CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

PIP Joint Fracture-Dislocation

Overview

- Clinical results for PIP joint dislocations and fracture-dislocations vary and are often difficult to predict due to the complexity of fracture patterns and potential for sub-acute or chronic presentation [4].
- Treatment of PIP joint fracture dislocations is based on joint stability, fracture fragment size, and soft tissue injuries [5].
- Soft tissue injury is a major factor in reoperation after PIP joint fracture dislocation [18].
- There are no consistent differences among treatment techniques for unstable dorsal fracture dislocations of the PIP joint regarding range of motion, pain, or radiographic degeneration [23].
- PIP joint fractures generally yielded satisfactory outcomes, whereas 50% of DIP joint fracture cases had only fair or poor results [6].
- Differences in hamate morphology may preclude anatomical reconstruction in the setting of a dorsal PIP fracture-dislocation, thereby affecting short- and long-term outcomes [2].

Anatomy & Pathophysiology

INJURY MECHANISMS AND CLASSIFICATION

- PIP joint fracture-dislocations are classified into three basic fracture patterns: palmar lip fractures, dorsal lip fractures, and pilon fractures [58].
- Dorsal PIP joint dislocations represent almost all PIP joint dislocations [61].
- The mechanism for dorsal PIP joint dislocation involves forced hyperextension, axial load, and radial or ulnar deviation [61].
- Lateral PIP joint dislocations are less common and result from direct radial or ulnar stress on the joint with axial load [61].
- Volar PIP joint dislocations are rare and usually arise from a rotatory longitudinal force on a semiflexed digit [15].

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- Volar PIP joint dislocation requires force in two vectors: ulnar or radial deviation causing rupture of the collateral ligament and volar plate, combined with an anteriorly directed force [61].
- Open PIP joint dislocations are predominantly dorsal dislocations of the index and middle fingers [43].
- The most common finding in unstable PIP joint fracture-dislocations is a volar articular surface fracture at the base of the middle phalanx with dorsal subluxation [39].
- If more than 30% of the articular surface of the middle phalangeal base is fractured, the injury should be considered unstable [39].
- Simulated volar articular bony defects of 20% were stable, whereas those with 60% and 80% defects were unstable during digital motion [104].

SOFT TISSUE DISRUPTION

- Dorsal PIP joint dislocation is characterized by volar plate rupture at its distal attachment [61].
- In dorsal PIP joint dislocation, a split occurs between the accessory collateral ligament and proper collateral ligament with detachment of the proper collateral ligament from its proximal attachment [61].
- In dorsal PIP joint dislocation, the volar plate is maintained beneath the condyle, held by intact attachment to the accessory collateral ligament [61].
- When a torsional mechanism is involved in dorsal PIP joint dislocation, soft tissue interposition can block reduction [61].
- Lateral PIP joint dislocation involves failure of the collateral ligament on the side of the force under tension, avulsing from its proximal attachment [61].
- Continued force in lateral PIP joint dislocation causes disruption of the volar plate on the side of the force [61].
- Volar PIP joint dislocation anatomic disruption includes unilateral rupture of a collateral ligament and partial avulsion of the volar plate [15].
- Volar PIP joint dislocation is accompanied by herniation of the head of the proximal phalanx through the extensor mechanism [15].
- Occasionally, an in-substance rupture of the central slip is associated with volar PIP joint dislocation [15].
- In its most severe form, volar PIP joint dislocation involves a dorsal lip fracture of the base of the middle phalanx at the insertion of the central slip [15].
- Complex volar PIP joint dislocations involve rotary displacement with a collateral ligament tear secondary to lateral stress combined with an anteriorly directed force [99].
- In complicated volar PIP joint dislocations, the central slip, lateral band, or torn collateral ligament may be interposed within the joint [99].

EXTENSOR MECHANISM AND BOUTONNIERE DEFORMITY

- In uncomplicated dorsal PIP joint fracture-dislocations, the central slip of the extensor mechanism ruptures or avulses from the dorsal lip of the middle phalanx [99].

- The intact lateral bands can perform joint extension even though the central slip is ruptured in dorsal PIP joint fracture-dislocations [99].
- Failure to immobilize the joint in extension to allow central slip healing can eventually lead to stretching of the triangular ligament holding the lateral bands [99].
- Stretching of the triangular ligament results in volar subluxation of the lateral bands, which can no longer extend the PIP joint [99].
- Tightening of the terminal extensor slip leads to hyperextension of the distal interphalangeal joint, resulting in the classic boutonniere deformity [99].
- The principal bony insertion of the extrinsic digital extensors is on the dorsal proximal aspect of the middle phalanx [49].
- Distal interphalangeal joint extension is achieved through the conjoined lateral bands, which are composed of tendinous slips from the extrinsic and intrinsic tendons [49].
- The deep head of each dorsal interosseous muscle forms a lateral tendon, or lateral band, at the level of the metacarpophalangeal joint [64].
- Oblique fibers from the lateral bands sweep over the distal third of the proximal phalanx to insert onto the lateral tubercles at the base of the middle phalanx to extend the PIP joint [64].
- The lateral bands are joined by the lateral slips of the extensor tendon to form the conjoined lateral band [64].
- The two conjoined lateral bands to each finger unite at the distal third of the middle phalanx to form the terminal tendon [64].

