

Acute Posterior Dislocation of the Proximal Interphalangeal Joint: Repair and Rehabilitation

Surgical Indications and Considerations

Anatomical Considerations: The proximal interphalangeal joint, with its relatively small amount of soft tissue support has notable stability throughout the 100+ degree arc of motion from extension to flexion. Bony joint structure allows for up to 9 degrees of supination during flexion. Multiple factors contribute to this joint's stability and include: joint configuration, the joint capsule and tightly adjoining soft tissue structures such as the periarticular ligaments, tendons volar plate and retinacular systems. Since the bone and soft tissue are so intimately close together, injury to the bone will invariably affect the surrounding tissues.

Pathogenesis: The collective forces of hyperextension and longitudinal compression can cause dorsal dislocations of the proximal interphalangeal joint. These anteroposterior and distal to proximal forces adversely affect the integrity of the volar plate and collateral ligaments which normally keep the joint from hyperextending. A strong compressive component of the force can fracture the volar aspect of the base of the middle phalanx or cause an impact fracture into the articular surface of the middle phalanx. Specific lesions to the ligament system define the categories for this injury. The publication of Kang and Stern is recommended for further understanding of the mechanism of injury.

Categorization: Multiple systems of categorizing this injury exist. Even if the same names for the types are used variation among definitions exist. Descriptions of types used in the treatment section are given here. Glickel et al used the following: Type I (hyperextension), defined as a partial or complete avulsion of the volar plate from the base of the middle phalanx, with or without bone fragments and with minor longitudinal rents in the collateral ligaments. Articular surfaces remain congruent but with the middle phalanx articulating with the dorsal third of the condyle of the proximal phalanx. Injury is usually stable. Type II (dorsal dislocation), defined as a complete dorsal dislocation of the proximal interphalangeal joint and avulsion of the volar plate accompanied by a major bilateral split in collateral ligament system. There is no contact between the articular surfaces. Injury is usually stable to active and passive testing. Type III (fracture-dislocation), defined as a shearing off or impaction of the volar base of the middle phalanx. This injury must be assessed carefully for stability or instability. Subclassification of Type III (fracture-dislocation) is as follows: Stable Fracture-Dislocation, defined as a small triangular fragment representing less than 40% of volar articular arc (much like simple dorsal dislocations except transverse disruption occurs through the base of the phalanx rather than at the insertion of the volar plate). Dorsal portion of the collateral ligament remains attached to middle phalanx which renders this injury inherently stable on reduction. Unstable Fracture-Dislocation, defined as >40% disruption of volar articular segment. The majority of collateral ligament-volar plate complex is attached to the fragment, not the remaining intact base of the middle phalanx. There is a loss of the buttressing effect of the volar margin of the middle phalanx that partially cups the proximal phalangeal condyles. It is difficult to achieve accurate closed reduction and even more difficult to maintain. Pilon fracture, defined as a compression vector force when the proximal interphalangeal joint is in extension. Treatment may be similar

to fracture dislocations. Hardy used the following three part subclassification of Palmar Plate Avulsion Fracture (also known as dorsal fracture dislocation): Less Severe Fracture (no definition). Moderately Severe Fracture, defined as 20-40% of articular surface involved. The last category is defined as: Fracture greater than 40% of the joint surface and joint does not usually remain congruent in any limited arc of motion. Other ways of categorizing fracture-dislocations are: Stable (Type I), Tenuous (Type II), Unstable (Type III) and a 16 component classification based on combinations of four fracture grades and four subluxation grades introduced by Schenck to aid in standardized and comparative research. The publications of Schenk, along with Kang and Stern are recommended for further understanding of categorization.

Epidemiology: Dorsal dislocation of the proximal interphalangeal joint appears to be one of the most common hand injuries. In approximately 1992 there were 9 fracture dislocations per 100,000 people. Circumstances causing a dislocation injury include: the tip of an outstretched finger being hit during a ball sport (volleyball, basketball, foot ball, baseball) or falling onto an outstretched hand.

Diagnosis

- History of hyperextension injury with dislocation at the proximal interphalangeal joint
- Tenderness in the specific ligaments involved
- Subluxation with active motion suggests major ligament disruption or a significant intra-articular fracture of the joint
- Passive testing of joint stability (may need local anesthesia) is useful to assess volar plate damage
- Anteroposterior, true lateral and oblique radiographs of the involved digit are recommended. Relying on a radiograph of the entire hand is greatly discouraged
- Computed Tomography and fluoroscopy are recommended for certain circumstances

Refer to the publication by Brandenburg for recommendations on appropriate emergency room diagnosis and treatment.

Nonoperative Versus Operative Management: Hardy gives this advice, “Fractures that cannot be reduced with closed manipulation (or those that fail to maintain their reduction), open fractures, and displaced articular fractures are candidates for operative fixation.” Advantages of internal fixation include: reduction and close approximation of fracture ends which allows for primary bone healing; no callous forms thereby decreasing the risk of the soft tissue adhesions.

Disadvantages for internal fixation include: opening of the skin which creates another tissue that needs to heal without adhesions. Also, internal fixation may disrupt the normal blood supply from the periosteum to the bone. It should be remembered that internal fixation does not imply faster healing; strengthening programs need to be delayed until the remodeling phase has begun at 6 to 8 weeks. Factors that adversely (or may) effect healing time include: comminuted fractures, open fractures, steroids, nonsteroidal anti-inflammatories, cytotoxins, osteopenia, malnutrition, instability, infection, surgical trauma, smoking, nicotine, alcohol and diabetes. Other factors in deciding course of treatment are: patient’s age, occupation, socioeconomic status, systemic illness, surgeon’s skill and patient compliance. Refer to publications by Hardy and by LaStayo, Winters and Harding for further information on fracture healing and fracture

fixation methods. For splinting and traction fabrication refer to publications by Chan and also Kearney and Brown.

