operative treatment include failure to achieve or maintain acceptable reduction, open fractures, oblique and spiral type fracture, multiple fractures in the hand, complex injuries, displaced / step deformity intra-articular injuries, and fractures with significant soft tissue injury requiring stable skeletal support. Metacarpal fractures generally consolidate within 3-5 weeks.

**Conservative Treatment**

***1) Stable non-displaced fractures of 3rd-5th metacarpal neck or boxer’s fractures:***

**Week 1**

* Hand based ulna gutter splint, oedema management and patient education

**Week 2**

* Splint check and oedema management

**Week 3**

* Commence active range of motion exercises

**Week 4**

* Removal of splint if patient is not tender on palpation (indicates clinical union) and commence light activity at home. Ongoing splint may be required for work/sport

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

***2) Stable non-displaced mid-shaft, transverse and oblique fractures of the 3rd-5th metacarpal:***

**Week 1**

* Forearm based ulna gutter splint with PIP joints free, oedema management and patient education

**Week 2**

* Splint check and oedema management

**Week 3**

* Commence active range of motion exercises

**Week 4**

* Removal of splint if patient is not tender on palpation (indicates clinical union)and commence light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* return to sport and heavy manual handling dependant on strength

***3)* Stable non-displaced base of 3rd-5th metacarpal fractures:**

**Week 1**

* Forearm based ulna gutter splint with MCP joints and PIP joints free, oedema management and patient education

**Week 2**

* Splint check and oedema management

**Week 3**

* Commence active range of motion exercises

**Week 4**

* Removal of splint if patient is not tender on palpation (indicates clinical union)and commence light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

\* Note that 2nd metacarpal fractures require a radial gutter splint to immobilize the 2nd and 3rd metacarpals.

***4)* Stable non-displaced base of 1st metacarpal fractures:**

**Week 1**

* Hand based thumb spica with IPJ free, oedema management and patient education.

**Week 2**

* Splint check and oedema management.

**Week 3**

* Commence active range of motion exercises

**Week 4**

* Removal of splint if patient is not tender on palpation and commence light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

**POST-OPERATIVE MANAGEMENT**

Considerations

* Type of fixation e.g. k-wire; screws; screws with a plate
* Does the K-wire cross the joint?
* Is mobilization of the unaffected joints ok?
* Is there a higher than usual risk of infection?

***1)* Open reduction and internal fixation of mid-shaft, transverse, oblique and spiral fractures of the 3rd-5th metacarpal*:***

**Week 1**

* Oedema management ++, active ROM ex’s, ezeform MC clamp splint only if necessary for protection at work

**Week 2**

* Wound check/scar management, continue oedema management and active ROM ex’s

**Week 4**

* Commence passive ROM ex’s

**Week 6**

* Return to regular work duties

**Week 8**

* Return to heavy manual duties and/or sports

***2)* Fractures of the 3rd-5th metacarpal neck or boxer’s fractures reduced with K-wires*:***

**Week 1**

* Hand based ulna gutter splint, consider pressure at pin sites, oedema management and patient education, mobilisation of unaffected joints

**Week 2**

* Splint check and oedema management

**Week 4**

* Removal of k-wire and commence active ROM ex’s and light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

***3)* Mid-shaft, transverse and oblique fractures of the 3rd-5th metacarpal reduced with K-wires:**

**Week 1**

* Forearm based ulna gutter splint with PIP joints free, consider pressure at pin sites, oedema management, mobilisation of unaffected joints and patient education

**Week 2**

* Splint check and oedema management

**Week 4**

* Removal of k-wire and commence active ROM ex’s and light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

***4)* Base of 3rd-5th metacarpal fractures reduced with K-wires:**

**Week 1**

* Forearm based ulna gutter splint with MCP joints and PIP joints free, consider pressure at pin sites, oedema management, mobilisation of unaffected joints and patient education

**Week 2**

* Splint check and oedema management

**Week 4**

* Removal of k-wire and commence active ROM ex’s and light activity at home, splint may be required at work

**Week 6**

* Commence passive range of motion and strengthening

**Week 8-10**

* Return to sport and heavy manual handling dependant on strength

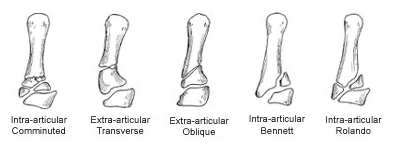
\* Note: 2nd metacarpal fractures require a radial gutter splint to immobilize the 2nd and 3rd metacarpals.

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2X per week first six weeks  1X per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Week 6  Final at approx. 10-12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 10-12 post injury depending on fracture healing |

# Base 1st Metacarpal Fractures

**(Thumb)**

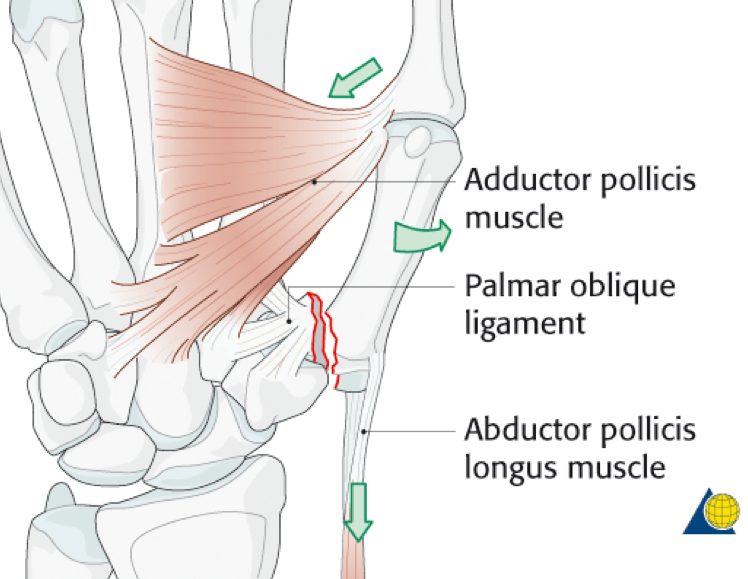
**FRACTURE CLASSIFICATION**

****

**PATHOPHYSIOLOGY**

**Bennett’s: volar fragment**

A two part intra-articular fracture-dislocation of the 1st metacarpal bone (thumb) at the 1st CMC joint (1st MC & trapezium). Usually caused by direct stress during a fall or punching with a closed fist against a hard object. Forced abduction with an axial loading force against a partially flexed 1st MC causes the fracture-dislocation pattern. The volar oblique ligament (VOL) attached to the volar lip of the 1st MC and the trapezium usually opposes the action of the APL and adductor pollicis muscles. When a Bennett’s fracture occurs, the unstable VOL avulsion fracture off the base of the 1st MC interrupts this opposing action as the VOL remains attached to the trapezium. The unopposed pull of APL and adductor pollicis dislocates the remaining base and shaft of the 1st MC in a radio-dorsal direction.

**Rolando: volar & dorsal fragment**

A three part intra-articular comminuted fracture-dislocation of the 1st MC bone at the 1st CMC joint. While less common than a Bennett’s fracture, the deforming forces are the same. Typically the base is split into a volar and dorsal fragment, commonly called a ‘Y’ fracture, however there may be more than two proximal fragments. As with a Bennett’s fracture, the volar fragment should still be attached to the volar oblique ligament that is attached onto the trapezium.

**ASSESSMENT**

**Initial**

* Mechanism of injury
* Oedema - screen
* Haematoma
* Deformity (dislocation/subluxation)
* T.O.P over proximal 1st MC (VAS)
* Sensation - screen
* AROM (IPJ,MCPJ, 1st CMC) - screen
* Resisted ROM for tendon function
* Radiographs/ Imaging (x-ray, CT scan, MRI)

**1-4 wks**

* T.O.P over # site
* Oedema
* Sensation (screen)
* Screen IPJ AROM
* K-wire site (if applicable)

**4-6 wks**

* T.O.P over # site
* Oedema
* Sensation
* Scar
* Goniometry
* AROM (flex, ext, opposition, abduction)

**6 wks**

* Scar
* Sensation (Semmes if required)
* Goniometry
* P/AROM
* Jamar pinch & grip strength

**8 wks**

* Scar
* Goniometry
* P/AROM
* Jamar pinch & grip strength

**12 wks**

* Scar
* Sensation (repeat Semmes if required)
* Goniometry
* P/AROM
* Jamar pinch & grip strength

**12 wks<**

* Consider COPM & DASH if cont. limited ROM & strength impacting function

**Left Untreated**

Oblique and comminuted #’s are predisposed to shortening and malrotation. Retraction of the 1st web space, persisting pain, and decreased mobility and strength may result, as well as continual dislocation & loss of function of the 1st CMC joint.

**TREATMENT CONSIDERATIONS**

**Extra-articular base #**

**Conservative**

Indicated if joint reduced, minimal displacement of fragments, <30 degree angulation.

**Operative**

Indicated if mod-severe displacement of fragments, and >30 degrees angulation.

\***Closed reduction with percutaneous pinning (CRPP, K-wires)** is typically used to stabilize the reduction. The 1st wire is driven down the medullary canal of the 1st MC into trapezium; the 2nd wire across the proximal fragment into the 2nd MC base.

\***Open reduction internal fixation (ORIF) - Mini-locking plate** is used if k-wires do not provide enough reduction & stability.

**Bennett’s # / Rolando #** (typically unstable)

**Conservative**

Indicated if the small volar fragment attached to the VOL is non-displaced, or less <2mm articular step-off.

**Operative**

Indicated if the volar fragment involves <30% articular surface, and there is <3mm articular step-off.

\***CRPP (k-wires)** areused to stabilize the reduction, and are positioned the same as for an extra-articular base #.

If the volar fragment involves >30% of the articular surface, and >3mm articular step-off:

**\*ORIF - Lag screws or T/L plate double locking plate** is used to stabilize the reduction;

\***Plate** used if lag screws/k-wires don’t provide enough compression &/or the fragment is large.

**TREATMENT GUIDELINES**

**Extra-articular base #**

**Conservative**

**0-4 Weeks**

* Immobilise in forearm thumb spica (IPJ free) full time for 4/52 wks
* Oedema & pain Mx;
* P/AROM ex’s: Thumb IPJ (flex/ext) and all unaffected digits, 10 repetitions x hourly

**4-6 Weeks**

* Continue AROM ex’s per weeks 0-4

Include:

* AROM ex’s – commence MCPJ joint blocking; opposition; composite flex/ext; abduction; wrist flex/ext, deviation and rotation ex’s, 10 repetitions x hourly
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.

**6-8 Weeks**

* Cease splint wear for all activities
* Increase functional use of hand
* Continue AROM ex’s per weeks 4-6

Include:

* Commence thumb PROM ex’s if ROM still limited– isolated joint and composite flexion/extension, and abduction stretch, 5-10 repetitions x hourly
* Commence wrist PROM ex’s if ROM still limited, including flexion/extension, deviation and rotation
* Commence resistive theraputty/theraband if ROM still limited, including isolated IPJ flexion; thumb press; extension; abduction; pinch
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation, 10-20 repetitions x 5 daily dependent on work load

**8-12+ Weeks**

* If ROM still limited, consider static progressive/dynamic flexion splinting (this may be commenced at week 6 if ROM significant reduced and clearance from surgeon given)
* If ROM into abduction limited consider web space divider splinting
* Continue strengthening if ROM full

**Operative**

**0-4 Weeks**

**If # still unstable following CRPP or if k-wires intra-articular**:

* Follow conservative guideline 0-4 wks

Include:

* K-wire site care, clean & dry 4/52 wks if wires exposed
* AROM ex’s - include gentle thumb MCPJ blocking if appropriate,

10 repetitions x hourly

* Reduce ROM ex’s to 4-5 x daily if mod-severe oedema, and/or significant pain secondary k-wires

**If # stable following CRPP & k-wires extra-articular:**

* **0-2 wks:** Immobilize in f/arm thumb spica (IPJ free) for 4/52 wks or until ROW
* Oedema & pain Mx
* K-wire site care
* P/AROM ex’s: Thumb IPJ (flex/ext) and all unaffected digits, hourly
* **2-4 wks:** AROM ex’s- commence gentle IPJ and MCPJ joint blocking; opposition to ring finger; composite flex/ext of MCPJ and IPJ; gentle wrist flex/ext ex’s,

10 repetitions x hourly

* Reduce ROM ex’s to 4-5 x daily if mod-severe oedema, and/or significant pain secondary k-wires

**Lag screws/ Locking plate**

\* **only extra-articular plated #’s** may be splinted in **hand based thumb spica** due to minimal impact of APL

* Follow as above for CRPP with extra-articular k-wires
* Include surgical wound care, keep clean & dry for 2/52 wks until ROS then commence scar Mx

**4-6 Weeks**

**If # still unstable following CRPP or if k-wires intra-articular**:

* Continue AROM ex’s per weeks 0-4

Include:

* AROM ex’s – opposition; composite flex/ext; abduction; wrist flex/ext, deviation and rotation ex’s, 10 repetitions x hourly
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.
* Commence scar massage following ROW

**If # stable following CRPP & k-wires extra-articular**

* Continue AROM ex’s per weeks 2-4
* Commence scar massage following ROW
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.