CHRONIC AND NEGLECTED INJURIES

- Chronic volar dislocations of the PIP joint are rare and present a therapeutic challenge when they occur [22].
- If 2 months or more have elapsed between injury and treatment for chronic volar PIP joint dislocation, there is a significant likelihood that the deformity has become fixed [22].
- Fixed chronic volar PIP joint dislocations may require collateral ligament and possibly volar plate releases to mobilize the joint and the fracture fragment [22].
- Range of motion at follow-up for chronic volar PIP joint dislocations is likely to be significantly less than in those treated acutely [22].
- In one series of chronic volar PIP joint dislocations, range of motion averaged 70° and the incidence of complications, including extension lag of the DIP joint, was high [22].
- Open dorsal PIP joint dislocations treated without palmar plate reinsertion are associated with substantial stiffness but no residual instability [40].
- Preoperative mobility of the injured finger in chronic palmar PIP joint dislocations is severely limited at both the PIP and DIP joints and did not exceed 20° for either joint [41].

GENERAL PATHOPHYSIOLOGY AND OUTCOMES

- Inappropriate treatment of PIP joint fracture-dislocations can lead to a dysfunctional joint secondary to persistent pain, stiffness, and posttraumatic degenerative arthrosis [58].
- Suboptimal treatment of intra-articular fractures typically leads to functional impairment of the hand [31].
- Flexion contractures and stiffness are common in PIP joint fracture-dislocations, and obtaining full range of motion is rare [106].
- The severity of bone and soft tissue damage in volar PIP joint dislocations manifests itself in the degree of subluxation, the size of the associated fracture, and the pattern of displacement of the fracture fragments [15].
- Proper treatment of PIP joint fracture-dislocations is predicated on maintenance of concentric reduction of the joint, restoration of joint stability, and institution of early motion [58].
- Anatomic reconstitution of the articular surface is less important than maintenance of concentric reduction and stability in PIP joint fracture-dislocations [58].
- Restoration of stability allowing early motion and a smooth articular surface are the goals of treatment for dorsal PIP joint fracture-dislocations [115].

Classification

FRACTURE PATTERNS AND MECHANISMS

- Dorsal dislocations represent almost all PIP joint dislocations [61].
- The mechanism for dorsal PIP dislocations involves forced hyperextension, axial load, and radial or ulnar deviation [61].
- Dorsal PIP dislocations are characterized by volar plate rupture at its distal attachment [61].
- Dorsal PIP dislocations involve a split between the accessory collateral ligament and proper collateral ligament with detachment of the proper collateral ligament from its proximal attachment [61].
- In dorsal PIP dislocations, the volar plate is maintained beneath the condyle, held by intact attachment to the accessory collateral ligament [61].
- Soft tissue interposition can block reduction when a torsional mechanism is involved in dorsal PIP dislocations [61].
- Lateral PIP dislocations are less common and result from direct radial or ulnar stress on the joint with axial load [61].
- In lateral PIP dislocations, the collateral ligament on the side of the force fails under tension, avulsing from its proximal attachment [61].
- Continued force in lateral PIP dislocations causes disruption of the volar plate on the side of the force [61].
- Volar PIP dislocation is the least common type and may occur with or without a rotatory component [61].
- Volar PIP dislocation is a rare injury that usually arises from a rotatory longitudinal force on a semiflexed digit [15].

- The anatomic disruption in volar PIP dislocation includes unilateral rupture of a collateral ligament and partial avulsion of the volar plate [15].
- Volar PIP dislocation involves herniation of the head of the proximal phalanx through the extensor mechanism [15].
- An in-substance rupture of the central slip (boutonniere injury) is occasionally associated with volar PIP dislocation [15].
- In its most severe form, volar PIP dislocation involves a dorsal lip fracture of the base of the middle phalanx at the insertion of the central slip (boutonniere fracture) [15].
- The severity of bone and soft tissue damage in volar PIP dislocation manifests in the degree of subluxation, the size of the associated fracture, and the pattern of displacement of the fracture fragments [15].

CLASSIFICATION SYSTEMS

- No universally accepted classification exists for volar PIP dislocations, probably because these injuries most commonly involve a combination of damaged structures [15].
- A grade I classification for dorsal lip fractures is defined as an associated dorsal lip fracture [15].
- The SCARF classification contributes to the management of PIP dislocations at initial therapy [32].
- Understanding the fracture within the context of a stability-based classification system helps guide the selection of the most appropriate treatment [58].
- PIP joint dislocations are defined by the position of the middle phalanx in relation to the proximal phalanx and are classified as dorsal, lateral, or volar [61].

