Management of Proximal Interphalangeal Joint Dislocations in Athletes

Randy R. Bindra, MD, FRCS*, Brian J. Foster, MD

KEYWORDS

- Proximal interphalangeal joint
- Dislocation • Fracture • Pilon • Volar plate

Proximal interphalangeal joint dislocations are common injuries in athletes. These injuries may be associated with fractures of the base of the middle phalanx. Principles of management include achieving and maintaining a congruent joint, early mobilization to prevent stiffness, and restoration of the joint articular surface, which is the least important issue. An athlete or coach may minimize injury to the proximal interphalangeal joint, especially dislocations that are reduced on the field; therefore, it is the responsibility of the treating orthopedic surgeon to fully and carefully evaluate and treat these injuries. In the following sections, basic anatomy, injury pathology and characteristics, clinical assessment, radiological findings, and treatment principles are reviewed.

ANATOMY

The proximal interphalangeal (PIP) joint is a hinge joint that accounts for 85% of the motion required to grasp an object.[1] The PIP joint is formed by proximal and middle phalanges and derives its stability from its bony architecture and soft tissue restraints. The majority of joint motion is in flexion-extension, with a normal range of motion between 100° and 120°. The proximal phalanx head has two concentric condyles that are separated by an intercondylar concavity or notch. The condyles articulate with corresponding concavities on the broad base of the middle phalanx. These concavities are separated by a saddle-shaped median ridge; the ridge fits into the corresponding intercondylar notch of the proximal phalanx for bony stability. This congruence offers stability in flexion-extension while limiting lateral and rotational movements.[2]

A collateral ligament on each lateral aspect of the PIP joint limits radial and ulnar deviation and offers side-to-side stability (**Fig. 1**). The ligaments arise from a notch distal to the epicondyle of the proximal phalanx and run in an oblique and volar direction to insert onto the middle phalanx in its volar lateral aspect. Each collateral ligament has two parts: a dorsal component that tightens during flexion and a volar component that tightens in extension.[3] A separate accessory collateral ligament runs with each proper collateral ligament; however, this accessory collateral ligament runs in a more volar direction to insert on the lateral edge of the volar plate and flexor tendon sheath. The primary function of the accessory ligament is to tension the volar plate and pull it proximally to provide clearance during finger flexion.[4]

Spanning the volar aspect of the joint is the volar plate, which primarily prevents hyperextension of the joint.[4] The volar plate is secured proximally to the proximal phalanx through thick lateral extensions (checkrein ligaments) that attach to the bone within the distal aspect of the second annular pulley. The proximal edge of the plate remains free so that it can move proximally during digital flexion. Its proximal origins are also confluent

Department of Orthopaedic Surgery, Loyola University Medical Center, Maguire Center Suite 1700, 2160 South 1st Avenue, Maywood, IL 60153, USA
* Corresponding author.
E-mail address: rbindra@lumc.edu (R.R. Bindra).

Hand Clin 25 (2009) 423–435
doi:10.1016/j.hcl.2009.05.008
0749-0712/09/$ – see front matter

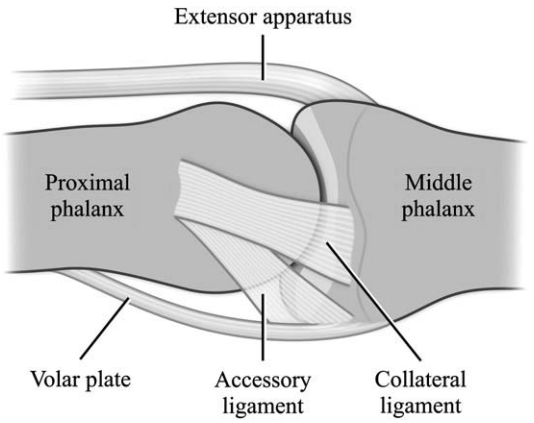

Fig. 1. Key anatomic structures surrounding the PIP joint.

with the proximal origins of the first cruciate pulley. The volar plate's central distal attachment is to the base of the middle phalanx where it blends with the periosteum just volar to the articular surface; its lateral distal attachment is thicker and blends with the insertion of the collateral ligaments. The volar plate and collateral ligaments form a strong boxlike design that stabilizes the PIP joint and resists joint displacement. PIP joint displacement occurs when the ligament-box complex is disrupted in at least two planes.[3,5] The volar plate and accessory collateral ligaments maintain joint stability in the extended PIP joint whereas the proper collateral ligaments maintain stability in flexion.[3]

The flexor and extensor tendons provide additional stability. The central slip of the extensor mechanism crosses over the PIP joint before it attaches to the dorsum of the middle phalanx. The lateral bands of the extensor mechanism (composed of the lumbrial and dorsal interossei tendons) travel on both sides of the PIP joint; they are held in place over the PIP joint by the transverse retinacular ligament. The flexor tendons are held close to the volar aspect of the joint by the third annular pulley, which attaches to the volar plate. In addition, the flexor digitorum superficialis tendon directly inserts on either side of the volar lateral edge of the middle phalanx through two lateral slips.

The PIP joint dorsal capsule has a small synovial lining and is separate from the overlying extensor mechanism.[6] The volar capsule consists of the volar plate, the proximal extension of which is continuous with a band of connective tissue that extends to the proximal phalanx neck.[2] The radial and ulnar aspects of the joint capsule can each be divided into three components: the collateral ligament and the two fan-shaped areas dorsal and volar to it. The fibers of the dorsal fan-shaped area blend distally with the extensor expansion; the fibers of the volar fan-shaped area blend distally with the collateral ligament, volar plate, and flexor sheath.[2]

INJURY CHARACTERISTICS

Due to its unprotected location, long lever arm, and low lateral and rotational mobility, the PIP joint is susceptible to injury in athletes.[7] Athletes who participate in sports involving catching or hitting a ball are especially susceptible to PIP injuries. Many of these injuries occur from the athlete "jamming" or "catching" their finger while catching a ball or falling, resulting in hyperextension or angular deformity to the PIP joint. Compounding the actual injury, the PIP joint has a propensity for stiffness after trauma or immobilization, especially immobilization of longer than 3 weeks.[8] This stiffness is likely due to pain, swelling, and fibrosis/scar tissue formation.

PIP injuries include sprains, dislocations, and fracture-dislocations. PIP dislocations are identified by the direction of the middle phalanx in relation to the proximal phalanx. If associated with fractures of the base of the middle phalanx, they are classified as fracture-dislocations. Increasing instability is associated with increased size of fracture fragments. The three types of PIP dislocations are dorsal (most common), volar, and lateral. The volar plate and at least one collateral ligament must be injured for PIP dislocation to occur.

PROXIMAL INTERPHALANGEAL JOINT DORSAL DISLOCATIONS

By far the most common type of PIP dislocation, dorsal dislocations, occur secondary to hyperextension of the PIP joint; there is usually also an axial load component to the deforming force. In these injuries, the volar plate is avulsed from the middle phalanx base and the middle phalanx rests on the dorsum of the proximal phalanx. The middle phalanx is dislocated dorsally and the volar plate is avulsed from its distal insertion, thus helping to prevent the plate from incarcerating within the joint. The volar plate usually retains its proximal and lateral attachments to the proximal phalanx and accessory collateral ligament, respectively.[4]

Dorsal PIP dislocations occur along a spectrum of injuries to the PIP joint. As a result of hyperextension injury, most injuries result in avulsion of the volar plate at its distal attachment with or without a small bony fragment. The collateral ligaments remain intact and joint congruity is maintained; clinically this presents as a "sprained"