**Lag screws/ Locking plate**

* Continue AROM ex’s per weeks 2-4
* Commence PROM ex’s at isolated joints if ROM very limited and clearance from surgeon given, 5-10 repetitions x hourly
* Continue with scar massage
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.
* Commence resistive theraputty/theraband ex’s if ROM very limited and clearance from surgeon given, including isolated IPJ flexion; thumb press; abduction; extension; pinch

**6-8 Weeks**

**CRPP & k-wires extra-articular & intra-articular**

* Continue scar massage
* Cease splint wear for all activities
* Increase functional use of hand
* Continue AROM ex’s per weeks 4-6

**Include:**

* Commence thumb PROM ex’s if ROM still limited– isolated joint and composite flexion/extension, and abduction stretch, 5-10 repetitions x hourly
* Commence wrist PROM ex’s if ROM still limited, including flexion/extension, deviation and rotation
* Commence resistive theraputty/theraband if ROM still limited, including isolated IPJ flexion; thumb press; extension; abduction; pinch
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation, 10-20 repetitions x 3-5 daily dependent on work load

**Lag screws/ Locking plate**

* Cease splint for all activities
* Increase functional use of hand
* Continue scar massage
* Continue with ROM ex’s per weeks 4-6 if still limited
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation, 10-20 repetitions x 3-5 daily dependent on work load

**8-12+ Weeks**

**All operatively managed #’s**

* If ROM still limited, consider static progressive/dynamic flexion splinting (this may be commenced at week 6 if ROM significant reduced and clearance from surgeon given)
* If ROM into abduction limited consider web space divider splinting
* Continue strengthening if ROM full

**Bennett’s & Rolando # (intra-articular)**

**Conservative**

**0-4 Weeks**

* Immobilise in forearm thumb spica (IPJ free) full time for 4/52 wks
* Oedema & pain Mx
* P/AROM ex’s: Thumb IPJ (flex/ext) and all unaffected digits, 10 repetitions x hourly

**4-6 Weeks**

* Continue AROM ex’s per weeks 0-4

**Include:**

* AROM ex’s – commence MCPJ joint blocking; opposition; composite flex/ext; abduction; wrist flex/ext, deviation and rotation ex’s, 10 repetitions x hourly
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.

**6-8 Weeks**

* Cease splint wear for all activities
* Increase functional use of hand
* Continue AROM ex’s per weeks 4-6

Include:

* Commence PROM ex’s if ROM still limited– isolated joint and composite stretch, 5-10 repetitions x hourly
* Commence resistive theraputty/theraband if ROM still limited, including isolated IPJ flexion; thumb press; extension; abduction; pinch
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation

**8-12+ Weeks**

* If ROM still limited, consider static progressive/dynamic flexion splinting (this may be commenced at week 6 if ROM significant reduced and clearance from surgeon given)
* If ROM into abduction limited consider web space divider splinting
* Continue strengthening if ROM full

**Operative**

**0-4 Weeks**

**If # still unstable following CRPP or if k-wires intra-articular**:

* Follow conservative guideline 0-4 wks
* K-wire site care, incl. clean & dry 4/52 wks if wires exposed
* AROM ex’s - include gentle thumb MCPJ blocking if appropriate, 10 repetitions x hourly;
* Reduce ROM ex’s to 4-5 x daily if mod-severe oedema, and/or significant pain secondary k-wires

**If # stable following CRPP & k-wires extra-articular:**

* **0-2 wks:** Immobilize in f/arm thumb spica (IPJ free) for 4/52 wks or until ROW
* Oedema & pain Mx
* K-wire site care
* P/AROM ex’s: Thumb IPJ (flex/ext) and all unaffected digits, 10 repetitions x hourly
* **2-4 wks:** AROM ex’s- commence gentle IPJ and MCPJ joint blocking; opposition to ring finger; composite flex/ext of MCPJ and IPJ; gentle wrist flex/ext ex’s, 10 repetitions x hourly
* Reduce ROM ex’s to 4-5 x daily if mod-severe oedema, and/or significant pain secondary k-wires

**Lag screws/ Locking plate**

* Follow as above for CRPP with extra-articular k-wires
* Include surgical wound care, clean & dry for 2/52 wks until ROS then commence scar Mx

**4-6 Weeks**

**If # still unstable following CRPP or if k-wires intra-articular**:

* Continue AROM ex’s per weeks 0-4

Include:

* AROM ex’s – commence opposition; composite flex/ext; abduction; wrist flex/ext, deviation and rotation ex’s, 10 repetitions x hourly
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.
* Commence scar massage following ROW

**If # stable following CRPP & k-wires extra-articular:**

* Continue AROM ex’s per weeks 0-4

Include:

* AROM ex’s – commence MCPJ joint blocking; opposition; composite flex/ext; abduction; wrist flex/ext, deviation and rotation ex’s, 10 repetitions x hourly
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.
* Commence scar massage following ROW

**Lag screws/ Locking plate**

* Continue AROM ex’s per weeks 2-4
* Commence PROM ex’s at isolated joints if ROM very limited and clearance from surgeon given, 5-10 repetitions x hourly
* Continue with scar massage
* Cease splint wear for all light ADL’s and encourage functional use of hand; continue splint wear for heavy activities, work and sleep for a further 2/52 weeks.
* Commence resistive theraputty/theraband ex’s if ROM very limited and clearance from surgeon given, including isolated IPJ flexion; thumb press; abduction; extension; pinch

**6-8 Weeks**

**CRPP & k-wires extra-articular & intra-articular**

* Cease splint wear for all activities
* Increase functional use of hand
* Continue scar massage
* Continue AROM ex’s per weeks 4-6

Include:

* Commence thumb PROM ex’s if ROM still limited– isolated joint and composite flexion/extension, and abduction stretch, 5-10 repetitions x hourly
* Commence wrist PROM ex’s if ROM still limited, including flexion/extension, deviation and rotation
* Commence resistive theraputty/theraband if ROM still limited, including isolated IPJ flexion; thumb press; extension; abduction; pinch
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation, 10-20 repetitions x 3-5 daily dependent on work load

**Lag screws/ Locking plate**

* Cease splint for all activities
* Increase functional use of hand
* Continue scar massage
* Continue with ROM ex’s per weeks 4-6 if still limited
* Commence strengthening if ROM close to full, include all putty ex’s and incorporate wrist with dumbells/theraband into flexion, extension, rotation, 10-20 repetitions x 3-5 daily dependent on work load

**8-12+ Weeks**

**All operatively managed #’s**

* If ROM still limited, consider static progressive/dynamic flexion splinting (this may be commenced at week 6 if ROM significant reduced and clearance from surgeon given)
* If ROM into abduction limited consider web space divider splinting
* Continue strengthening if ROM full

**Treatment frequency**

**Hand Therapy**

**0-4 weeks:** 1-2 x weekly

**4-6 weeks:** 1 x weekly

**6-12 weeks:** 1 x weekly or 1 x fortnightly until full ROM and strength achieved

**Doctor schedule**

**0-4 weeks:** 1 x weekly

**4-8 weeks:** 1 x fortnightly

**12 weeks:** Final issued/discharged unless complications occur

**RTW schedule**

**0-4 weeks:** One handed/light duties with splint on fulltime

**4-6 weeks:** Light duties with splint on/off depending on work environment

**6-8 weeks:** Increasing duties as tolerated

**8-12 weeks:** Full duties/ return to contact sports

**Treatment Modalities**

* **Immobilisation**: Long thumb spica (IPJ free) if conservative Mx/ Full resting pan if operative Mx and k-wires dorsally positioned - thumb in moderate abduction & opposition best maintains reduction
* **Pain:** Inter-X; heat; NSAID’s
* **Oedema:** Inter-X; coban; tubigrip; NSAID’s; contrast baths if persistent
* **Scar:** Inter-X; mini massager
* **Desensitisation:** Inter-X; textured paddle; particle immersion; vibration
* **AROM:** joint blocking; flexion; extension; opposition; abduction; TGE’s (digits)
* **PROM:** isolated IPJ; composite flexion/extension; abduction; composite digits
* **Resistive:** theraputty; theraband
* **Strengthening:** theraputty; theraband; functional putty tools; dumbells
* **Splinting for mobilization:** S/progressive or dynamic flexion; webspace divider

**Complications**

* Infection from k-wires/surgical wound
* Fragment displacement/gapping
* Intra-articular “step-off”- type of malunion where the bone heals but joint surface is not aligned in a smooth continuous fashion, ie. incongruent
* Subsequent post-traumatic arthritis
* Persistent pain
* Reduced thumb mobility & strength

## Proximal Phalanx Fractures

**Description**

Fractures and dislocations of the phalanges most commonly occur from falls, sporting accidents and machinery. The stability of phalangeal fractures depends on location, fracture orientation, and degree of initial displacement. Fractures with an intact periosteal sleeve and no initial displacement are usually stable. Common complications following mid and proximal phalanx fractures are: 1) fixed flexion contracture of the PIP joint or 2) extension lag at the PIP joint due to adhesion of the extensor tendon.

**Treatment**Phalangeal fractures that are non-displaced or stable following reduction can have closed treatment with splinting and early rehabilitation. Transverse fractures of the shaft and unicondylar and bicondylar fractures are commonly unstable and warrant fixation.

**General treatment principles**

* Protect fracture and facilitate bone healing
* Oedema management
* Maintain AROM unaffected joint
* Restore full ROM affected digit

**Conservative Treatment – stable  
Week 0 - 3**

* Immobilisation splint in safe position - immobilize the joints above and below the fracture site in the safe position of IPJ’s at 0o
* Lycra buddy
* Active range of motion exercises of all joints (tendon glides and joint blocking) completed hourly with injured digit buddy taped
* Oedema management

**Week 3** (or when clinically stable)

* Continue splint for protection in between exercise sessions.
* Continue buddy tape full time for a further 2 weeks.
* Oedema management.

**Week 6** (or 2 weeks following clinical union)

* Discontinue protective splinting.
* Resume light activity.
* Passive range of motion can be introduced as needed. Mobilization splinting is instituted as needed.
* Protective splinting can be maintained for sports level activities.
* If FFD present consider night extension splint

**Week 8 – 12** (or 4 weeks after clinical union)

* Strengthening exercises.
* Dynamic splinting/casting as needed for fixed flexion or poor flexion range
* Full unrestricted activities at work and recreation.

**Conservative Treatment – unstable**

**Day 1 – Week 6**

* Hand based immobilization splint in safe position
* Lycra buddy.
* AROM unaffected digits joints.
* Oedema management.

**Week 6 (**or when clinically stable)

* Commence gentle AROM.
* Continue lycra buddy for a further 2 weeks.
* Cease splint for light activity only.

*If flexion contractures developed consider;*

* Serial static extension splinting
* Light passive ranging

*If PIP extension lags due to adhesion of extensor tendon consider;*

* Progress active/passive program and liaise with senior therapist.

**Week 8 -12** (or 2 weeks following clinical union)

* Discontinue protective splinting.
* AROM and PROM exercises.
* Commence dynamic or static progressive splinting as needed.
* Light strengthening exercises.
* Full unrestricted activities at work and recreation.

**Post-operative management**Aim of fixation is to allow early movement however this is not always possible. Treatment approach depends on the stability of the fracture, therefore discuss plan with surgeon / senior hand therapist. Following stable or rigid fixation, active range of motion exercises should commence immediately with a resting splint used in between. Treatment progression is similar to that for a stable conservative approach.

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2X per week first six weeks  1 time per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Week 6  Final at approx. 10-12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 10-12 post injury depending on fracture healing |

## Middle Phalanx Fractures

**Description**

Least common type of hand fractures; typically present as PIPJ (e.g. volar plate) avulsion injuries and central slip avulsions (volar plate and central slip fractures are dealt with in a different section). Transverse fractures are a common presentation.

**Treatment**

Stable and non-displaced #

**Week 0-3**

* Splint: finger based extension splint, or buddy and ROM.

**Week 3-6**

* Splint: night and protection
* Exercises: TGE’s, focus on PIPJ extension.

**Week 6-8**

* Exercises: Increase resistance and PROM as required

Stable # following fixation

**Week 0-4**

* Splint: finger based extension splint, until removal of wires
* Exercises: TGE’s +/- buddy straps

**Week 4-8**

* Splint: night and protection as needed (cease week 6)
* Exercises: TGE, progress to PROM and strengthening from week 6

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2 times per week first four weeks  1 time per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Week 6  Final at approx. 10-12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 10-12 post injury depending on fracture healing |

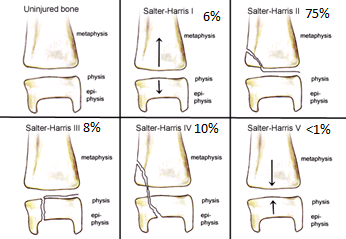
## Salter Harris Fracture Protocol

**Pathophysiology**

Fractures that include the growth plate (physis) and are therefore specific to a paediatric and adolescent population. Fractures are classified by the Salter Harris classification system. Fractures are more common to occur in children than ligament damage as the growth plate (physis) provides a weak point. Most common mechanism of injury is fall, punch, or strike with a ball during play. Most common locations of fractures are in the thumb and little finger in children, and most commonly occur during sport, play, from a fall or from a punch injury. Important to look for signs of non-accidental fractures or fractures of abuse in the paediatric population.