CLINICAL PRESENTATION AND PROGNOSIS

- Early recognition of joint instability is essential for adequate treatment of injuries of the PIP joint [13].
- Timely diagnosis is imperative, especially if there is any persistent incongruity of the joint, as fracture dislocations of the PIP joint may rapidly develop fixed deformity [21].
- Patients are often cavalier about digit injuries, assuming they represent "jammed fingers" that will heal spontaneously, which occasionally results in volar fracture dislocations becoming chronic [22].
- Chronic volar dislocations of the PIP joint are rare but present a therapeutic challenge when they occur [22].
- If the duration between injury and treatment for a chronic volar PIP dislocation is relatively short, the joint may still be supple and reducible without soft tissue releases [22].
- If 2 months or more have elapsed between injury and treatment for a chronic volar PIP dislocation, there is a significant likelihood that the deformity has become fixed and that collateral ligament and possibly volar plate releases may be needed [22].
- The range of motion at follow-up for chronic volar PIP dislocations is likely to be significantly less than in those in whom the injury is treated acutely [22].
- In one series of chronic volar PIP dislocations, range of motion averaged 70° and the incidence of complications, including extension lag of the DIP joint, was high [22].

Clinical Presentation

GENERAL PRESENTATION AND PROGNOSIS

- The PIP joint has the largest arc of motion (120°) of the three joints in the finger and is extremely prone to stiffness after an injury [52].
- PIP joint fracture–dislocations may result in permanent and severe disability if they are not adequately treated [52].
- Patients often have unsatisfactory results despite intervention for closed PIP joint fracture-dislocation [52].

ACUTE INJURY MECHANISMS AND PATTERNS

- Volar dislocation of the PIP joint is a rare injury and usually arises from a rotatory longitudinal force on a semiflexed digit [15].
- Volar PIP dislocation is accompanied by herniation of the head of the proximal phalanx through the extensor mechanism [15].
- Occasionally, an in-substance rupture of the central slip (boutonniere injury) is associated with volar PIP dislocation [15].
- The severity of bone and soft tissue damage in volar PIP dislocation manifests itself in the degree of subluxation, the size of the associated fracture, and the pattern of displacement of the fracture fragments [15].
- Open dislocations are predominantly dorsal dislocations of the index and middle fingers [43].
- Palmar fracture of the base of the middle phalanx may lead to a clinical deviation and rotational deformity of the digit [81].
- Injury to the PIP joint may be associated with fracture of the distal interphalangeal (DIP) joint resulting in bony mallet deformity or a tendinous injury [81].
- PIP joint subluxation on lateral radiographs presents a “V” sign [81].
- Fracture reduction in dorsal PIP fracture–dislocation can be difficult due to incarceration of the flexor tendons at the fracture site [87].

CHRONIC AND DELAYED PRESENTATION

- Patients are often somewhat cavalier about injuries to the digits, assuming that they represent “jammed fingers” that will heal spontaneously, which occasionally results in volar fracture dislocations becoming chronic [22].
- Chronic volar dislocations of the PIP joint are rare but present a therapeutic challenge when they do occur [22].
- If the duration between injury and treatment is relatively short, the joint may still be supple and reducible without soft tissue releases [22].
- In cases in which 2 months or more have elapsed between injury and treatment, there is a significant likelihood that the deformity has become fixed [22].

- Fixed chronic PIP deformities may require collateral ligament and possibly volar plate releases to mobilize the joint and the fracture fragment [22].
- The range of motion at follow-up for chronic PIP injuries is likely to be significantly less than in those in whom the injury is treated acutely [22].
- In one series of chronic PIP injuries, range of motion averaged 70° and the incidence of complications, including extension lag of the DIP joint, was high [22].
- Preoperative mobility of the injured finger in chronic palmar PIP dislocations is severely limited at both the PIP and DIP joints and did not exceed 20° for either joint [41].
- The duration of chronic palmar PIP dislocation before surgery ranged from 4 weeks to 19 months with a mean of 17.4 weeks [41].

Investigations

- Timely diagnosis is imperative, especially if there is any persistent incongruity of the joint, as fracture dislocations of the PIP joint may rapidly develop fixed deformity, leaving an athlete with a poor outlook for complete correction [21].
- No universally accepted classification of volar PIP joint dislocations exists, probably because these injuries most commonly involve a combination of damaged structures [15].
- Occasionally an in-substance rupture of the central slip is associated with volar PIP dislocation [15].
- In its most severe form, volar PIP dislocation involves a dorsal lip fracture of the base of the middle phalanx at the insertion of the central slip [15].
- If the duration between injury and treatment for chronic volar PIP dislocation is relatively short, the joint may still be supple and reducible without soft tissue releases [22].
- In cases in which 2 months or more have elapsed between injury and treatment for chronic volar PIP dislocation, there is a significant likelihood that the deformity has become fixed and that collateral ligament and possibly volar plate releases may be needed to mobilize the joint and the fracture fragment [22].
- If the dorsal fracture fragment in chronic volar PIP dislocation is reasonably large, it should be fixed as anatomically as possible with Kirschner wires, a screw, or an interosseous wire [22].
- If the dorsal fracture fragment in chronic volar PIP dislocation is small and not amenable to fixation, it may be necessary to excise the fragment and reconstruct the extensor mechanism by advancing the central tendon into the defect created by the dorsal fracture fragment [22].
- The range of motion at follow-up in chronic volar PIP dislocation is likely to be significantly less than in those in whom the injury is treated acutely [22].
- In one series of chronic volar PIP dislocations, range of motion averaged 70 degrees and the incidence of complications, including extension lag of the DIP joint, was high [22].
- The most common finding in PIP joint fracture dislocation is a volar articular surface fracture at the base of the middle phalanx with dorsal subluxation [39].

