# Rehabilitation of Phalangeal Fractures

**By Dr. Ian MacIntyre**

The small joints of the hand are characterized by their wide ROM in inherent stability. The diverse positions that the hand and individual fingers can obtain exposes them to varying degrees of trauma. Unfortunately, many of these injuries are considered trivial and go unrecognized or untreated until the sequelae of stiffness or mobility restricts hand function. The goal of the therapist is early recognition of the injured structures and initiation of appropriate treatment that will offer protection and allow early ROM.

The proximal interphalangeal (PIP) joint is particularly vulnerable to injury as either ligamentous or intra-articular fracture with or without dislocation. Middle phalangeal articular fractures at the PIP joint include dorsal lip fractures, palmar lip fractures, and central articular disruptions or pilon fractures. Avulsion and impaction sheer are 2 fracture mechanisms. Middle phalanx palmar lip fractures are the most common form of osseous injury associated with PIP joint fracture-dislocations. Dorsal fracture-dislocation of the PIP joint is reported to occur in 9 of every 100,000 people each year. Many of these injuries frequently are ignored or treated inappropriately. As a result, there can be permanent swelling, pain, and variable degrees of stiffness, angulation, and degenerative changes.

Hand fractures in the athlete are treated with adequate alignment, immobilization, and then motion. In general, intra-articular fractures must be reduced anatomically. Reduction requires early recognition of the exact location of the fracture and having a complete understanding of the muscle pull on the fragments, then minimizing the deforming force.

**Functional Anatomy:** The phalanges do not contain muscle bellies, and motor function is accomplished only by the flexor and extensor tendons. An overview of the muscles and tendons of the hand is necessary. The thenar muscles consist of 3 intrinsic muscles including the abductor pollicis brevis (which abducts the thumb), the flexor pollicis brevis (which flexes the proximal phalanx of the thumb), and the opponens pollicis (which produces opposition of the thumb).

All 3 intrinsic thenar muscles are supplied by the recurrent branch of the median nerve. The adductor pollicis adducts the thumb and is supplied by the deep branch of the ulnar nerve. The hypothenar muscles also are supplied by the deep branch of the ulnar nerve.

The abductor digiti minimi abducts the fifth digit and flexes its proximal phalanx. The flexor digiti minimi is deeper and also flexes the proximal phalanx of the fifth digit. The opponens digiti minimi, as its name implies, opposes the fifth digit.

The lumbricals are 4 muscles that arise from the tendons of flexor digitorum profundus. Their tendons insert into the radial side of each of the proximal phalanges of the fingers and into the dorsal hood. They flex the metacarpophalangeal joints and extend the interphalangeal joints. The first and second lumbricals are supplied by the median nerve, and the third and fourth lumbricals are supplied by the ulnar nerve.

The palmar and dorsal interossei arise from the metacarpals. The palmar interossei insert into the proximal phalanx and the expansion of the extensor digitorum communis. The palmar interossei are adductor muscles. Dorsal interossei are abductors and insert into the proximal phalanges and the dorsal digital hood. The interosseous muscles are all supplied by the deep branch of the ulnar nerve.

As the tendons of the long flexor and extensor muscles reach the hand, the flexor tendons must first pass deep to the flexor retinaculum and the extensor tendons must pass under the extensor retinaculum. Flexor tendons on the palmar side are anchored to the phalanges by fibrous flexor sheaths to prevent “bow-stringing.” Synovial sheaths prevent friction from occurring between fibrous flexor sheaths and the tendons. Synovial sheaths are present on the dorsum of the hand deep to the extensor retinaculum. They extend from a point proximal to the retinaculum to a point in the proximal one third of the dorsum of the hand.

**The PIP Joint**

The PIP joint is the most commonly injured area in the hand. There is both anatomic and functional complexity to this joint, which consists of the articulation of the proximal end of the middle phalanx and the distal end of the proximal phalanx. It is a hinge joint with range of motion from 0-120° in the extension-flexion plane, with the bulk of static and dynamic stability provided by the surrounding ligaments and tendons.

The capsule surrounding the articular surface is composed of the volar plate, thick collateral ligaments, and the extensor tendon dorsally, which divides into 3 slips as it passes over the proximal phalanx. The central slip of the extensor tendon passes directly over the joint and inserts on the dorsal base of the middle phalanx. The lateral bands of the extensor tendon combine distally with the tendons of the intrinsic hand muscles (the retinacular ligaments) to form the extensor tendon that attach to the distal phalanx.

The thick ulnar and radial collateral ligaments of the PIP joint combine with the volar plate to provide lateral stability. The volar plate, a thick fibrocartilaginous structure, forms a sturdy attachment to the middle phalanx where it becomes continuous with the articular cartilage. This limits extension of the PIP joint beyond 0°. Proximally, the volar plate forms a thin continuous attachment with the synovial reflection. The lateral margins remain thick strong ligaments. This

results in a cul-de-sac between the proximal half of the volar plate and the head of the proximal phalanx, which allows the base of the middle phalanx to glide along the articular surface of the proximal phalanx as the finger flexes. Thus, the volar plate becomes both a static stabilizer limiting hyperextension beyond 0° and a dynamic stabilizer that influences the position of the flexor tendons at initiation of PIP joint flexion.