The stability of phalangeal fractures depends on location, fracture orientation, and degree of initial displacement. The physes are radiolucent on x-ray until ossification occurs. Paediatric bones have a thicker and more metabolically active periosteum contributing to faster healing time and the ability to remodel (‘grow out of a fracture’) over time. Salter Harris 2 fractures are the most common, making up ~75% of all salter harris fractures and are seen as a small triangular fracture on x-ray.

**Salter Harris Classification system** (% of prevalence)



**Assessment**

X-ray: interpretation of images and report. Need PA, lateral and oblique view.

Tenderness on palpation: over fracture site or location of pain

Oedema and pain

Nail bed: if it is not intact or if there is bleeding it could be a Seymour fracture (needs x-ray)

AROM: check for malrotation and/or lag. Measure AROM at week 2, 3 and 5.

Strength: JAMAR at week 5/6

Patient history: hypermobility, low or high tone history, hand dominance chosen etc.

Developmental assessment: screens can be used to assess level of understanding child has

**Treatment**Generally speaking, physeal fractures heal quicker than other fractures and stiffness does not follow as a secondary complication – over splinting is generally okay.

Salter Harris fractures usually heal without complications, however malunion of the growth plate or a mistreated Salter Harris fracture can lead to growth arrest.

**General treatment principles**

* Protect fracture and facilitate bone healing
* Oedema management
* Maintain AROM unaffected joint
* Restore full ROM affected digit

**Conservative management for a stable Salter Harris 1 fracture**

**Distal phalanx week 1-2 / 6**

* Mechanism of injury: forceful flexion (usually by a ball) against an extended finger
* Splint: mallet finger splint, less that 50% of the available hyperextension, involve PIPJ if lax ligaments to avoid swan necking.
* Exercises: Unaffected joints active and passive ROM as indicated.
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline, cartwheels)

**Distal phalanx week 3-4 / 6**

* Splint: cease splinting if fracture healing allows, continue protective splinting
* Exercises: AROM affected joints and assess for lag
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations

**Distal phalanx week 5-6 / 6**

* Splint: cease completely
* Exercises: AROM should be full, commence strengthening if req.
* Oedema management as required
* Occupations: pre-injury occupations

**Seymour fracture:**

* Mechanism of injury: as per mallet, can also happen when slammed in door and attempting to pull out of door
* Mimics mallet, fracture of the distal phalanx physis with avulsion of the proximal edge of the nail from the eponycheal fold
* Treated as per distal phalanx fracture except need weekly x-rays

**Proximal/middle phalanx week 1-2 / 6**

* Splint: finger barrel, ulna gutter, radial gutter full time. Usually okay to over splint based on person/environment factors. Buddy fabrication if required.
* Exercises: unaffected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline, cartwheels)

**Proximal/middle phalanx week 3-4 / 6**

* Splint: cease splinting full time, continue protective splinting, continue buddy
* Exercises: AROM affected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations

**Proximal/middle phalanx week 5-6 / 6**

* Splint: cease splinting, continue buddy for sport
* Exercises: AROM full, commence strengthening if req
* Oedema management as required
* Occupations: pre-injury occupations

**Metacarpal week 1-2 / 6**

* Splint: resting, ulna gutter, radial gutter full time. Usually okay to over splint based on person/environment factors. Buddy fabrication if required.
* Exercises: unaffected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline, cartwheels)

**Metacarpal week 3-4 / 6**

* Splint: cease splinting full time, continue protective splinting, continue buddy
* Exercises: AROM affected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations

**Metacarpal week 5-6 / 6**

* Splint: cease splinting, continue buddy for sport
* Exercises: AROM full, commence strengthening if req
* Oedema management as required
* Occupations: pre-injury occupations

**Distal Radius/ Ulna week 1-2 / 6**

* Splint: wrist gauntlet full time. Usually okay to over splint based on person/environment factors.
* Exercises: unaffected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline, cartwheels)

**Distal Radius/ Ulna week 3-4 / 6**

* Splint: cease splinting full time, continue protective splinting, continue buddy
* Exercises: AROM affected
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations

**Distal Radius/ Ulna week 5-6 / 6**

* Splint: cease splinting, continue buddy for sport
* Exercises: AROM full, commence strengthening if req
* Oedema management as required
* Occupations: pre-injury occupations

**Operative management for a stable Salter Harris 1 fracture**

Salter Harris 1 not operated on unless closed reduction is not achievable. Usually casted by ED and not seen through Redimed.

**Conservative management for a stable Salter Harris 2 fracture**

**Distal phalanx:** same as treatment for Salter Harris 1

**Proximal phalanx:** same as treatment for Salter Harris 1

**Metacarpal:** same as treatment for Salter Harris 1

**Distal radius/Ulna:** same as treatment for Salter Harris 1

**Operative management for a stable Salter Harris 2 fracture**

Salter Harris 2 not operated on unless closed reduction is not achievable (very rare). Usually casted by ED and not seen through Redimed.

**Conservative management for a stable Salter Harris 3 fracture**

**Distal Phalanx:** most likely will require Sx otherwise follow protocol in Salter Harris 1

**Proximal/middle Phalanx:** most likely will require Sx otherwise follow protocol in Salter Harris 1

**Metacarpal:** most likely will require Sx otherwise follow protocol in Salter Harris 1

**Distal Radius/Ulna:** most likely will require Sx otherwise follow protocol in Salter Harris 1

**Operative management for a stable Salter Harris 3 fracture**

**Distal phalanx week 1-2 / 6**

* Splint: mallet finger splint, less that 50% of the available hyperextension, involve PIPJ if lax ligaments to avoid swan necking.
* Exercises: Unaffected joints active and passive ROM as indicated.
* Oedema management as required
* Wound: check k-wire sites for infection, education regarding infection control
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Distal phalanx week 3-4 / 6**

* ROW
* Splint: cease for light activities, splint for protection (ie. School)
* Exercises: AROM affected and assess for lag
* Oedema management as required
* Wound management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Distal phalanx week 4-6 / 6**

* Splint: cease
* Exercises: full AROM usually, commence strengthening if req.
* Occupations: back to pre-injury occupations

**Proximal/middle phalanx week 1-2 / 6**

* Splint: finger barrel, ulna gutter, radial gutter full time. Usually okay to over splint based on person/environment factors. Buddy fabrication if required.
* Exercises: unaffected
* Wound: check k-wire sites for infection, education regarding infection control
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Proximal/middle phalanx week 3-4 / 6**

* ROW
* Splint: cease splinting full time, continue protective splinting, continue buddy
* Exercises: AROM affected
* Wound management as required
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Proximal/middle phalanx week 5-6 / 6**

* Splint: cease splinting, continue buddy for sport
* Exercises: AROM full, commence strengthening if req
* Oedema management as required
* Occupations: pre-injury occupations

**Metacarpal week 1-2 / 6**

* Splint: often long thumb spica as base of thumb usually affected. Usually okay to over splint based on person/environment factors.
* Exercises: unaffected
* Wound: check k-wire sites for infection, education regarding infection control
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Metacarpal week 3-4 / 6**

* ROW
* Splint: cease splinting full time, continue protective splinting
* Exercises: AROM affected
* Wound management as required
* Oedema management as required
* Occupations: no sport at this stage, avoid high risk leisure occupations (ie. Trampoline)

**Metacarpal week 5-6 / 6**

* Splint: cease splinting, possible taping for sport
* Exercises: AROM full, commence strengthening if req
* Oedema management as required
* Occupations: pre-injury occupations

**Conservative management for a stable Salter Harris 4 fracture**

**Distal phalanx:** as per conservative Salter Harris 3 protocol

**Proximal/middle phalanx:** as per conservative Salter Harris 3 protocol

**Metacarpal:** as per conservative Salter Harris 3 protocol

**Distal Radius/ulna:** as per conservative Salter Harris 3 protocol

**Operative management for a stable Salter Harris 4 fracture**

**Distal phalanx:** as per operative Salter Harris 3 protocol

**Proximal/middle phalanx:** as per operative Salter Harris 3 protocol

**Metacarpal:** as per operative Salter Harris 3 protocol

**Distal Radius/ulna:** as per operative Salter Harris 3 protocol

**Conservative/operative management for a stable Salter Harris 5 fracture**

Not seen in acute injury, usually see in retrospect.

|  |  |
| --- | --- |
| **Hand therapy schedule** | 1 time per week first two weeks  1 time per week/fortnight until full strength and ROM achieved (approx. 5-7 weeks) |
| **Doctor Schedule** | **Conservative**  Initial assessment  Week 2  Week 4 – if concerning fracture  Week 6 – usual discharge  **Surgical**  Initial assessment  Post op assessment  Week 2 – removal of sutures  Week 4 – usually for removal of wires  Week 6 – usual discharge |
| **Return to pre-injury occupations** | No sport/high risk play for 4-5 weeks  Return to pre-injury occupations week 5-7 (depending on PEO factors) |

## Distal Radius Fractures

**Description**

Fracture of the distal radius is the most common fracture of the upper extremity. Common fracture patterns include:

• Colles fracture - fracture is dorsally displaced, usually stable.

• Smiths fracture - fracture displacing volarly, usually unstable.

• Bartons – Displaced, unstable fracture with subluxation of the DR relative to the carpus.

The majority of wrist fractures are stable with minimal displacement and can be adequately treated with conservative measures. Approximately 30% are more complex and will require surgical treatment.

**Treatment**

Unstable fractures require surgical fixation through open or closed methods including percutaneous pins, plating, external fixation or a combination of these techniques.

Treatment considers the fracture location, configuration, degree of displacement, stability of the fracture and associated injuries including the integrity of the DRUJ. The quality of fracture reduction will affect outcome and must be considered when designing a therapy program and setting goals. Factors that will affect motion include:

* Mechanical blocks
* Flattening of the radial angle
* Dorsal angulation “silver fork deformity” – limits pronation and flexion.

Can increase ulnar load and may explain ulnar sided pain with gripping activities.

* Radial shortening – limits flexion, pronation, and ulnar deviation and grip strength. >6mm with limit rotation.
* Articular step off and interruption of joint space.

Therapy aims to restore a functional and pain free range of motion. The outcome is not known for at least 6 months and in complicated cases up to 2 years. Movement and pain may continue to slowly improve over this time.

Ideally, commence hand therapy immediately post fracture reduction. Poor prognosis is likely if oedema and stiffness of unaffected joints does not resolve by the time wrist immobilisation is ceased.

CRPS is a common complication following DR fractures.

**Conservative management for a stable DR fracture**

**Week 0-4 / 6**

* Splint: Forearm based functional wrist splint with wrist in neutral deviation and functional extension unless requested otherwise by the surgeon. Colles fractures commonly immobilise the wrist in moderate flexion and ulnar deviation although care should be taken not to position the wrist greater than 20 degrees flexion due to the risk of stiffness.
* Exercises: Unaffected joints (shoulder, elbow hand and thumb) active and passive ROM as indicated.
* Oedema management as required
* Soft tissue treatment as needed (i.e. trigger points in forearm)
* Function: Encourage light functional use (using splint).

**Week 4 – 6** (or when fracture healing permits)

* Splint: Night wear and during the day for protection as required, or static progressive to improve wrist extension.
* Exercises: AROM wrist, AROM and PROM unaffected joints.
* Oedema management as needed.
* Soft tissue treatment as needed (i.e. trigger points in forearm)
* Function: Encourage light function with splint off

**Week 6 – 8**

* Splint: Cease unless being used for progressive night extension.
* Exercises: Commence gentle PROM of wrist as tolerated, grip strengthening for improved function.
* Gradually increased to full functional use at 8 weeks

**Week 8**

* Exercises: Wrist joint mobilisations as indicated, increased PROM of wrist
* Commence wrist strengthening once movement relatively pain free.
* Function: Resume full duties

**Post operatively**

Therapy depends upon fixation and resulting stability of the fracture. Refer to specific instructions from the surgeon.