- Dorsal subluxation in PIP joint fracture dislocation is easily confirmed by lateral radiographs showing the appearance of the "V" sign [39].
- If > 30% of the articular surface of the middle phalangeal base is fractured, the injury should be considered unstable [39].
- The SCARF classification would contribute to management of PIP dislocations at the initial therapy [32].
- Follow-up radiographs in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed bone healing in all cases [24].
- At final follow-up, 20 patients (95%) in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed a stable aligned and centered joint [24].
- Twelve patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator achieved bone union in anatomic alignment [24].
- Seven patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed a central articular step off of mean 0.3 mm (SD 0.1 mm) [24].
- One patient in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed a deepened articular cavity of 1.2 mm [24].
- One patient in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator remained in a subluxated dorsal position and showed a restricted movement with stage 4 osteoarthritis following a pin infection [24].
- 85.7% of patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator had minimal-to-severe osteoarthritic changes [24].
- Three patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed osteoarthritis stage 0 [24].
- Five patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed osteoarthritis stage 1 [24].
- Nine patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed osteoarthritis stage 2 [24].
- Three patients in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed osteoarthritis stage 3 [24].
- One patient in a series of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator showed osteoarthritis stage 4 [24].

Treatment

NON-OPERATIVE MANAGEMENT

- Stable dorsal PIP fracture-dislocations can be managed nonsurgically with buddy taping for several weeks to allow early range of motion [33].

- Buddy taping for stable dorsal PIP fracture-dislocations has been shown to be superior to static immobilization [33].
- For stable volar PIP fracture-dislocations, predictable restoration of central slip function without surgery is suggested for fractures with an avulsed fragment displaced ≤ 2 mm [33].
- Nonsurgical management of stable volar PIP fracture-dislocations involves dorsal splinting to immobilize the PIP joint in full extension while allowing motion at the DIP and MCP joints for 3 to 4 weeks, followed by a dynamic extension splint for another 2 weeks [33].
- Surgery is considered for volar PIP fracture-dislocations when fracture displacement is large enough to raise concern regarding excessive extensor lag of the PIP joint [33].
- Tenuous dorsal PIP fracture-dislocations with no hinging during range of motion are often managed with extension block splinting [33].
- Extension block splinting prevents extension of the PIP joint into the range where it is unstable [33].
- Conservative treatment of volar plate sprains of the PIP joint does not depend on the presence of an avulsion fracture for short-term prognosis [34].
- Fractures presenting with less than 30% joint involvement have demonstrated positive outcomes when managed nonsurgically [53].
- Simple neighbour strapping is recommended for volar avulsion fractures of the PIP joint provided the joint is clinically stable [84].
- A bivalve finger fracture orthosis has been used as an alternative approach to surgical treatment for PIP fracture dislocation injuries [118].

OPERATIVE MANAGEMENT: EXTERNAL FIXATION

- Dynamic distraction external fixation results for unstable PIP joint fracture-dislocations are comparable with other techniques used in the management of these injuries [1].
- Dynamic intradigital external fixation is recommended as an easy technique to treat fracture dislocations of the PIP joint [7].
- Results of PIP fracture treatment with external fixators are similar to those reported in other studies [8].
- A novel technique for dynamic external fixation of PIP joint fracture-dislocations produced results comparable to other dynamic external fixation techniques [10].
- Delayed treatment of unstable PIP joint fracture-dislocations with a dynamic external fixator is effective in restoring function to the PIP joint [12].
- Dynamic external fixation for complex PIP joint fractures represents a significant advance in treatment and may be of use in other types of IP joint injury [17].
- A parabolic dynamic external fixator for pilonoidal fracture dislocations of the PIP joint resulted in bone healing in all cases and a stable aligned and centered joint in 95% of patients at final follow-up [24].
- In a series treated with a parabolic dynamic external fixator, 85.7% of patients had minimal-to-severe osteoarthritic changes [24].