**The Physical Examination:**

A complete examination includes a thorough history regarding the mechanism of injury, presence of any deformity, the primary treatment received and the time elapsed since the traumatic event. The examination begins with the inspection for the location and amount of swelling, ecchymosis or gross deformity. Palpation is carried out in an organized fashion to localize specific areas of tenderness about the PIP joint.

X-ray is obtained assessing joint stability and functional ROM. If no fracture is found, functional ROM is tested. The Patient is asked to actively flex and extend the finger, looking for any instability. Radial and ulnar stress is then applied and compared to the contralateral uninjured joint.

Fractures of the PIP joint can involve the head of the proximal phalanx and/or the base of the middle phalanx. The goal of treating intrarticular fractures of the PIP are to obtain anatomic alignment and achieve a stable construct to allow early ROM.

**Fracture Classification**

**Type I:** Unicondylar, non displaced and stable
**Type II:** Oblique displaced and shortening of the digit, causing the joint to angle.
**Type III:** Bicondylar and unstable

Any displacement of the articular surface of more than 1mm requires reduction.

Treatment of non-displaced fractures requires splint immobilization in the position of function with an anterior-posterior splint. The position of function is with the wrist in 30-60 degrees of extension, the MCP joint in 70 degrees of flexion and the Interphalangeal joint in 0-10 degrees of flexion. This position maintains all the important ligaments of the wrist and hand in maximum tension to prevent contractures. The splint is to be worn for approx 2-3 weeks.

Allowing early ROM of the PIP and DIP is essential. Motion prevents adhesions between the tendons and the underlying fracture and also controls edema.

**Rehabilitation Protocol for Non-displaced Metacarpal/Phalangeal Fractures** ***According to Brotzman;***

**0-3 Weeks:**

-Splint in position of function
-Begin active PIP and DIP flexion and extension exercises
-elevate hand to control edema

**3 Weeks:**

**-**Discontinue splinting
-protect fingers with buddy taping
-continue gentle active and active assisted ROM exercises
-begin strengthening with silicone putty
-continue exercises until grip strength is restored

**Return to Play:** Return to play is guided by the patient's symptoms, healing, and potential for re-injury. If the fracture can be adequately protected and immobilized, while not interfering with the patient's ability to participate, then participation can be allowed, providing the patient has adequate pain control.

**Complications:** Phalangeal fractures, as with all fractures, are subject to the risks of delayed union, mal-union, and non-union. These can be the result of inadequate immobilization and patient non-compliance with immobilization.

**Prognosis:** Most phalangeal fractures heal without significant complications. Fractures that involve a joint are more prone to prolonged stiffness and decreased range of motion.