**Week 0-3**

* Splint: If indicated, remove for exercises
* Exercises: Pain free flexion/extension wrist, PROM/AROM fingers and thumb. Monitor for signs of intrinsic tightness and scar adhesions
* Oedema and scar management is essential

**Week 3-4**

* Splint: Cease
* Exercises: Add pronation/supination and deviation, light grip strengthening and functional tasks
* Continue oedema and scar management, monitor for signs of CRPS

**Week 4-6**

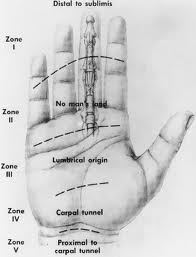
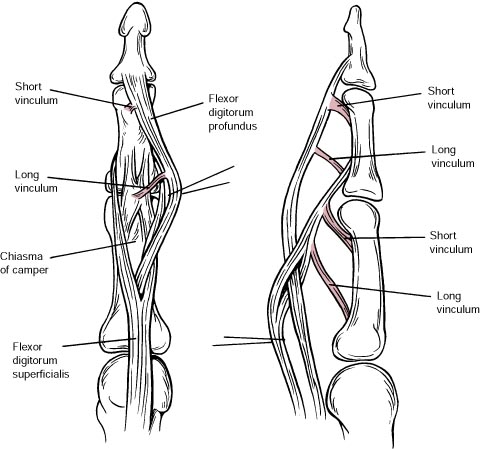
* Exercises: Add PROM of wrist with long duration stretches (weighted bag or hammer). Commence strengthening of forearm muscles

**Week 8**

* Return to normal function
* Continue with scar management as needed

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2 time per week first 6 weeks  1 time per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8 weeks post injury  Heavy lifting/contact sports week 8 weeks post injury. |

# Flexor Tendons



**FDP/FDS Repair**

**Pathophysiology**

Flexor tendons are frequently injured in the hand, commonly caused by knife injuries and power tools. Flexor tendon injuries are challenging to rehabilitate due to extensive scarring; especially in zone II where the FDP and FDS are located in close proximity. Differential glide of FDS and FDP is essential for full range of motion. Other difficulties result from the avascular nature of tendon and their relatively slow healing times.

**Treatment**

Rehabilitation post flexor tendon repair aims to balance tendon glide and tendon healing. The recommended therapy programme is achieved through early active movement in a dorsal block splint which is worn full-time for six weeks (and subsequent ‘at risk’ times for a further 2-3 weeks). Effective oedema and scar management is paramount.

**Early Active Mobilisation (EAM)**

**Week 0-1**

* Splint: Dorsal block splint with wrist in neutral, MCPJ’s 70o flexion and IPJ’s extended at 0o
* Exercises: Passive composite flexion with active extension to hood of splint and graded active flexion, aiming for 50% composite flexion
* Wound: light coban dressing whenever possible to allow ROM
* Oedema management: Single layer coban

**Week 2**

* Exercises: continue; aiming for full passive composite flexion and 75% active composite flexion. On discussion with senior OT, commence differential glide exercises (hook and FDS glide)
* Wound: ROS, Commence scar massage
* Continue oedema management

**Week 3-4**

* Exercises: Full active composite flexion should now be achieved. Add wrist tenodesis (fingers must be assisted into flexion when wrist moving into extension.
* Scar: Debride if needed. Silicone or digi-caps when wound fully healed

**Week 5**

* Splint: removed for exercises only
* Exercises: Commence graded active extension out of splint (wrist neutral), commence tendon glide exercises.

**Week 6-7**

* Splint: Night and protection only, consider static progressive night extension splint if fixed flexion deformity (discuss with senior/surgeon)
* Exercises: Continue. Add gentle resistance activities and light functional tasks.
* If fixed flexion deformity develops commence isolated PIPJ passive extension with wrist in full flexion or splinting (discuss with senior/surgeon). IP Joint blocking exercises
* Patient can return to desk based job

**Week 8**

* Exercises: Increase resistance exercises and commence passive composite extension. Consider capener splint for persistent fixed flexion deformity (discuss with senior)
* Patient can drive

**Week 8-12**

* Exercise: progressive strengthen until full strength achieved
* At week 12 return to heavy lifting and contact sports

\* **Note:** for musculotendinous or muscle belly injury bring protocol forward by 1 week. Also reduce exercises if full ROM in early phase and concentrated on reducing scar adhesions.

|  |  |
| --- | --- |
| Hand Therapy schedule | 2-3 time per week first 6 weeks  2 times per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Week 12  Final at approx. 24 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Desk based tasks from 6-8  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 8 weeks post injury, buddy strap until 12-16 weeks post injury |

## FPL Repair

**Pathophysiology**

FPL’s primary function is to flex the IPJ of the thumb. Prone to reduced glide due to scarring and effect of pulley system.

**Therapy Guidelines**

FPL injuries are challenging to rehabilitate due to scar formation and reduced tendon glide. The thumb IPJ has a tendency to become very stiff in both active and passive ROM. FPL repairs are treated in a forearm based radial splint blocking extension of the thumb while allowing flexion. Early movement is essential to limit scar adhesions to the tendon.

**Treatment**

**Week 1**

* Splint: Wrist neutral to slight extension (mechanical advantage) - increase wrist flexion angle for tight repair. Thumb MCP 20-30 degrees flexion, CMC abduction and IP neutral thumb (unless short repair). Splint worn for 6 weeks full time.
* Exercises:
  + Passive composite flexion thumb across palm
  + Active exercises using fingers to grade movement of thumb flexion (i.e. Thumb flexion to touch IF/MF/RF/LF then base of LF) – increase weekly based on progress
  + Stabilise base of thumb (i.e. thenar eminence) to encourage movement from MCP and IP joints.
  + IPJ flexion/extension within splint (approval from surgeon/senior OT)
* Wound: light scar massage and light dressing
* Oedema: single layer coban

**Week 2**

* Splint and exercises continue
* Wound: removal of sutures at 14 days post op
* Scar: scar massage and oedema management

**Week 3-5**

* Exercises: Full active and PROM should be achieved at this stage
* Wound: Debride as needed
* Scar: Add silicon as required

**Week 6-7**

* Splint: Night and protection only, can have night static progressive extension splint to being to increase extension if needed (discuss with senior/surgeon first)
* Exercises: light daily activities (e.g. to dress, eat and wash), light resistance with theraputty

**Week 8**

* Splint: Ceased, unless for extension splinting
* Exercises: Gradual strengthening of thumb and grip starts. Increase functional uses of hand.
* Can drive

**Week 12**

* Return to manual labour

|  |  |
| --- | --- |
| Hand Therapy schedule | 2-3x per week first 6 weeks  2x per week/fortnight until full strength and ROM achieved (approx. 6-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Week 12  Final at approx. 24 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Desk based tasks from 6-8  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 8 weeks post injury.  Lycra/neoprene or RTW support from 8-16 weeks |

## Wrist Flexor Repairs (FCU/FCR)

**Pathophysiology**

Wrist flexor tendon injuries are often associated with nerve injuries at this level.

**Treatment**

Normal treatment is to immobilise the wrist in neutral for 4 weeks. Prognosis is good. Often relatively straight forward injuries, except when a nerve is involved.

**Post-Surgical Treatment**

**Week 0-4**

* Splint: Dorsal forearm based splint, wrist in neutral-slight flexion (depending on surgeon preference and tightness of repair)
* Exercises: Full ROM of thumb and fingers
* Wound/Scar: Commence scar massage after ROS, commence silicon use once healed.
* Oedema: Coban and tubigrip as required

**Week 5**

* Splint: night and protection only
* Exercise: commence AROM wrist, light functional activity

**Week 6**

* Cease splint, static progressive extension if needed
* Exercises: Commence light function out of splint and continue with wrist AROM
* Can return to desk based work

**Week 8**

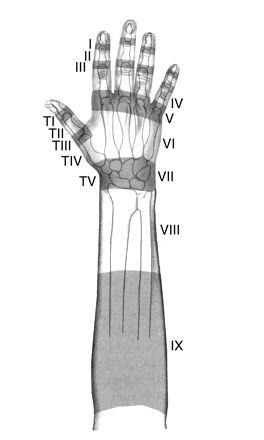
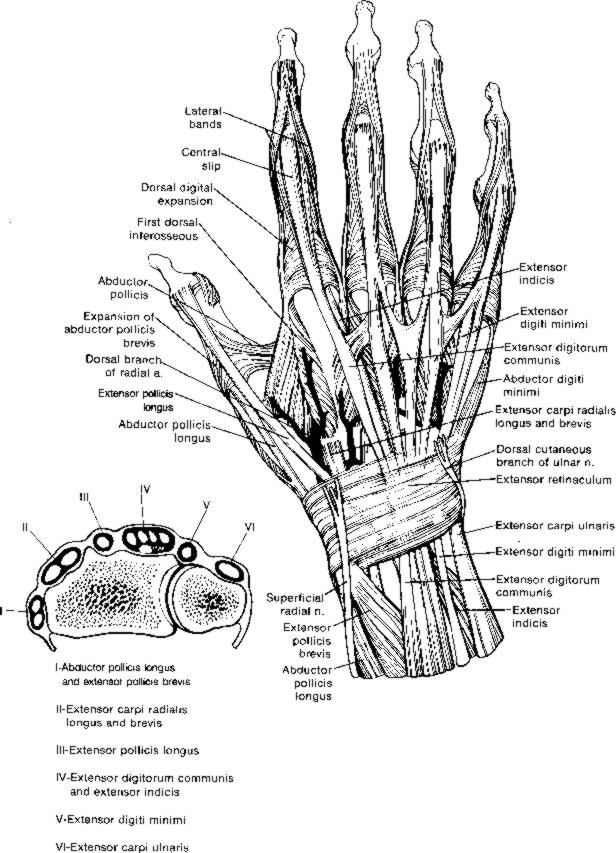
* Exercises: Commence Passive ROM of wrist or dynamic splinting if needed

**Week 10-12**

* Full ROM should be achieved
* Can return to manual work and heavy lifting

|  |  |
| --- | --- |
| Hand Therapy schedule | 2-3x per week first 6 weeks  2x per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Week 12  Final at approx. 16-20 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Desk based tasks from 6-8  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

# Extensor Tendons

[](http://www.jaaos.org/content/vol16/issue10/images/large/586f03.jpeg)

## Zone I-II Extensor Tendons

**Description**

A mallet finger/thumb injury is the deformity that occurs from interruption to the extensor mechanism of the finger DIP or thumb IPJ. The injury can be classified as a tendinous (closed rupture or laceration of the extensor tendon in zone 1) or bony mallet (avulsion fracture of the base of the distal phalanx).

**Symptoms**

Presents as a DIP joint extension lag of the affected finger/thumb, which can be passively corrected to neutral. There is associated swelling, inflammation, pain and bruising over and distal to the DIP joint. A swan neck deformity can develop if untreated.

**Classification**

|  |  |
| --- | --- |
| **Injury** | Type 1a Closed trauma, zone 1 extensor tendon injury  Type 1b Closed trauma, small bony avulsion  Type 2 Laceration at or proximal to DIPJ with loss of tendon continuity  Type 3 Deep abrasion with loss of skin subcutaneous cover and tendon damage  Type 4 Fracture subluxation in children, 20-50% Fracture of articular surface with volar subluxation of the distal phalanx. |
| **Outcome** –Crawford’s classification system | Excellent: Full extension/flexion and absence of pain and loss of extension between 0 and 10o  Good: Painless full flexion and loss of extension between 10 and 25o  Fair: Absence of pain and any loss of flexion or loss of extension >25o. Any persistent pain |

**Treatment**

**Conservative management**

**Week 0-6**

* Splint: Finger based, PIPJ free, DIPJ in slight (10-15o) hyperextension
* Exercises: PIPJ ROM
* Oedema management and scar management as needed

**Week 6-12**

* Splint: night and protection (including at work if needed)
* Exercises: Hourly tendon glide exercises week 6-8, PROM/dynamic splinting from week 8-10 if needed
* Oedema management and scar management as needed
* Note: If a closed tendinous injury splint for 8 weeks continuously. If lag is present on removal of splint, or develops soon after splint another 2 weeks and reassess. If lag continues to be present, continue splinting for a maximum of 6 weeks (12 weeks total)

**Surgical** – the DIP can be fixed in an extended position with a K wire or small screw for up to 6 weeks. Management is as for conservative management. Monitor for signs of infection while wire is in-situ.

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2 time per week first 6 weeks  1 time per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 4  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-6 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 8-12 weeks post injury |

## Zone III-IV Extensor Tendons

**Description**

Repair to the central slip tendon +/- lateral bands (for closed central slip injuries see PIPJ dislocation). Early active motion is recommended, and must be commenced within 7 days of surgery.