Surgical Procedure: Many different methods for surgical reduction and devices used to stabilize fractures are available. Surgeons also have their own preferences on which procedures to use. Devices that align the fracture ends but do not give internal strength or control rotational stress are termed coaptive. These coaptive devices such as K-wires, pins, or wiring techniques should be used along with an external support to eliminate forces that may injure the healing fracture. Open reduction with internal fixation, hemihamate autografts and volar plate arthroplasty are techniques that have also been advocated. Dynamic skeletal traction is recommended in certain circumstances. The author's choice section in *Green's Operative Hand Surgery* describes Volar Plate Arthroplasty Surgery. In the surgical process, the collateral ligaments are excised to allow access to the articular surfaces by hyperextending the joint. The volar plate is advanced to a surgically made groove (in volar rim of the middle phalanx) and sutured in place using drill holes in the middle phalanx. Kirschner wires are applied to help keep the proximal interphalangeal joint in 20 to 30 degrees flexion.

NONOPERATIVE REHABILITATION

Note: The following rehabilitation progression is taken from Glickel, Barron, and Catalano. Refer to their chapter in *Green's Operative Hand Surgery* to obtain further information.

Phase I for Stable Injuries: Weeks 1-3

Goals: Rest soft tissue
 Avoid prolonged immobilization
 Avoid flexion contracture
 Avoid redislocation
 Realistic patient expectations

Intervention:

- Dorsal block splinting of the proximal interphalangeal joint in no more than 30 degrees flexion
 - Type I (hyperextension): no more than 1 week of splinting
 - Type II (Dislocation): no more than 2-3 weeks of splinting
 - Type III (Fracture-Dislocation): 3 weeks of splinting
 - Postsplinting and weekly radiographs for follow-up recommended
- Patient education in length of recovery – it may take longer than 6 months for the swelling and stiffness to dissipate

Phase II for Stable Injuries: Weeks 2 or 3 or 4

Goals: Minimal soft tissue protection
Return to active use

Intervention:

- After full time splinting the finger can be buddy-taped to adjacent digit while active use and range-of-motion exercises are begun
- Type III (Fracture-Dislocation): intermittent static or dynamic splinting may be necessary to overcome a flexion contracture

Note: The following rehabilitation progression is taken from Hardy, please refer to her publication to obtain principles for fracture management, edema control and tendon gliding exercises. Post-splinting and weekly follow-up radiographs recommended for 3 weeks by Lairmore and Engber.

Less Severe Palmar Plate Avulsion Fracture (dorsal fracture dislocation)

Goals: Protected range of motion

Intervention:

- Buddy taping and immediate active motion

Phase I for Moderately Severe Palmar Plate Avulsion Fracture (dorsal fracture dislocation): Weeks 1-8

Goals: Fracture compression

Avoidance of displacement of fracture due to fracture separation during extension

Early protected range of motion at proximal and distal interphalangeal joint

Protected slow gains in extension range of motion of the proximal interphalangeal joint

Intervention:

- Extension block splinting for >6 weeks at 30 to 40 degrees flexion
- Weekly (as fracture heals) splint angle is remodeled at less extension block
- With splint on, active flexion and extension (as splint allows)

Phase II for Moderately Severe Palmar Plate Avulsion Fracture (dorsal fracture dislocation): Weeks 6-8

Goals: Full extension range of motion

Intervention:

- If there is a flexion contracture at the end of the 6-8 week splinting regime, may treat with dynamic extension

Palmar Plate Avulsion Fracture >40% of joint surface and joint does not usually remain congruent in any limited arc of motion

Goals: Surgical stability of Fracture

Intervention:

- Open Reduction with Internal Fixation

POSTOPERATIVE REHABILITATION

Note: The following rehabilitation progression is taken from Glickel, Barron, and Catalano. Refer to their chapter in *Green's Operative Hand Surgery* to obtain further information regarding evaluation, specific surgical techniques of the volar plate arthroplasty, anticipated outcome and complications, and other surgical interventions.

Phase I for Unstable Type III (Fracture-Dislocations) after Volar Plate Arthroplasty: Weeks 1-3

Goals: Active motion at distal interphalangeal joint
Realistic patient expectations
Avoidance of infection

Intervention:

- Use splint to help immobilize joint (remember Kirschner wire is also in place)
- Start distal interphalangeal joint motion immediately
- Patient needs to be educated from the beginning that normal proximal phalangeal joint function is possible but is highly unlikely
- Pin care instruction as indicated

Phase II for Unstable Type III (Fracture-Dislocations) after Volar Plate Arthroplasty: Weeks 3-7

Goals: Initiate active extension

Initiate dynamic extension splinting if necessary

Intervention:

- After Kirschner wire is removed (3 weeks after surgery) unlimited flexion of the PIP joint is begun using a dorsal extension block splint
- Unrestricted active extension is permitted at 4 weeks after surgery
- Dynamic extension splinting is begun if full active extension is not regained by 5 weeks

Phase III for Unstable Type III (Fracture-Dislocations) after Volar Plate Arthroplasty: 8 weeks to 4-6 months

Goals: Return to sports with protection

Patient education

Intervention:

- Unlimited sports activities are allowed at 8 weeks with buddy taping
- Buddy taping continued for 4-6 months
- Educate patient that swelling may persist for several months and it may take up to 6-8 months to reach final range of motion

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