- A dynamic traction splint and early active movement for PIP joint fractures resulted in a mean total arc of active motion of 80° in the fingers and 60° in the thumb [25].
- A simplified Kirschner-wire-based dynamic external fixator for unstable PIP joint fractures resulted in an average PIP joint range of motion of 76.4 ± 23.51° and average grip strength of 85 ± 13.95% compared to the healthy side [54].
- Three dynamic external fixation devices restored PIP joint stability following simulated dorsal fracture-dislocation in a cadaver model, with all reductions maintained after motion testing [57].
- A 3-dimensional printed dynamic external fixator provides stability comparable to the pins and rubbers traction system while offering benefits such as easy placement, controlled distraction, and clear visualization of the articular surface [59].
- Hand-based swing traction splinting for intra-articular PIP joint fractures resulted in no cases of non-union or joint collapse [80].
- A ligamentotaxis device is used in a multidisciplinary approach for the treatment of fracture subluxations of the PIP joint [83].

OPERATIVE MANAGEMENT: PINNING AND INTERNAL FIXATION

- Extension block pinning is a simple and valuable technique for treating unstable dorsal PIP fracture-dislocation injuries, producing satisfactory long-term results [9].
- Percutaneous, intramedullary reduction of impacted volar articular fragments associated with unstable dorsal PIP fracture-dislocation restores joint congruence and function [11].
- Closed reduction and percutaneous Kirschner wire pinning in dorsal PIP fracture-dislocations is a minimally invasive and simple technique that gives satisfactory outcomes in the short to intermediate term [20].
- Extension-block pinning is a simple and reproducible technique that provides stabilization and allows early movement of the PIP joint, yielding highly satisfactory functional results for dorsal PIP fracture-dislocation [29].
- A pins and rubbers traction system represents a safe, efficient, and cost-effective treatment modality for fractures involving the PIP joint [30].
- Mini plate and screw fixation of acute PIP joint fracture dorsal dislocation can achieve comparable favourable clinical and radiographic outcomes through stable fixation and early range of motion exercise [42].
- A dorsal blocking plate is a simple technique associated with a satisfactory outcome for volar fracture dislocation injuries of the PIP joint [27].
- A plate and screw construct provides adequate stability for dorsal PIP fracture-dislocations to allow early active rehabilitation, potentially resulting in better functional outcomes compared to screws alone [28].
- Mini hook plate fixation achieved rigid fixation and early active motion in a patient with a chronic palmar PIP joint fracture-dislocation, resulting in a successful outcome with almost normal range of motions [19].
- Mini-fragment screw fixation for volar PIP dislocations involves reducing the fragment and fixing it with a single 1-mm mini-fragment cortical screw across the fracture plane and reconstituting the central slip [79].

- Potential disadvantages of mini-fragment screw fixation for volar PIP dislocations include interference with flexor digitorum profundus and reduced DIP joint movement, and dorsal prominence of the screw requiring removal as a second procedure [79].
- Open reduction and internal fixation has been used to treat PIP joint fracture-dislocations, with the specific technique depending on the injury [85].

OPERATIVE MANAGEMENT: ARTHROPLASTY AND RECONSTRUCTION

- Long-term results of hamate osteochondral grafts for PIP fracture-dislocation have generally acceptable clinical and radiologic outcomes [16].
- Under appropriate indications and with aggressive postoperative rehabilitation, a hemihamate autograft to reconstruct an unstable, comminuted dorsal PIP fracture dislocation can produce a very satisfying outcome [47].
- Open reduction of chronic untreated PIP joint dislocations can successfully achieve a functional range of motion with a stable joint [3].
- Individualized reconstruction of chronic fractures affecting the PIP joint can achieve excellent recovery with minor donor site sacrifice if nonunion and malunion are treated as soon as recognized [46].

GENERAL TREATMENT PRINCIPLES

- For simultaneous DIP and PIP joint fracture-dislocations, 50% of DIP joint fracture cases had only fair or poor results, whereas PIP joint fractures generally yielded satisfactory outcomes [6].
- There are no consistent differences among treatment techniques for unstable dorsal PIP fracture dislocations regarding range of motion, pain, or radiographic degeneration [23].
- Volar dislocation of the PIP joint is a rare injury that usually arises from a rotatory longitudinal force on a semiflexed digit [15].
- The anatomic disruption of volar PIP dislocation includes unilateral rupture of a collateral ligament, partial avulsion of the volar plate, and herniation of the head of the proximal phalanx through the extensor mechanism [15].
- Closed reduction of grade I volar PIP dislocation may be achieved by extending the wrist and flexing the metacarpophalangeal and PIP joints to relax the volarly displaced lateral bands and extensor mechanism [15].
- Treatment of palmar PIP fracture dislocations has been satisfactory, with patients achieving 87% of the range of motion of the normal PIP joint [55].

Complications

GENERAL PROGNOSIS AND STIFFNESS

- The proximal interphalangeal joint is extremely prone to stiffness after an injury [52].

- Fracture dislocations of the PIP joint may rapidly develop fixed deformity, leaving an athlete with a poor outlook for complete correction [21].