**Post-Surgical Treatment**

***Early Active motion – Short Arc Motion***

**Central slip with no lateral band involvement**

**Day 1-5 (week 1)**

* Splint: Resting: finger based extension splint worn full time for 5-6 weeks.
* Exercise 1: finger based volar splint; allowing 30o flexion at PIP and 20o at DIPJ
* Exercise 2: Finger based volar splint; PIPJ 0o and DIPJ 60-90o flexion
* Exercises: 10 reps hourly (slow and gentle) with Exercise splint 1 and 2. Note: wrist at 30o flexion and MCPJ in 0o
* Scar: gentle massage
* Oedema management

**Day 14 (week 2)**

* Splint: Adjust exercise splint 1 to 40o PIPJ flexion and 20o DIPJ flexion, if NO extensor lag developed
* Exercises: Continue hourly
* Scar: Increase scar massage after removal of sutures
* Oedema management

**Day 21 (week 3)**

* Splint: Adjust exercise splint 1 to 50o PIPJ flexion and 20o DIPJ flexion, if NO extensor lag developed
* Exercises: continue hourly
* Scar and oedema management

**Day 28 (week 4)**

* Splint: Adjust exercise splint 1 to 70-80o PIPJ flexion and 20o DIPJ flexion, if NO extensor lag developed
* Continue exercises

**Day 35 (week 5)**

* Splint: Continue with resting splint at all times
* Exercises: Commence active composite flexion exercises, continue with ORL glide exercises

**Day 42 (week 6)**

* Splint: Cease, unless extensor lag
* Exercises: Commence PROM and or flexion splinting. Can begin light strengthening program

**Week 8-10**

* Increase resistive exercises

**Week 12**

* Return to heavy manual work

**Central slip repair with lateral bands**

Allow 30o DIPJ flexion for the first 6 weeks and don’t use exercise splint 2.

**Immobilisation Protocol for Zone III/IV (distal)**

**0-3 weeks**

* Splint in PIPJ and DIPJ free. Focus on scar and oedema management
* Exercises: DIPJ flexion

**Week 3**

* Splint: Continue with splint unless exercising
* Exercises: Commence gradual mobilisation. PIPJ to 30o. Avoid DIPJ blocking if lateral band repaired. Also commence wrist tenodesis and intrinsic plus with wrist extended

**Week 4**

* Splint: Continue with splint unless exercising
* Exercises: PIPJ to 40-50o

**Week 5**

* Splint: Continue with splint unless exercising
* Exercises: PIPJ to 60-80o

**Week 6**

* Splint: Cease unless extensor lag present
* Exercises: Tendon glides. Encourage full DIPJ and PIPJ flexion

**Variation at week 6**

* Extensor lag present: Consider continuing static splint for up to 12 weeks, or reducing exercises or capener
* Poor flexion: Consider dynamic flexion/PROM

**Week 8-10**

* Gradually increase resistive exercises and work duties

**Week 12**

* Full duties

|  |  |
| --- | --- |
| Hand Therapy schedule | 2x per week first 6 weeks  1x per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-6 weeks  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

## Zone V-VI Extensor Tendons

**Description**

Zone V-VI includes the dorsum of the hand up to and including the MCP joints. The sagittal bands or dorsal hood surrounding the MCP joints provide support. Injuries to this zone are generally caused by lacerations and metacarpal fractures including punch injuries.

**Post-Surgical Treatment**

**Week 0-3**

* Splint: Postoperatively in a thermoplastic volar forearm-based static resting splint including all 4 fingers, extending nearly to the PIP joint, but leaving both IP joints free. Splint must be worn 24 hours per day, except for skin care.
* Splint position: Wrist 30° extension, MCPs blocked at 45° flexion, straps located at forearm, wrist and neck of metacarpals (not over proximal phalanges).
* Exercises: Within splint
* Composite MCP and IPJ flexion, 10 reps hourly
* Intrinsic plus

**Week 3-5**

Splint: MCPJ position adjusted to allow 70o flexion NO extensor lag

Exercises: Continue, add hyperextension of MCPJ’s with IPJ’s flexed

**Week 5**

Splint: Night and protection at the discretion of the surgeon

Exercises: Commence AROM (avoid extreme wrist flexion)

Light ADL use commenced

**Week 6**

Splint: Cease

Exercises: Commence PROM as indicated, progress slowly. Full arc tenodesis, individual finger hyperextension

**Week 8-10**

Return to driving

Gradually increase resistance exercise

**Week 12**

Return to heavy work

|  |  |
| --- | --- |
| Hand Therapy schedule | 2X per week first 6 weeks  1-2X per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Week 6  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-6 weeks  Full duties at approx. 10-12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

## Zone VII-VIII Extensor Tendons

**Description**

Zone VII is located over the dorsum of the wrist with zone VIII located at the distal end of the forearm. EDC is the most superficial muscle of on the dorsum. Typically these injuries are caused by lacerations.

**Post-Operative Treatment**

**Early active motion in static splint**

**Week 0-3**

* Splint: Postoperatively in a thermoplastic volar forearm-based static resting splint extending to the distal palmar crease, with MCP and IP joints free. Must be worn 24/24
* Splint position: Wrist 30° extension, MCPs blocked at 70° flexion, straps located at forearm, wrist and neck of metacarpals (not over proximal phalanges).
* Exercises: composite flexion and intrinsic plus within splint, 10x waking hour, AAROM wrist tenodesis, In mid forearm position, commence active wrist flexion to 20 degrees, then with assistance from the other hand brings wrist into extension with digits flexed, attempt to hold for 1-2 seconds.

**Week 3**

* Splint: remove MCPJ block to allow full composite flexion
* Exercises: continue AAROM wrist tenodesis to approx. 40o wrist flexion and MCPJ hyperextension with IPJ flexed

**Week 4**

* Exercises: Progress to 50o AAROM wrist tenodesis, commence gentle composite wrist and finger flexion (50%)

**Week 5**

* Splint removed
* Exercises: AAROM tenodesis to 60o and composite digit and wrist flexion (75%)
* Light ADLs

**Week 6**

* Return to desk based duties
* Gradual increase to full motion, PROM can be gradually commenced with wrist in extension, tendon gliding exercise

**Week 8-10**

* Driving
* Gradual increase in resistance exercises

**Week 12**

* Return to heavy lifting and manual work

|  |  |
| --- | --- |
| Hand Therapy schedule | 2X per week first 6 weeks  1-2X per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 4  Week 6  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-6 weeks  Full duties at approx. 10-12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

## ECRL/ECRB/ECU repair

**Post-Surgical Treatment**

**Week 0-4**

* Splint: Volar forearm based splint; Wrist in neutral
* Exercises: Full tendon glide exercises
* Oedema and scar management

**Week 4-6**

* Splint: night and protection only
* Exercises: Commence AROM of wrist

**Week 6**

* Cease splint
* Commence gentle passive flexion of wrist
* Return to desk based duties

**Week 8-10**

* Increase resistance exercises
* Dynamic splints if needed

**Week 12**

* Return to heavy lifting

|  |  |
| --- | --- |
| Hand Therapy schedule | 1X per week first 4 weeks  1-2X per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 4  Week 8  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 4 weeks (splint on full time)  Increasing duties as tolerated next 2 weeks  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury |

## EPL/EPB Extensor Tendons

**Pathophysiology**

Extensor Pollicis Longus (EPL) hyperextends the thumb, and Extensor Pollicis Brevis (EPB) is the main MP joint extensor. Injuries to EPL and EPB are classified by zones:

Zone I: over the IPJ and the insertion of EPL (for closed zone I thumb see extensor tendon – mallet injury)

Zone II: over the proximal phalanx (generally involves intrinsic muscles of the thumb)

Zone III: over the MP joint, this can involve both EPL and the insertion of EPB

Zone IV: over the1st metacarpal

Zone V: over the wrist (anatomical snuff box)

**Treatment**

Treatment varies from immobilisation, early active mobilisation and early passive mobilisation. The thumb is placed in a forearm based wrist splint with the MP and IP joints in 0-5° extension, wrist in 30 with the digits free.

****ImmobilisationEarly Active Mobilisation Early Passive Mobilisation



**Post-Operative Management**

***Immobilisation Protocol***

**Weeks 0-4**

* Fabricate splint
* Circumferential design for complete thumb and wrist immobilisation
* Scar management commence post removal of stitches at 2/52
* Desensitisation as required
* Oedema management and tendon education

**Weeks 4-6**

* Commence active exercises of thumb out of splint at four weeks
* Continue splint wear full-time to 6 weeks, with additional ‘at risk situations’ and heavy work protection until 8 weeks
* Wean out of splint progressively over 2 weeks
* Continue with scar management, desensitisation and pain management.

**Weeks 6-8**

* Commence passive range of motion exercises

**Week 8-10**

* Commence gradual strengthening and return to full duties

***Early Active Mobilisation Protocol***

**Week 1**

* Fabricate splint
* Mould splint around thumb sufficiently to avoid 1st MCPJ hyperextension and swan neck deformity
* Splint block across volar thumb surface to limit exercises and restrict functional thumb use (initially allow approx. 30 degrees flexion)
* Commence hourly blocked IPJ flexion and extension exercises, and composite flexion IPJ and MCPJ to block. Passive hyperextension of IPJ if full active not demonstrated.
* Velcro strap to maintain IPJ full extension - release to do exercises
* Oedema management and tendon education

**Week 2-3**

* Increase flexion block weekly to allow for increase ROM
* Scar management commence post removal of stitches at 2/52
* Desensitisation as required

**Week 4-5**

* Remove block from splint completely and commence full active ROM

**Week 6-8**

* Commence passive range of motion and gradual strengthening with aim to return to pre-disability function/duties by 8/52

***Early Passive Mobilisation***

**Week 1**

* Fabricate splint 30 degrees wrist extension, CMCJ, MCPJ in full extension and IPJ supported in full extension at rest in dynamic component (sling and elastic tension) - IPJ block can be progressively remodelled to allow more flexion
* Splint worn full-time to 6 weeks
* Oedema management and tendon education

**Week 2-6**

* Continue with splint and adjust block weekly to allow more flexion
* Scar management commence post removal of stitches at 2/52
* Desensitisation as required

**Week 6-8**

* Commence passive range of motion and gradual strengthening with aim to return to pre-disability function/duties by 8/52

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2x per week for first 2 weeks  1x per week for weeks 3-6  1-2x per week dependant on ROM from 6-8 weeks  Fortnightly from 8 weeks until full ROM and strength is achieved |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Week 8  Final at approx. 6 months post injury |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 8-12 weeks post injury  Heavy lifting/contact sports week 10-12 |

# Wrist and Elbow Conditions

**Triangular Fibro Cartilage Complex (TFCC)**

**Description**

The articulation between the ulna head and ulna notch of the radius comprises the DRUJ. The TFCC is a compilation of the fibrocartilagenous articular disc, palmar and dorsal radio-ulnar ligaments, the ulnocarpal ligaments and the extensor carpi ulnaris tendon sheath. This stabilises the DRUJ and separates is from the carpals and distal radius.

**Treatment**

Therapy is supported by limited research for patients post TFCC arthroscopy and subsequent debridement or repair. Recommendations range from nil splinting post debridement through to gradual weaning out of a volar wrist splint over 6/52. Repair of TFCC tears class 1b and 1d typically require immobilisation for 3-6 weeks with range of motion exercises begun at 4/52 post surgery. Typically, active wrist pronation and supination movement is avoided for the longest period of time, approximately 8-12 weeks.

**Conservative Management**

**Week 1**

* Initial assessment – focus on the patient’s occupation and specific duties which have aggravated/caused the wrist injury
* Provide education regarding activity modification, splinting and healing timeframes
* Fabricate a wrist gauntlet in 0-10ºof extension
* Address current oedema and pain issues
* Exercises can include tendon glides for the digits

\* Note: if the patient is having cortisone injection, provide education regarding this process and book an appointment for 1/52 after the injection

**Week 2-8**

* Continue with splintage
* Aims of therapy include;
  + Maintenance of all joints through passive ROM
  + Reduce inflammation through icing, rest and compression
  + InterX treatment for ongoing pain
  + Release of myofascial trigger points in the forearm, shoulder and neck

**Week 8**

* Commence active range of motion exercises
* Continue with pain and oedema management if required

**Week 10-12**

* Commence graded strengthening and training for specific work tasks

\* Discharge when a full range of motion, grip strength and return to pre-disability duties is achieved.

**Surgical Management**

***Arthroscopic Debridement***

Goals of therapy

1. Effective scar management which results from the surgery.
2. Aim to achieve full functional range of motion at the forearm, wrist and hand within 8 weeks of surgery.
3. Return to typical activities of daily living and work duties within approximately 12 weeks of surgery.
4. Regain loss of strength as a result of the injury within 18 weeks of the surgery.

**Week 1**

* Remove POP
* Fabricate anti-pronation/supination splint
* Education re: injury, healing time and splint regime
* Home therapy program (HTP): wrist ext/flex x 10 p/hour; tendon glides x 10 p/hour
* Oedema management

**Week 2**

* Wound (ROS > 10days) and oedema review
* Performance of exercises
* Commence gradual decrease in use of splint at home and during light activities
* InterX pain management

**Week 3-4**

* Range of motion measures
* Oedema and scar management
* Performance of exercises
* InterX pain management

**Week 5-8**

* Upgrade home therapy program to include pronation/supination (10x p/hour) and radial/ulna deviation (10x p/hour)
* Range of motion measures
* Oedema and scar management
* Re-commence interX if there is still a ROM deficit or pain upon ROM
* Cease use of splint if patient has good quality range of motion (Splint can be worn for a further 2/52 if pain is limiting ROM)
* Commence graded resistance program with thera-band or thera-putty. Exercises should include wrist ext/flex, forearm ext/flexion and composite finger flexion (avoid resisted pronation/supination)

**Weeks 8-12**

* 1x session per fortnight to monitor progress. More hand therapy may be required if the patient is experiencing decreased ROM, pain and difficulty with return to work (goal to return to full ADL’s and work duties 12 weeks post-surgery).