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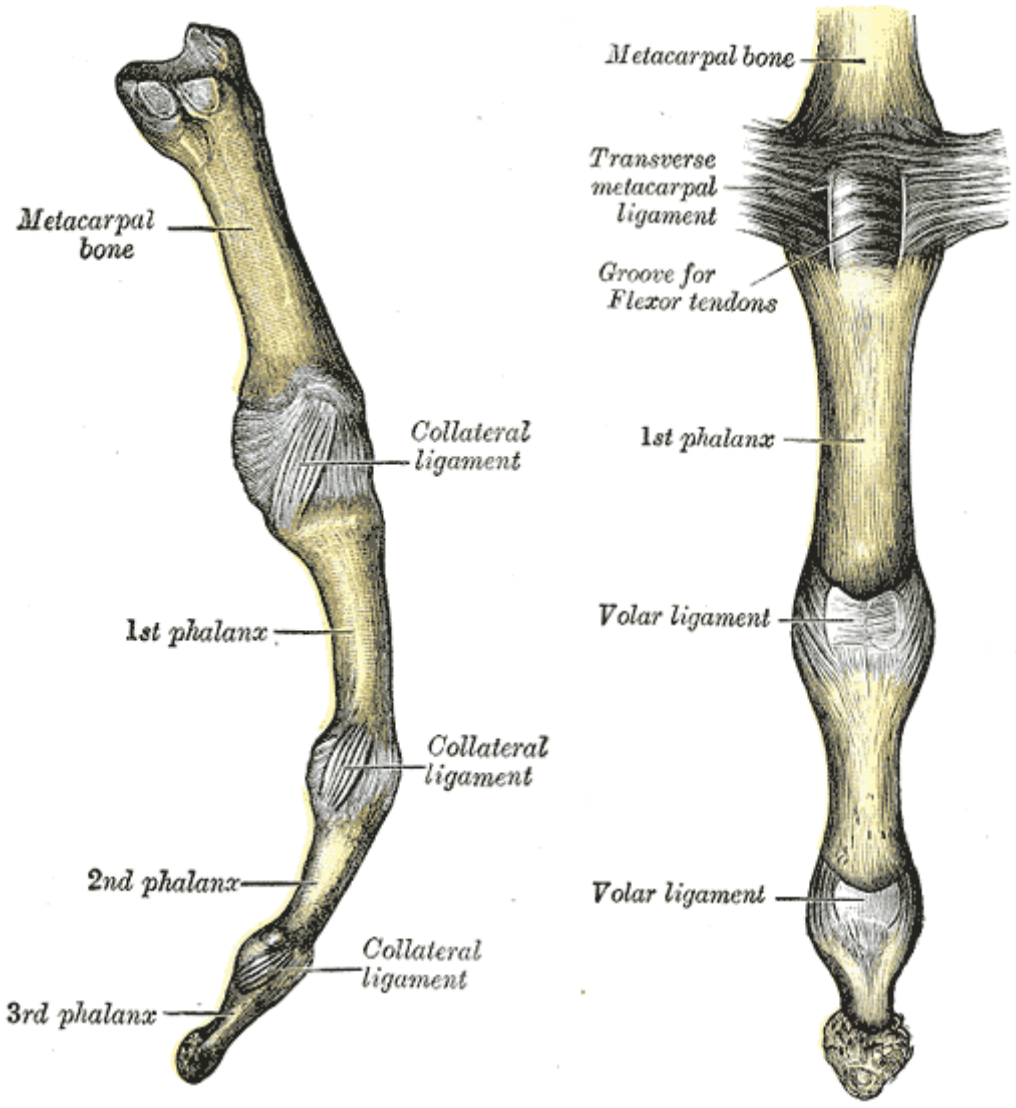
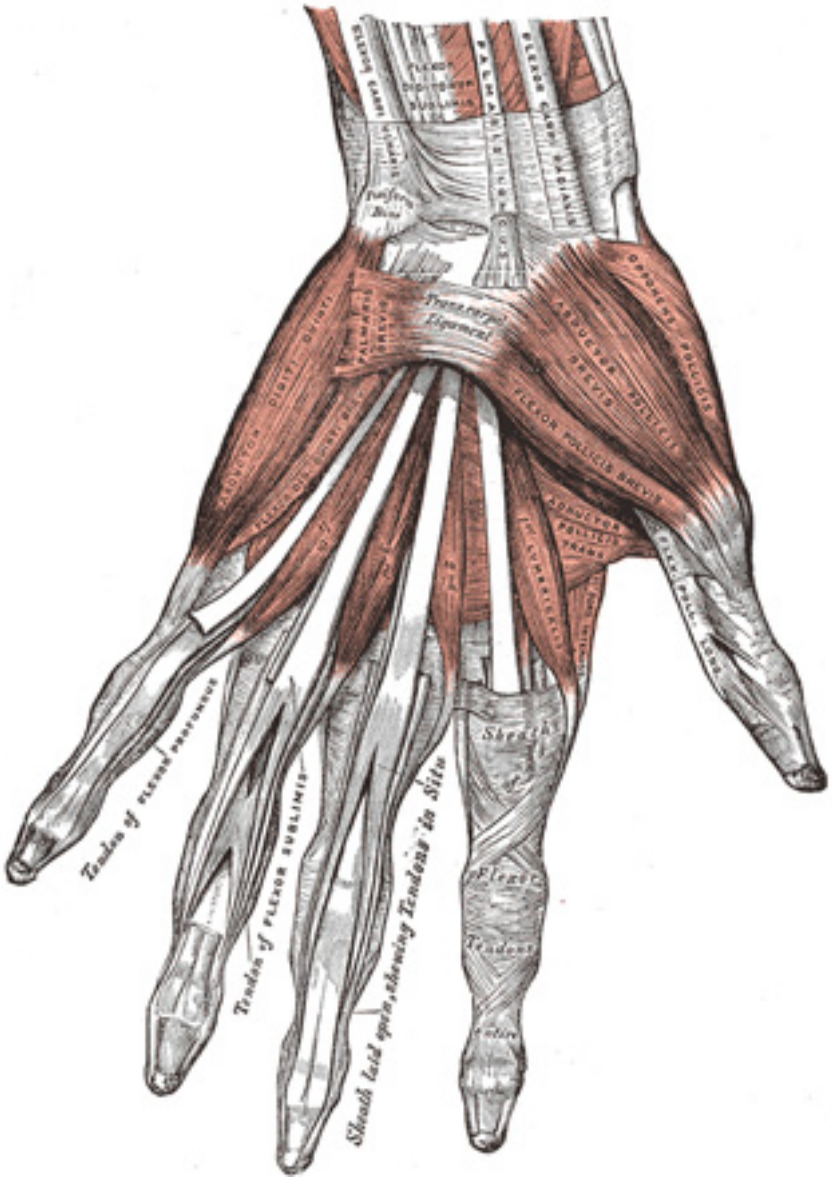

Metacarpal bone
Collateral ligament
1st phalanx
Collateral ligament
2nd phalanx
Collateral ligament
3rd phalanx
Metacarpal bone
Transverse metacarpal ligament
Groove for Flexor tendons
1st phalanx
Volar ligament
Volar ligament


Tendon of flexor profundus
Tendon of flexor sublimis
Sheath laid open, showing Tendons in Situ