CHRONIC AND DELAYED PRESENTATION

- If 2 months or more have elapsed between injury and treatment for chronic volar dislocations, there is a significant likelihood that the deformity has become fixed and that collateral ligament and possibly volar plate releases may be needed to mobilize the joint and the fracture fragment [22].
- The range of motion at follow-up in chronic PIP joint injuries is likely to be significantly less than in those in whom the injury is treated acutely [22].
- In one series of chronic PIP joint injuries, range of motion averaged 70° and the incidence of complications, including extension lag of the DIP joint, was high [22].
- Preoperative mobility of the injured finger in chronic palmar dislocations was severely limited at both the PIP and DIP joints and did not exceed 20° for either joint [41].
- The total active ROM was 85° for the acute fracture-dislocation group and 61° for the chronic group in volar plate arthroplasty, which was a significant difference ($p = .03$) [110].
- The average extension lag was 15° in the acute group and 29° in the chronic group for volar plate arthroplasty, though these differences did not reach statistical significance [110].
- The average DIP ROM differed significantly between the acute (58°) and chronic (28°) groups in volar plate arthroplasty ($p = .04$) [110].

SPECIFIC COMPLICATIONS AND SEQUELAE

- Open dorsal PIPJ dislocations treated without palmar plate reinsertion are associated with substantial stiffness but no residual instability [40].
- Intraoperative fractures occur in about 5% of PIP joint arthroplasties and do not appear to influence outcomes, including revision surgery, refracture rate, or other early complications [93].
- Recurrent subluxation occurred in 2 of 6 patients treated with Kirschner wire fixation and 2 of 6 patients treated with screw fixation for dorsal PIP fracture-dislocations [52].
- Infection and fusion occurred in 1 of 6 patients treated with screw fixation for dorsal PIP fracture-dislocations [52].
- Six of 8 patients with central slip fracture subluxations had radiographic evidence of arthritis prior to their salvage procedures or at follow-up [111].
- At the time of K-wire or external fixator removal, the PIP joint was reduced in 4 patients, subluxated in 3, and dislocated in 1 patient with central slip fracture subluxations [111].
- At follow-up, the PIP joint was reduced in 3 of the 5 patients and subluxated in 2 patients who did not undergo salvage procedures for central slip fracture subluxations [111].
- Five patients with extension block pinning had a superficial pin track infection occurring between 7–17 days (mean 13) after operation, all successfully treated with local pin site care and a short course of oral antibiotic [94].

- Two patients with extension block pinning underwent PIP arthrodesis for persisting pain at 5 and 10 months after injury [94].
- One patient with extension block pinning and an associated distal phalangeal shaft fracture underwent distal interphalangeal (DIP) arthrodesis 2 years after the initial injury [94].
- One patient with extension block pinning sustained another dorsal fracture-dislocation of the same PIP joint, which was treated by extension block pinning 8 years after the first injury [94].
- The primary reasons for dissatisfaction in patients with extension block pinning were joint stiffness (five fingers), poor grip posture (three), or pain (one) [94].
- At 4 months, the PIP joint in a patient with irreducible palmar dislocation flexed to 70 degrees and lacked 20 degrees of extension [45].

IATROGENIC AND RARE PATTERNS

- An iatrogenic PIPJ fracture dislocation pattern involving a Salter-Harris II middle phalanx base fracture with dorsal dislocation has not been previously described in the literature [14].

Recovery

- The mean active range of motion of the PIP joint was 95 degrees in acute cases and 80 degrees in chronic patients treated with a dynamic external finger fixator [122].
- Delayed treatment of unstable PIPJ fracture-dislocations with a dynamic external fixator is effective in restoring function to the PIPJ [12].
- The results of treatment for palmar fracture dislocation of the proximal interphalangeal joint were satisfactory, with patients achieving 87% of the range of motion of the normal PIP joint [55].
- At 4 months following treatment for irreducible palmar dislocation of the proximal interphalangeal joint with bilateral avulsion fractures, the PIP joint flexed to 70 degrees and lacked 20 degrees of extension [45].
- The short-term prognosis for conservative treatment of volar plate sprains of the PIP joint does not depend on the presence of an avulsion fracture [34].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, follow-up radiographs showed bone healing in all cases [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 20 patients (95%) showed a stable aligned and centered joint at final follow-up [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 12 patients achieved bone union in anatomic alignment [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 7 patients showed a central articular step off of mean 0.3 mm (SD 0.1 mm) [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 1 patient showed a deepened articular cavity of 1.2 mm [24].

- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 1 patient remained in a subluxated dorsal position and showed restricted movement with stage 4 osteoarthritis following a pin infection [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 85.7% of patients had minimal-to-severe osteoarthritic changes [24].
- In a study of pilonoidal fracture dislocations treated with a parabolic dynamic external fixator, 3 patients showed osteoarthritis stage 0, 5 stage 1, 9 stage 2, 3 stage 3, and 1 stage 4 [24].
- The long-term results of hamate osteochondral grafts for PIP fracture-dislocation have generally acceptable clinical and radiologic outcomes [16].
- The short-term results of hamate osteochondral grafts for PIP fracture-dislocation are encouraging, with patients returning to pre-injury work and low pain scores [60].
- Hemi-Hamate Arthroplasty reconstruction showed promising early functional outcomes for delayed, severe dorsal PIPJ fracture-dislocations in a small case series [36].
- Preliminary results of Hemi-Hamate Autograft Arthroplasty for the Proximal Interphalangeal Joint compare well with published series and are encouraging, especially when cases had a very much delayed time of presentation to surgery and a greater degree of articular loss [121].
- Treat PIP joint nonunion and malunion as soon as it is recognized, excellent recovery can be achieved with minor donor site sacrifice [46].