**Arthroscopic Debridement and Repair**

Goals of therapy

1. Effective scar management which results from the surgery.
2. Aim to achieve full functional range of motion at the forearm, wrist and hand within 8 weeks of surgery.
3. Return to typical activities of daily living and work duties within approximately 12 weeks of surgery.
4. Regain loss of strength as a result of the injury within 18 weeks of the surgery.

**Week 1**

* Remove POP
* Fabricate sugar tong or munster splint
* Education re: injury, healing time and splint regime
* Home therapy program (HTP): wrist tenodesis x 10 p/hour; tendon glides x 10 p/hour; elbow flex/ext
* Oedema management

**Week 2-5**

* Wound (ROS > 10days) and oedema review
* Continue with exercises of unaffected joints, oedema management, scar management and pain management

**Week 6-8**

* Fabricate anti-pronation/supination splint
* Education re: splint regime (at work and at risks activities only, patient can perform light ADL’s)
* Full range of motion exercises excluding pronation and supination

**Weeks 8-12**

* Upgrade home therapy program to include pronation/supination (10x per hour) and radial/ulna deviation (10x per hour)
* Cease use of splint if patient has good quality range of motion (can be worn for a further 2/52 if pain is limiting ROM)
* Commence graded resistance program with thera-band or thera-putty. Exercises should include wrist ext/flex, forearm ext/flexion and composite finger flexion (avoid resisted pronation/supination)
* 1x session p/fortnight for follow up, more hand therapy may be required if the patient is experiencing decreased ROM, pain and difficulty with return to work.
* Goal of returning to full ADL’s and work duties at approximately 12 weeks post Sx.

**Weeks 12+**

* 1x session p/fortnight if required by patient in order to continually upgrade strengthening program and manage pain and ongoing symptoms.

|  |  |
| --- | --- |
| Hand Therapy schedule | 1-2x per week first 8 weeks  1x per week/fortnight until full strength and ROM achieved (approx. 8-12 weeks) |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Final at approx. 12 weeks post injury |
| Return to work schedule | One handed/light/office duties first 6-8 weeks (splint on full time)  Increasing duties as tolerated next 2-4 weeks  Full duties at approx. 12 weeks post injury  Heavy lifting/contact sports week 12 weeks post injury. |

## De Quervain’s Tenosynovitis

**Pathophysiology**

Abductor pollicis longus and extensor pollicis brevis create the first dorsal compartment of the wrist and share a common tendon sheath. Pain is generally localised around the radial styloid process and can radiate both proximally and distally. Pain is generally increased by resisted thumb extension or abduction or Finklestein’s test.

The problem is generally caused by fibrotic, thickened tissue and/or hyper-vascular changes as well as tendon degeneration. Symptoms present increasingly over time due to repetitive use or acutely from direct trauma.

**Conservative Treatment**

**Week 1**

* Fabricate a forearm based thumb spica
* Tubigrip for oedema
* Commence InterX treatment
* Icing
* Patient education

\* Following a cortisone injection, the patient should completely rest the thumb/wrist for 1 week, but if there is no injection, review 2x/week.

**Weeks 2 – 6**

* Review patient 1-2x/week for pain and oedema management
* Continue InterX treatment
* Isometric exercises of APL and EPB; active exercises in a short arc motion i.e. thumb to index finger and full extension; isolated IPJ exercises; isolated wrist flexion/extension
* Develop a return to work plan and strategies to eliminate/adapt activities causing symptoms

**Week 7**

* Patient can remove splint and commence full active range of motion as well as passive if required.
* Graded strengthening program focusing on grip and wrist flexion/extension, avoid forceful repetitive thumb flexion for a further 2/52.
* Patient to be seen fortnightly
* Any recurrence of symptoms 2/52 further immobilised is required

**Week 12**

* Patient has generally returned to full duties and manual activity.
* If there is ongoing pain consideration of surgical intervention or differential diagnosis may be required.

**Post-Operative Management**

**Week 1**

* Wound review
* Fabrication of splint if required as per consulting surgeon, a RTW thumb spica can be used for support for 2-4 weeks following surgery.
* Early active range of motion exercises including;
  + Isolated IPJ flex/ext
  + Isolated IPJ and MPJ flex/ext
  + Wrist flex/ext
  + Tendon glides for digits
* Education regarding precautions
* Patient is seen 1-2x p/week for the first 2/52

**Week 2**

* ROS and wound/scar management
* Desensitisation
* Commence full composite thumb ROM; continue with wrist and digit AROM and commence PROM if required

**Week 4-6**

* Continue with all ROM exercises; commence passive thumb ROM if required
* Ongoing scar management and further desensitisation if required.

**Week 7**

* Graded strengthening program focusing on grip and wrist flexion/extension, avoid forceful repetitive thumb flexion for a further 2/52.
* Patient to be seen fortnightly until comfortable with full work duties

**Week 12**

* Patient has generally returned to full duties and manual activity.

|  |  |
| --- | --- |
| Hand therapy schedule | 1-2x per week for the first 6 weeks  1x per week or fortnight for until pain free full range of motion and strength is achieved (approx. 10-12 weeks) |
| Doctors schedule | Initial assessment  Week 1 following cortisone injection  Week 3  Week 6  Week 12  Final at approximately 6 months |
| Return to work schedule | Light one handed duties, office duties and supervisory duties for 6 weeks.  Two handed light duties, office duties and supervisory duties for a further 2-4 weeks depending on range of motion and pain.  Increase duties as tolerated for 2 weeks.  Return to full duties at approx. 12 weeks. |

## Overview of Wrist Tendinitis/Tendinosis

**Intersection Syndrome**

Structures involved: APL and EPB muscle bellies 4cm proximal to wrist where they intersect with ECRB and ECRL.

Characteristics: localised swelling and crepitus; pain with resisted wrist extension.

Treatment: as per DeQuervain’s protocol

**ECU Tendonitis**

Structures involved: Extensor carpi ulnaris, stenosing tenosynovitis of the 6th dorsal compartment.

Characteristics: Pain during forearm supination with ulna deviation, ulna sided wrist pain; associated with DRUJ instability, TFCC tears and/or ulnocarpal abutment. Pt’s present with oedema, pain and tenderness along the ECU tendon.

Treatment: cortisone injection, NSAIDS, activity modification, splinting: forearm based ulna gutter or wrist gauntlet (generally in 0-10° wrist extension and slight ulna deviation) for approximately 6/52.

Surgical Rx: release of the 6th dorsal compartment in order to prevent subluxation of the ECU tendon from the ulnar groove. Typically a splint is worn for 2-3 weeks and the active range of motion is commenced.

**FCU Tendinitis**

Structures involved: flexor carpi ulnaris, pisiform and pisotriquetral joint

Characteristics: Pain with palpation over the pisiform, resisted wrist flexion and ulnar deviation as we as painful passive wrist extension and radial deviation.

Treatment: Cortisone injection, NSAIDS and activity modification; InterX treatment, oedema management and icing.

Splinting: Forearm based ulna gutter or wrist gauntlet with the wrist at neutral - 5° flexion and slight ulna deviation for approximately 6/52.

Surgical Rx: complete synovectomy of the tendons +/- removal of the pisiform bone. The patients utilises a wrist gauntlet in neutral for 2-3/52 and then active ROM and gradual strengthening begins. The wrist will always likely be reduced in strength due to the structural change.

**FCR Tendonitis**

Structures involved: flexor carpi radialis and scaphoid.

Characteristics: pain over the proximal wrist crease and scaphoid. Painful resisted wrist flexion and radial deviation. Generally part of an overuse syndrome or associated with soft tissue changes adjacent to the tendon.

Treatment: Immobilize the wrist in neutral or position of comfort for approximately 6/52. Cortisone injection, NSAIDS and general therapies are also effective.

Surgical Rx: prolonged tendonitis often leads to rupture of the FCR and therefore surgical intervention is required. Following surgery the wrist is immobilised in a neutral position for 4/52.

**Therapy Considerations**

**Week 1**

* Initial assessment – focus on the patient’s occupation and specific duties which aggravated/caused the wrist injury
* Provide education regarding activity modification, splinting and healing timeframes
* Fabricate a condition specific splint
* Address current oedema and pain issues
* Exercises can include tendon glides for the digits

\* Note: if the patient is having cortisone injection, provide education regarding the process and review 1/52 following the injection.

**Week 2-6**

* Aims of therapy include;
  + Maintenance of all joints through passive ROM
  + Reduction of inflammation through icing, rest and compression
  + InterX treatment for ongoing pain
  + Release of myofascial trigger points in the forearm, shoulder and neck

**Week 6-8**

* Commence active range of motion exercises
* Continue with pain and oedema management if required

**Week 8-12**

* Commence graded strengthening and training for specific work tasks

\* Discharge when full range of motion, grip strength and return to pre-disability duties is achieved.

|  |  |
| --- | --- |
| Hand therapy schedule | 1-2x per week for the first 6 weeks  1x per week or fortnight for until pain free full range of motion and strength is achieved (approx. 10-12 weeks) |
| Doctors schedule | Initial assessment  Week 1 following cortisone injection  Week 3  Week 6  Week 12  Final at approximately 6 months |
| Return to work schedule | Light one handed duties, office duties and supervisory duties for 6 weeks.  Two handed light duties, office duties and supervisory duties for a further 2-4 weeks depending on range of motion and pain.  Increase duties as tolerated for 2 weeks.  Return to full duties at approx. 12 weeks. |

**Lateral and Medial Epicondylitis**

**Pathophysiology**

Lateral epicondylitis is an overuse injury involving muscles and tendons of the forearm. Most commonly affected is the ECRB tendon, and sometimes involves EDC and ERCL. Medial epicondylitis is a similar overuse injury affecting the common flexor origin on the medial epicondyle.

Four stages identified are:

1. Inflammatory changes that are reversible
2. Non-reversible pathologic changes to origin of the ECRB muscle
3. Rupture of ECRB muscle origin
4. Secondary changes such as fibrosis or calcification

For work-related lateral epicondylitis, a systematic review identified 3 risk factors: handling tools heavier than 1 kg, handling loads heavier than 20 kg at least 10 times per day, and repetitive movements for more than 2 hours per day.

**Assessment**

Upon examination, the patient has a point of maximal tenderness just distal (5-10 mm) to the lateral epicondyle in the area of the ECRB muscle. Wrist extension or supination (but not flexion or pronation) against resistance with the elbow extended should provoke the patient's symptoms. Ultrasound assessment can be used to help with diagnosis.

**Treatment**

Treatment options depend on chronicity and type of symptoms. If the patient is presenting within 6 weeks of onset of symptoms and if caused by one incident, inflammation is likely to be present. In this stage controlling inflammation and pain is of importance. If patient has had symptoms for more than 6 weeks, they are more likely to have degenerative changes to the tendon and strengthening and reconditioning should be the focus.

**Therapy Assessments**

Week 0 – Forearm Evaluation, VAS pain, max grip strength and pain free grip strength, resisted wrist extension test (rated pain out of 10), wrist ROM, Occupational Assessment, nerve tension assessment (ulna nerve for medial epicondylitis and radial nerve for lateral epicondylitis)

Week 6 – VAS, max and pain free grip strength, wrist ROM

Week 12 – All measures as week 0

**Treatment guidelines**

**Acute LE/ME (0-6 weeks)**

Aim: Pain management, allowing functional use of the hand/arm whilst strengthening as able. Avoid repetitive/heavy lifting and provide education regarding conditioning of the upper limb.

Inter X (varied acute setting)

* If pain in area of extensor muscle bellies; soft tissue array
* Common Extensor origin pain; scan and treat around area of lateral epicondyle and pads
* If InterX effective refer for home unit

Pain/oedema

* Icing techniques including ice massage
* Arm sleeve is visible oedema

ROM

* Stretching to wrist flexion, extension, supination and pronation
* Stretching to elbow extension/flexion
* Hold for 30 seconds each repeat 3x each muscle group
* Stretches before and after strengthening

Strengthening

* Commence after initial pain has settled (i.e. 2nd or 3rd session)
* Flex bar (red, green, blue) progress as able 3 sets of 15 reps 3 x daily with 1 minute rest between sets.
* Detailed home exercise program

Soft tissue

* If points in extensor muscle area treat with trigger point release and massage

Ergonomics/Education

* Important to discuss see patient handout for details

Nerve glides as indicated

**Chronic LE/ME (6+ weeks)**

Aim: accommodate chronic nature of condition including deconditioning, muscle atrophy and work conditioning.

