Surgical Approaches to the Proximal Interphalangeal Joint

Andre Eu-Jin Cheah, MD, MBA,*† Jeffrey Yao, MD*

The proximal interphalangeal (PIP) joint may be affected by many conditions such as arthropathy, fractures, dislocations, and malunions. Whereas some of these conditions may be treated nonsurgically, many require open surgical intervention. Open interventions include implant arthroplasty or arthrodesis for arthropathy, open reduction internal fixation, or hemihamate arthroplasty for dorsal fracture-dislocations. Volar plate arthroplasty and corrective osteotomy for malunion about the PIP joint are also surgeries that may be required. The traditional approach to the PIP joint has been dorsal, which damages the delicate extensor apparatus with subsequent development of an extensor lag. This has led surgeons to explore volar and lateral approaches to the PIP joint. In this article, we describe each of these surgical approaches, discuss their advantages and disadvantages, and provide some guidance on which approach to choose based on the surgery that is to be performed. *(J Hand Surg Am. 2016;41(2):294–305.*

Key words Proximal interphalangeal joint, arthroplasty, open reduction internal fixation, corrective osteotomy.

Surgical approaches to the proximal interphalangeal (PIP) joint are often discussed in the context of implant arthroplasty for arthropathy of the joint. The traditional surgical approach for these cases was dorsal[1–14] although there are advocates for the volar[12,13,15–20] and lateral approaches[13,19,21–23] to avoid injury to the delicate finger extensor mechanism and dorsal veins. Disruption of the extensor mechanism may lead to an extensor lag whereas disrupting the dorsal veins may lead to increased postoperative swelling and ultimately poor range of motion.

*From the *Robert A. Chase Hand and Upper Limb Center, Department of Orthopaedic Surgery, Stanford University Medical Center, Redwood City, CA; and the †Department of Hand and Reconstructive Microsurgery, National University Hospital, National University Health System, Singapore.*

Received for publication August 11, 2015; accepted in revised form November 15, 2015.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Jeffrey Yao, MD, Robert A. Chase Hand and Upper Limb Center, Department of Orthopaedic Surgery, Stanford University Medical Center, 450 Broadway Street, mailcode:6342, Redwood City, CA 94063; e-mail: jyao@stanford.edu.

0363-5023/16/4102-0024$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2015.11.013

Proximal interphalangeal joint dorsal fracture-dislocation (DFD) is another important indication for open surgical access to the PIP joint when closed methods cannot achieve good joint reduction. Open reduction internal fixation (ORIF),[24–27] hemihamate arthroplasty,[28–30] and volar plate arthroplasty (VPA)[31,32] are good options for treatment of PIP joint DFD. Other reasons for open surgery about the PIP joint include proximal phalangeal condylar fracture fixation[1,33] and intraarticular corrective osteotomy (CO) for malunion of the PIP joint.[34,35]

In this article, we will describe surgical approaches to the PIP joint and highlight modifications that have been proposed. In addition, we will review published clinical series, describe their techniques, and discuss soft tissue complications which we believe are appreciably affected by the surgical approach. Most important, we will highlight pearls and pitfalls for each approach and propose the best surgical approach for a given surgery on the PIP joint.

SURGICAL ANATOMY

The PIP joint is a sloppy hinge joint in the middle of the kinetic chain of the digit. It is stabilized primarily by a

3-sided box made up of the volar plate (VP) and the radial and ulnar collateral ligaments, each in turn made up of the proper collateral ligament (PCL) and the accessory collateral ligament (ACL).[36] The thick distal portion of the VP has a broad attachment to the volar lip of the middle phalanx (P2) base whereas the thin, membranous proximal portion forms checkrein ligaments that attach to the volar surface of the proximal phalangeal (P1) neck. The VP can be raised as a proximally or distally based flap after the lateral edge (and insertion of the ACL) is incised to expose the volar aspect of the PIP joint articular surface. The PCLs originate from the lateral portion of the P1 condyle and insert into the lateral tubercles of the P2 base. Both the origin and insertions are broad based, allowing the collateral ligaments to be recessed instead of completely released, to afford greater exposure to the joint surface.

The flexor tendons and sheath (namely, the C1, A3, and C2 pulleys) cover the volar surface of the joint. Within the sheath, the flexor digitorum superficialis (FDS) lies deep to the flexor digitorum profundus (FDP) and inserts via 2 slips into the volar metaphysis of P2, distal to the attachment of the VP. On either side of the flexor sheath lie the digital neurovascular bundles. The extensor apparatus envelops the dorsal and dorsal-lateral surfaces of the PIP joint. The central slip inserts into the base of P2 in the midline. This insertion is approximately 5 mm wide, allowing partial release to increase joint surface exposure. The lateral bands pass 5 mm on either side of the central slip to coalesce with each other into the terminal tendon and insert distally into the base of the distal phalanx. They are stabilized centrally by the triangular ligament. The transverse retinacular ligament (TRL) covers the collaterals of the PIP joint laterally. The TRL originates from the flexor sheath at the level of the PIP joint and inserts into the lateral bands at the same level.

SURGICAL TECHNIQUES: APPROACHES TO THE PIP JOINT

The aim of the surgical approach to the PIP joint is to gain safe access to the articular surface of the joint. This involves the skin incision, the path past the tendons (and in some approaches, the flexor tendon sheath and neurovascular structures), and then the handling of the periarticular tissues, namely the VP and collateral ligaments for the volar approach, the central slip in the dorsal approach, and the collateral ligaments in the lateral approach.

The volar approach

This approach has been described for implant arthroplasty, ORIF, CO, hemi-hamate arthroplasty, and VPA. It begins with the skin incision, which may be a Bruner type, Bruner-midlateral hybrid, or zigzag incision with smaller flaps and additional apices between the flexion creases (Fig. 1). For the former 2 skin incisions, the base of the flap is best positioned on the blind side of the finger in arthroplasty or the more involved side in PIP joint DFD. The latter 2 incisions may be chosen if the need for more surgical exposure is anticipated. The next structures encountered are the flexor tendons in their sheath centrally and the neurovascular bundle on either side (Fig. 2). One option

FIGURE 1: Skin markings for the choice of volar skin incisions. From left to right: Bruner incision, Bruner midlateral hybrid incision, and zigzag incision with smaller flaps.

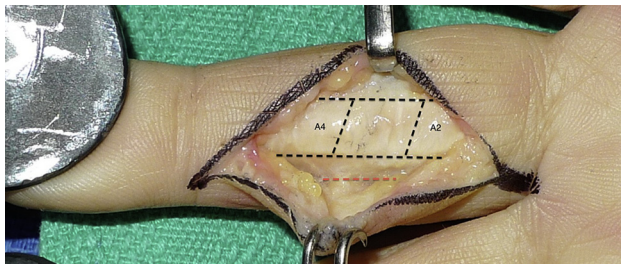

FIGURE 2: Exposed flexor sheath with neurovascular structures on either side after elevation of the skin flap. The pulleys are marked with black dashed lines and the ulnar digital neurovascular bundle is marked with a red dashed line (the radial bundle is protected by the Ragnell retractor).