Key Evidence

- [L4] Our results are comparable with other techniques used in the management of unstable PIP joint fracture-dislocations. [1] (10.1016/j.jhsa.2007.07.018)
- [L4] The differences may still preclude anatomical reconstruction in the setting of a dorsal PIP fracture-dislocation, thereby affecting short- and long-term outcomes. [2] (10.1016/j.jhsa.2019.11.009)
- [L4] This surgical technique of open reduction of chronic untreated PIP joint dislocations can successfully achieve a functional range of motion with a stable joint. [3] (10.1016/j.jhsa.2020.07.002)
- [L5] Clinical results for PIP joint dislocations and fracture-dislocations vary and are often difficult to predict due to the complexity of fracture patterns and potential for sub-acute or chronic presentation. [4] (10.1177/17531934231183259)
- [L5] This article serves as a reference for the current understanding and best practices in treating PIP joint fracture dislocations, emphasizing that treatment is based on joint stability, fracture fragment size, and soft tissue injuries. [5] (10.1016/j.hcl.2017.12.005)
- [L4] For DIP joint fractures, 50% of cases had only fair or poor results, whereas PIP joint fractures generally yielded satisfactory outcomes. [6] (10.1054/jhsb.1999.0228)
- [L4] Based on our experience we recommend this easy technique to treat fracture dislocations of the PIP joint. [7] (10.1016/j.jhsa.2004.07.019)

- [L4] The results of this series are similar to those reported in other studies of PIP fracture treatment with external fixators. [8] (10.1016/j.main.2015.08.002)
- [L4] The extension block pinning technique is a simple and valuable technique for treating unstable dorsal PIP fracture-dislocation injuries producing satisfactory long-term results. [9] (10.1016/j.jhsa.2015.11.007)
- [L4] The results were comparable to other dynamic external fixation techniques used for unstable PIP joint fracture-dislocations. [10] (10.1142/s2424835520500460)
- [L4] Percutaneous, intramedullary reduction of the impacted volar articular fragments associated with unstable, dorsal fracture–dislocation of the PIP joint restores joint congruence and function. [11] (10.1016/j.jhsa.2010.08.004)
- [Paper] Delayed treatment of unstable PIPJ fracture-dislocations with a DDEF is effective in restoring function to the PIPJ. [12] (10.1016/j.injury.2015.06.027)
- [L5] Early recognition of joint instability is essential for adequate treatment of injuries of the PIP joint. [13] (10.5435/00124635-200011000-00006)
- [L5] To our knowledge, this pattern of iatrogenic PIPJ fracture dislocation has not been previously described in the literature. [14] (10.1177/15589447241278957)
- [L5] [15] (10.1016/s0894-1130(03)80007-8)
- [L4] The long-term results of hamate osteochondral grafts for PIP fracture-dislocation have generally acceptable clinical and radiologic outcomes. [16] (10.1016/j.jhsa.2025.11.020)
- [L4] This seems a significant advance in treatment of complex PIP joint fractures and may be of use in other types of IP joint injury. [17] (10.1016/s0020-1383(98)00034-5)
- [L3] Soft tissue injury is a major factor in reoperation after PIP joint fracture dislocation. [18] (10.1177/1558944719858429)
- [L4] The technique using a mini hook plate achieved rigid fixation and early active motion in a patient with a chronic palmar PIP joint fracture-dislocation, resulting in a successful outcome with almost normal ROMs. [19] (10.1007/s00402-010-1200-6)
- [L4] Closed reduction and percutaneous Kirschner wire pinning in dorsal fracture-dislocations of the PIP joint is a minimally invasive and simple technique which appears to give satisfactory outcomes in the short to intermediate term. [20] (10.1007/s11552-014-9660-8)
- [L5] Timely diagnosis is imperative, especially if there is any persistent incongruity of the joint, as fracture dislocations of the PIP joint may rapidly develop fixed deformity, leaving an athlete with a poor outlook for complete correction. [21] (10.1016/j.hcl.2012.05.036)
- [L5] [22] (10.1016/s0749-0712(21)00575-8)
- [L5] There are no consistent differences among treatment techniques for unstable dorsal fracture dislocations of the PIP joint regarding range of motion, pain, or radiographic degeneration. [23] (10.1016/j.jhsa.2008.08.017)
- [Paper] [24] (10.1007/s00402-019-03275-8)
- [L4] The mean total arc of active motion was 80° in the proximal interphalangeal joints of the fingers and 60° in the interphalangeal joint of the thumb. [25] (10.1016/s0894-1130(12)80193-1)