Inter X (varied chronic settings)

* Continue with use on affected arm. Consider pads on shoulder and trigeminal points.

Pain/oedema

* Intermittent compression pump
* Heat/Ice combinations

ROM

* Continue with stretching

Strengthening

* Add shoulder and back exercises
* Upper limb ergometer
* Progression through flex bar
* Possible referral to exercise physiology

Soft tissue

* Trigger point therapy and cross friction massage

Ergonomic/Education

* As discusses on patient handout
* Consider meeting/liaison with employer

***Post injection of PRP or steroid therapy***

* Rest the arm for approximately 24 hours.

**Week 0-1**

* Stretching protocol for 2 weeks; pain and oedema management as indicated

**Week 2-6+**

* Eccentric muscle and tendon strengthening program added to program

*Note: If pain increases with HEP, cease strengthening and focus on pain management, ROM and activity modification.*

**Week 6+**

* Allow normal work, sporting or recreational activities as tolerated.

**Week 12**

* Full work duties

***Assessments***

* VAS and FRFEQ before injection and at 4/8/12/26 and 52
* Grip strength pre- injection and week 4/8/12/26/52

**Post-surgery Treatment**(As per surgeon’s post-op orders)

**Week 0-4**

* Pain and oedema management
* Scar management
* ROM and maintain movement of unaffected joints
* Stretching (if allowed)

**Week 4**

* Commence strengthening as pain allows

# Nerve Injuries and Neuropathies

**Digital Nerve**

**Pathophysiology**

Digital nerves supply sensation to the pulp and sides of the finger or thumb with two nerves to each finger and thumb in the hand. Damage to the nerve reduces sensation and if not repaired, results in permanent sensory loss and may develop a neuroma.

**Treatment**

Repaired digital nerves are managed in a hand based splint (MCPJ 40o flexion and IPJ 0o extension to the affected digit only), which is usually worn for about 3 weeks (depends on surgeon preference).

**Therapy**

**Week 0-2**

* Splint fabricated
* Exercises: Active flexion and extension within splint. Maintain active and passive motion of the unaffected joints.
* Scar management and desensitisation
* Sensory assessment and education

**Week 3-5**

* Cease splint
* Exercises: active flexion and extension all digits. No passive extension until week 6.
* Continue with scar management and desensitisation

**Week 6**

* Exercises: Strengthening and passive extension if needed.
* If full ROM patient may be discharged from hand therapy although may benefit from monitoring sensory return

## Nerve repair at the wrist level

***Ulna Nerve***

**Pathophysiology**

The ulna nerve at the wrist level enters through Guyon’s canal and innervates motor function of the hypothenar muscles, 3rd and 4th lumbricals, dorsal and palmar interossei, and provides sensation to the LF and ulnar half of RF. An injury or lesion at this level results in reduced sensation to the RF and LF and the classic “ulna claw” deformity.

**Treatment**

Protect the nerve repair in a dorsal forearm based splint for 3 weeks. Additional therapy aims to address sensory and motor deficit. Recovery varies due to slow recovery of peripheral nerves.

**Therapy**

**Week 0-3**

* Splint: Volar forearm based splint with wrist in slight flexion to neutral
* Exercises: unaffected joint ROM
* Oedema and scar management
* Sensory assessment and education

**Week 3-6**

* Cease splint; change to progressive wrist extension if needed (discuss with senior OT or surgeon)
* Exercises: gradual restoration of full wrist AROM
* Silicone products for scarring as needed

**Week 6**

* Splint: anti-claw deformity splint
* Return to desk based duties

**Week 8**

* Return to full duties

**Median nerve**

**Pathophysiology**

The median nerve enters the hand through the carpal tunnel and provides sensation to the radial 3 ½ digits (i.e. IF/MF/½ RF) on the volar surface and motor power to the thenar eminence, 1st and 2nd lumbricals. Median nerve denervation presents with flattening of the thenar and loss of opposition and flexion (ape hand deformity), and median nerve “claw” affecting IF and MF may develop. The injury can result from a direct injury or from chronic carpal tunnel syndrome.

**Treatment**

Following median nerve repair at wrist level, the wrist is positioned in slight flexion to neutral for 3 weeks. The treatment regime is similar to ulna nerve repair at the wrist. The median nerve repair needs thenar atrophy and loss of opposition to be monitored as it is functionally disabling.

**Week 0-3**

* Splint: Volar forearm based splint with wrist in slight flexion
* Exercises: unaffected joint ROM
* Oedema and scar management
* Sensory assessment and education

**Week 3-6**

* Splint: Cease, can be progressive wrist extension if needed (discuss with senior or surgeon) to increase functional opposition; short opponens splint, elastic opposition strap
* Exercises: gradual restoration of full AROM of wrist, exercises to promote opposition and thumb flexion
* Silicone products as needed

**Week 6**

* Return to desk based duties

**Week 8**

* Return to full duties

**Radial nerve injury**

**Pathophysiology**

Radial neuropathies are commonly related to fractures of the humerus or ‘Saturday night palsy’ (historically named when someone who is inebriated falls asleep on their arm but not realising they are impeding blood vessels and nerves). The radial nerve innervates the extensor muscles (triceps, brachioradialis, ECRL, ECRB, supinator, EDM EDM, ECU, EPL, EPB, AdPL and EI). The superficial branch of the radial nerve provides sensation to the back of the hand and skin between the thumb and index finger.

**Treatment**

Radial neuropathy treatment aims to monitor muscle return and prevent overstretching of tendons and typically return takes several months depending on the extent of the injury.

**Treatment**

**Week 0-3**

* Splint: resting splint at night and wrist gauntlet during the day
* Exercises: Prevention of stiffness of joints into extension, AROM of unaffected joints.
* Manual muscle testing and sensory re-education
* Mirror Box exercises for cortical mapping

**Week 4-12**

* Continue with therapy as above
* Consider granger/dynamic extension splint to increase function (can be fitted earlier if patient has sufficient active composite finger flexion).

## Carpal Tunnel

***Carpal Tunnel Syndrome***

**Pathophysiology**

The carpal tunnel in the wrist is formed by carpal bones arranged in a ‘U’ shape, and joined by a tight ligament called the flexor retinaculum. The median nerve and several flexor tendons run through the carpal tunnel. CTS results from pressure in the carpal tunnel on the median nerve. Symptoms often begin gradually with occasional burning, tingling, or numbness in the palm of the hand and fingers (thumb, index, middle and ring fingers). Symptoms can occur anytime but are often worse at night while sleeping. If ignored, symptoms may worsen, with increased pain, numbness, muscle weakness and difficulty using the affected hand for normal daily activities. Common causes of increased pressure in the carpal tunnel are:

* Extremes in wrist position and repetitive movements of the hand
* Normal ageing which results in thickening of the tendon sheaths
* Bone/joint conditions which narrow the carpal tunnel space due to inflammation or structural changes (e.g. fractures, sprain and arthritis).
* Increased fluid from conditions (e.g. pregnancy, obesity).

**Conservative treatment (8-12 weeks total)**

Non-surgical treatment is preferred for mild to moderate conditions and usually involves:

* Night splinting to rest and support the wrist in a neutral position (either thermoplastic splint or RTW splint.
* Home exercise program to maintain tendon and nerve glide and strengthen muscles of the hand.
* Workplace modification and education to avoid repetitive activities, strong hand grips and extremes of wrist position.
* InterX to reduce inflammation
* Anti-inflammatory medication- prescribed by the doctor

*Note: for all nerve injuries complete 2pt discrimination and Semmes Weinstein Monofilament at 0 weeks and then at 6 weekly intervals to 18 weeks. Long term follow up is most likely needed with this group to monitor sensory return.*

|  |  |
| --- | --- |
| Hand Therapy schedule | 1 time per week for 6 weeks  Review as needed for sensory assessment |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Final at approx. 18-52 weeks post injury (dependent on nerve regeneration) |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint on full time)  Increasing duties as tolerated next 2 weeks  Full duties at approx. 8 weeks post injury (cubital tunnel release may be on restricted duties for longer)  Heavy lifting/contact sports week 8 weeks post injury |

***Carpal Tunnel Release***

Surgical release of the carpal tunnel involves dividing the flexor retinaculum to reduce pressure on the median nerve.

**Treatment**

Aims to improve and maintain tendon and nerve glide through the carpal tunnel and prevent excessive adhesion and scarring. Most problems develop from the patient being overzealous or overprotective of their hand. Monitor for signs of pillar pain.

**Therapy**

**Week 0-1**

* Splint: none
* Exercises: AROM wrist, digits and thumb, gentle median nerve gliding exercises.
* Wound: commence light scar massage, light dressing only
* Oedema: A compression sleeve (e.g. Tubigrip) to help minimize swelling will be fitted by the hand therapist if needed. A sling does not need to be used, but avoid long periods of time with the arm hanging down.
* Education: normal light function encouraged.

**Week 2**

* Exercises: same
* Wound: ROS and debride if needed, light dressing, can get wet

**Week 3-8**

* Exercise: Progressively increase functional tasks, strengthening. Full return to usual daily activities and work by 6-8 weeks. Avoid repetitive or heavy gripping for 4 weeks after this. Particular exercises to strengthen the thenar muscle.
* Scar: Contact media as needed

## Cubital Tunnel Release

**Pathophysiology**

The cubital tunnel is a passageway between the bony prominence of the inside of the elbow (medial epicondyle) and the tip of the elbow (olecranon process). The ulnar nerve travels through this passageway and is prevented from moving in and out of position by a covering of tissue called fascia. The exit of the tunnel is between the two muscle origins of flexor carpi ulnaris. Cubital tunnel syndrome occurs when there is compression or injury to the nerve in the cubital tunnel.

**Causes**

1. Chronic compression (such as resting on the elbow) may produce swelling within the cubital tunnel and irritate the nerve
2. Chronic stretching of the nerve may occur when a person sleeps with their elbows very bent up against them. When the elbow is bent, the nerve is a little stretched around the “corner” of the bony prominence (medial epicondyle). Long periods of this stretching at night or during the day may irritate the nerve.
3. The fascia covering the nerve may lose its ability to stabilize the nerve when the elbow is bent or straightened. The nerve is repetitively injured as it slides in and out of its normal position (subluxation).
4. Fractures of the elbow may cause deformity which stretches the nerve or narrows the tunnel.
5. The floor of the cubital tunnel is formed by the elbow joint, so arthritis or swelling of the joint may narrow the tunnel and compress the ulnar nerve.
6. Tumours such as ganglion cysts or extra muscles may compress the nerve.

**Symptoms**

* Intermittent numbness and tingling of the small and ½ ring finger and aching along the inner aspect of the forearm and elbow
* Weakness and clumsiness of the hand.

**Conservative treatment (4-6 weeks)**

* Night splinting with elbow in 40o extension
* Ulna nerve gliding exercises (3 reps 3 times daily)
* Postural assessment and modification to avoid resting on elbow and working with elbow in flexion or repetitive flexion

**Post-surgery (simple decompression)**

* No splinting
* Mobilise at 1 week post-op
* Scar management as needed
* Strengthening programme to focus on elbow, wrist and FDP to ring and little intrinsic muscles

**Post-surgery treatment (transposition)**

**0-14 days**

* The arm is immobilised in a bulky dressing from the hand to above the elbow with a plaster splint under the dressing to keep the elbow flexed at 90o.

**2-4 weeks**

* Splint: volar resting, with elbow in some flexion (discuss with surgeon)
* Scar and oedema management as needed

**4-8 weeks**

* Cease splint; provide anti-claw splint as needed
* Exercises: Strengthen elbow, wrist and FDP to ring and little intrinsic muscles
* Scar and oedema management as needed

**Week 10-12**

* Can return to heavy manual work

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| --- | --- |
| Hand Therapy schedule | 1X per week for 6 weeks  Review as needed for sensory assessment |
| Doctor schedule | Initial assessment or post op assessment  Week 2  Week 6  Final at approx. 18-52 weeks post injury (dependent on nerve regeneration) |
| Return to work schedule | One handed/light/office duties first 6 weeks (splint full time)  Increase duties as tolerated during next 2 weeks  Full duties at approx. 8 weeks post injury (cubital tunnel release may be on restricted duties for longer)  Heavy lifting/contact sports week 8 weeks post injury |

## Anterior Interosseous Nerve Compression

**Pathophysiology**

The anterior interosseous nerve (AIN) is a motor branch of the median nerve which innervates pronator quadratus, flexor pollicis longus and the lateral half of flexor digitorum profundus. It divides from the main median nerve branch 5-8cm distal to the medial epicondyle. It passes between the deep and superficial heads of pronator teres, beneath the fibrous arch of FDS, along the anterior aspect of the interosseous membrane of the forearm and between FDP and FPL. It terminates in pronator quadratus and distal wrist joint (including the radiocarpal, midcarpal and carpometacarpal joints). While it is a purely motor nerve, it does also provide the central nervous system with proprioceptive information from the wrist joint capsule and ligaments.

AIN compression occurs when there is compression to the nerve at any point along its course. This compression may be due to a number of causes.

**Causes**

1. Entrapment neuropathy due to:
   1. Muscular and fibrous abnormalities
      1. Tendinous origin of the deep head of PT
      2. Tendinous origin of head of FDS
      3. Thrombosis of ulnar collateral vessels
      4. An aberrant radial artery
   2. Gantzer’s muscle (an accessory head to FPL which occurs in 45% of the population)
   3. Bicipital aponeurosis
   4. Space occupying mass including tumour, ganglion and lipoma
2. Compression due to soft-tissue swelling or fixation device following ORIF of mid-shaft radius fracture

**Symptoms**

* Difficulty or fatigue with fine motor tasks
* Tip pinch deformity
* Decreased pinch strength
* Weak pronation
* May have acute pain in anterior, proximal forearm over course of nerve

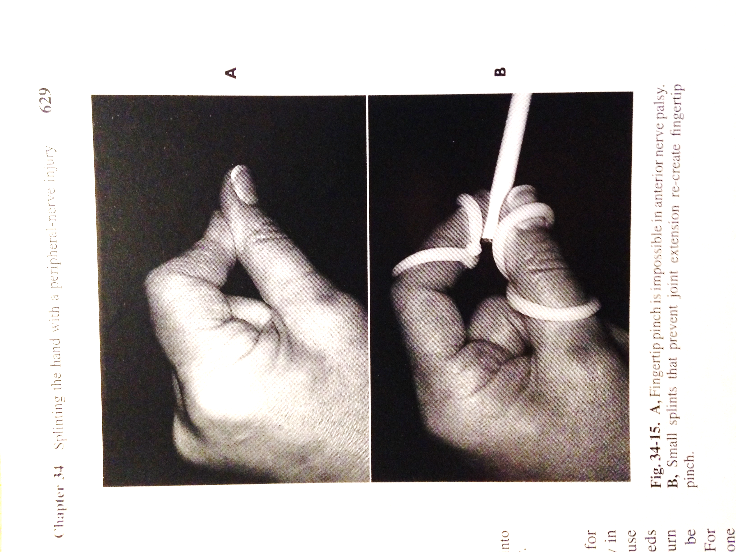
**Assessment**

* Initial:
  + History of injury, onset of signs and symptoms etc.
  + Past medical history
  + Observational assessment:
    - Ok sign – instruct the patient to make an ok sign by touching the tip of their thumb to the tip of their index finger. A positive test is indicated when the patient is unable to do this and the index finger DIPJ and thumb IPJ is observed to extend or hyperextend.
    - Spinner’s sign – instruct the patient to make a composite fist. In a positive test, the patient’s index finger and thumb will remain extended and not be included in the fist.
    - Pinching paper test – instruct the patient to pinch a sheet of paper between their thumb and IF using their finger tips then try to pull the paper away. A patient with AIN injury will be unable to hold the paper using their fingertips and will compensate by extending their IPJ’s.
    - Muscle wastage
  + Circumferential measurement of muscle belly if muscle wastage noted – repeated monthly
  + Manual muscle testing (MMT) of muscles innervated by AIN
  + If patient experiences numbness or tingling (may indicate a more proximal injury):
    - Semmes Weinstein Monofilament Assessment and/or 2 point discrimination
    - Tinel’s over median nerve
* Prior to reinnervation:
  + DASH – week 1
  + If patient experiences pain:
    - LANNS or S-LANNS Pain Scale – at week 1 to determine if pain is neuropathic
    - Neuropathic Pain Scale (if pain is neuropathic) – week 1 and repeat every 2 months
  + MMT – repeat monthly
* After reinnervation:
  + MMT – repeat monthly
  + AROM – repeat every 2 weeks
  + Grip strength – repeat every 2-3 weeks after achieving a MMT grade of 4
  + Lateral pinch strength – repeat every 2-3 weeks after achieving a MMT grade of 4
  + DASH – final appointment

**Conservative treatment**

Each patient with AIN compression will present differently in regards to their symptoms and functional deficits, as well as in their return of nerve function. For this reason, there is no set treatment protocol, rather guidelines which must be tailored according to each individual patient’s specific symptoms and rate of nerve reinnervation.

The following interventions are used during the initial phase of management, prior to signs of reinnervation:

* **Splint**:
  + Surgeon may request a sugar tong splint to allow for rest during acute phase: elbow at 900, forearm in mid prone and wrist neutral
  + A functional splint can be fabricated to assist in functional fine motor tasks. This splint blocks joint extension but allows further flexion. Alternatively, a Siris spiral splint can also be used.
* **Pain:** Inter-x, splinting, medication
* **Muscle tightness:** Inter-x, soft tissue release, dry needling, stretches
* **Maintenance of joint ROM:** PROM of all affected joints and A/PROM of all unaffected joints
* Median nerve gliding exercises
* **Education:** condition, nerve regeneration, prognosis, clear home exercise program

Conservative management is trialled for approximately 3 months. If no signs of reinnervation are seen after this period, referral to a surgeon is necessary to determine further course of treatment. Further scans, surgical exploration or tendon transfers may be required.

Once the patient demonstrates signs of nerve reinnervation, treatment focuses on motor retraining. Initially, therapy sessions are kept short to avoid fatigue. Interventions are graded according to the patient’s MMT grade:

* **MMT grade 2- - 2+**
  + ROM exercises (with gravity eliminated): AROM, AAROM, PROM, P+Hs
* **MMT grade 3- - 4-**
  + ROM exercises (against gravity): AROM, AAROM, PROM, P+Hs
  + Strengthening exercises (with gravity eliminated): gentle theraputty, isometric loading
* **MMT grade 4 - 5**
  + Strengthening exercises (against gravity): theraputty, theraband, eccentric loading

**Post-operative management (simple decompression)**

As per conservative management. Additional interventions include:

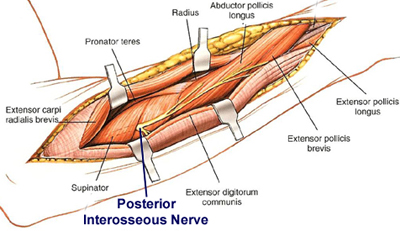
* **Splint**: according to surgeon preferences, splinting may or may not be required. If requested by the surgeon, a sugar tong splint with elbow in flexion and wrist in neutral can be used for 1-2 weeks
* **Exercises**: if no splint is required, commence immediate AROM of all joints (elbow, wrist, thumb, digits)
* An arm sling may be used at night to assist in patient comfort by maintaining the elbow in flexion
* **Wound**: light dressing for 2 weeks
* **Scarring**: commence scar management after removal of sutures – Vaseline, mini massager, Inter-x, silicone

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| --- | --- |
| Hand Therapy schedule | * Education phase (initial phase, setting up patient with comprehensive home exercises program) – 1-2 x per week * Maintenance phase (patient completing HEP, assess progress/make changes to HEP) – 1 x per fortnight * Rehabilitation phase (after signs of reinnervation) – 2 x per week |
| Doctor schedule | Conservative   * Initial * Week 2 * Before reinnervation – 6 weekly or as required * After reinnervation – 6 weekly or as required   Post-operative   * Week 1 * Week 2 – removal of sutures * Week 4 * Before reinnervation – 6 weekly or as required * After reinnervation – 6 weekly or as required |
| Return to work schedule | * One handed/light/office duties before reinnervation * Slowly increase as tolerated as reinnervating * Full duties after reinnervated |

## Posterior Interosseous Nerve Compression

**Pathophysiology**

The posterior intersseous nerve (PIN) is the deep motor branch of the radial nerve which innervates extensor carpi radialis brevis, extensor carpi ulnaris, extensor digitorum communis, extensor indicis, extensor digiti minimi, supinator, abductor pollicis longus, extensor pollicis longus and extensor pollicis brevis. The radial nerve divides into the PIN and superficial radial nerve beneath brachioradialis. After dividing, the PIN travels through the arcade of Fröhse, between the superficial and deep heads of the supinator and beneath the radial tunnel. The PIN then branches into superficial and deep branches to supply various extensor muscles.



PIN compression occurs when there is compression to the nerve at any point along its course. This compression may be due to a number of causes.

**Causes**

1. Entrapment neuropathy due to:
   1. Compression in:
      1. Radial tunnel – begins anterior to the radiocapitellar joint and is approximately 5cm in length. It is formed laterally by ECRL, ECRB and brachioradialis, medially by biceps tendon and brachialis, and posteriorly by the radiocapitellar joint capsule. Brachioradialis passes over the PIN in a lateral to anterior direction, forming the roof of the tunnel
      2. Arcade of Fröhse – fibrous structure at the proximal origin of supinator which forms an arch over PIN. In 30% of the population, the structure is tendinous and forms a point of PIN entrapment
      3. Leash of Henry – the radial recurrent artery which crosses the PIN on its way to supplying the brachialis and brachioradialis
   2. Fibrous bands between brachialis and brachioradialis
   3. Tendinous edge of ECRB
   4. Space occupying mass including tumour, ganglion and lipoma
2. Compression due to soft-tissue swelling or fixation device following ORIF of humeral shaft or proximal radius
3. Following elbow dislocation, distal biceps repair or elbow arthroscopy

**Symptoms**

* Wrist drop deformity
* Loss of MCPJ extension
* Loss of thumb radial abduction and extension
* Weak active wrist extension with radial deviation
* Weak supination
* Decreased grip strength
* Fatigue
* May have acute pain over posterior forearm

**Assessment**

* Initial:
  + History of injury, onset of signs and symptoms etc.
  + Past medical history
  + Observational assessment:
    - Wrist drop
    - Loss of MCPJ extension and thumb radial abduction and extension
    - Muscle wastage
  + Circumferential measurement of muscle belly if muscle wastage noted – repeated monthly
  + Manual muscle testing (MMT) of muscles innervated by PIN
  + If patient experiences numbness or tingling (may indicate a more proximal injury):
    - Semmes Weinstein Monofilament Assessment and/or 2 point discrimination
    - Tinel’s over superficial radial nerve
* Prior to reinnervation:
  + DASH – week 1
  + If patient experiences pain:
    - LANNS or S-LANNS Pain Scale – at week 1 to determine if pain is neuropathic
    - Neuropathic Pain Scale (if pain is neuropathic) – week 1 and repeat every 2 months
  + MMT – repeat monthly
* After reinnervation:
  + MMT – repeat monthly
  + AROM – repeat every 2 weeks
  + Grip strength – repeat every 2-3 weeks after achieving a MMT grade of 4
  + Lateral pinch strength – repeat every 2-3 weeks after achieving a MMT grade of 4
  + DASH – final appointment

**Conservative treatment**

Each patient with PIN compression will present differently in regards to their symptoms and functional deficits, as well as in their return of nerve function. For this reason, there is no set treatment protocol, rather guidelines which must be tailored according to each individual patient’s specific symptoms and rate of nerve reinnervation.

The following interventions are used during the initial phase of management, prior to signs of reinnervation:

* **Splint**:
  + Surgeon may request a sugar tong splint to allow for rest during acute phase: elbow at 900, forearm in mid prone and wrist neutral
  + Night resting splint: to prevent joint contractures, maintain length of flexors, prevent overstretching of extensors, prevent shortening of ligaments
  + Functional:
    - Granger splint – dynamic splint which allows full movement of fingers and normal grasp.
    - Dynamic Second Skin splints – can be fitted with flexible boning to better position hand in order to increase functional use
* **Pain:** Inter-x, splinting, medication
* **Muscle tightness:** Inter-x, soft tissue release, dry needling, stretches
* **Maintenance of joint ROM:** PROM of all affected joints and A/PROM of all unaffected joints
* Radial nerve gliding exercises
* **Education:** condition, nerve regeneration, prognosis, clear home exercise program

Conservative management is trialled for approximately 3 months. If no signs of reinnervation are seen after this period, referral to a surgeon is necessary to determine further course of treatment. Further scans, surgical exploration or tendon transfers may be required.

Once the patient demonstrates signs of nerve reinnervation, treatment focuses on motor retraining. Initially, therapy sessions are kept short to avoid fatigue. Interventions are graded according to the patient’s MMT grade:

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  + Strengthening exercises (with gravity eliminated): gentle theraputty, isometric loading
* **MMT grade 4 - 5**
  + Strengthening exercises (against gravity): theraputty, theraband, eccentric loading

**Post-operative management (simple decompression)**

As per conservative management. Additional interventions include:

* **Splint**: according to surgeon preferences, splinting may or may not be required. If requested by the surgeon, a sugar tong splint with elbow in flexion and wrist in neutral can be used for 1-2 weeks
* **Exercises**: if no splint is required, commence immediate AROM of all joints (elbow, wrist, thumb, digits)
* An arm sling may be used at night to assist in patient comfort by maintaining the elbow in flexion
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| Return to work schedule | * One handed/light/office duties before reinnervation * Slowly increase as tolerated as reinnervating * Full duties after reinnervated |