- [L4] A dorsal blocking plate is a simple technique, associated with a satisfactory outcome, for volar fracture dislocation injuries of the PIP joint. [27] (10.1016/j.jhsa.2021.07.025)
- [Case_report] The plate and screw construct provides adequate stability for dorsal fracture-dislocations of the PIP joint to allow early active rehabilitation, potentially resulting in better functional outcomes compared to screws alone. [28] (10.1016/j.jhsa.2010.02.011)
- [L4] Extension-block pinning is a simple and reproducible technique that provides stabilization and allows early movement of the PIP joint, yielding highly satisfactory functional results for dorsal fracture-dislocation of the PIP. [29] (10.1016/j.otsr.2012.02.009)
- [L4] It represents a safe, efficient, and cost-effective treatment modality for fractures involving the PIP joint. [30] (10.1007/s00402-007-0526-1)
- [L5] Suboptimal treatment of intra-articular fractures typically leads to functional impairment of the hand. [31] (10.1177/1753193414559464)
- [L2] The SCARF classification would contribute to management of PIP dislocations at the initial therapy. [32] (10.1016/j.jos.2019.08.007)
- [L5] [33] (10.5435/jaaos-21-02-88)
- [L4] This study demonstrates that the short-term prognosis for conservative treatment of volar plate sprains of the PIP joint does not depend on the presence of an avulsion fracture. [34] (10.1016/j.hansur.2016.09.015)
- [L5] In this small case series, HHA reconstruction showed promising early functional outcomes for delayed, severe dorsal PIPJ fracture-dislocations. [36] (10.1016/j.jhsg.2026.101061)
- [L4] [39] (10.1097/bth.0000000000000268)
- [L4] Open dorsal PIPJ dislocations treated without palmar plate reinsertion are associated with substantial stiffness but no residual instability. [40] (10.1177/17531934261464365)
- [L4] [41] (10.1016/s0363-5023(86)80064-8)
- [L4] Mini plate and screw fixation of acute PIP joint fracture dorsal dislocation can achieve comparable favourable clinical and radiographic outcomes through stable fixation and early range of motion exercise. [42] (10.1055/a-1075-2668)
- [L4] Open dislocations are predominantly dorsal dislocations of the index and middle fingers. [43] (10.1177/17531934251405707)
- [L5] At 4 months the PIP joint flexed to 70 degrees and lacked 20 degrees of extension. [45] (10.1016/0363-5023(90)90060-5)
- [L4] Treat PIP joint nonunion and malunion as soon as it is recognized, excellent recovery can be achieved with minor donor site sacrifice. [46] (10.1016/j.jhsa.2015.06.043)
- [L5] Under the appropriate indications and with aggressive postoperative rehabilitation the use of a hemihamate autograft to reconstruct an unstable, comminuted dorsal PIP fracture dislocation can produce a very satisfying outcome. [47] (10.1097/00130911-200212000-00005)
- [L1] [52] (10.1016/j.jhsb.2004.10.011)

- [L4] The literature demonstrated positive outcomes for fractures presenting with less than 30% joint involvement that were managed nonsurgically. [53] (10.1177/15589447241231308)
- [L4] Average PIPJ-ROM was 76.4 ± 23.51°, and the average grip-strength was 85 ± 13.95% as compared to the healthy side. [54] (10.1007/s00068-020-01443-9)
- [L4] The results of treatment were satisfactory, with patients achieving 87% of the range of motion of the normal PIP joint. [55] (10.1016/s0363-5023(98)80155-x)
- [L5] All 3 external fixators restored PIP joint stability following simulated dorsal fracture-dislocation, with all reductions maintained after motion testing. [57] (10.1016/j.jhsa.2022.01.019)
- [L5] [58] (10.1053/jssh.2002.33317)
- [L5] The 3DPDEF is a suitable option for PIP fracture-dislocations, providing stability comparable to that of the PRTS while offering benefits, such as easy placement, controlled distraction, and clear visualization of the articular surface. [59] (10.1016/j.jhsa.2024.09.019)
- [L4] The short-term results of hamate osteochondral grafts for PIP fracture-dislocation are encouraging, with patients returning to pre-injury work and low pain scores. [60] (10.1177/1753193416671886)
- [L5] [61] (10.1016/j.hcl.2017.12.004)
- [L4] [79] (10.1007/s004020000156)
- [L4] [80] (10.1177/1758998313490856)
- [L4] [81] (10.4103/0970-0358.90822)
- [L4] [83] (10.1177/1753193415578305)
- [L4] [84] (10.1016/0266-7681(89)90120-4)
- [L5] In this patient, the fracture reduction was difficult due to incarceration of the flexor tendons at the fracture site, a complication of dorsal fracture–dislocation of the PIP joint that had never been described in the literature. [87] (10.1016/j.hansur.2018.01.005)
- [L3] Intraoperative fractures occur in about 5% of PIP joint arthroplasties and do not appear to influence outcomes, including revision surgery, refracture rate, or other early complications. [93] (10.1016/j.jhsa.2015.06.101)
- [L4] [94] (10.1177/17531934221102251)
- [L5] [99] (10.1016/j.hcl.2009.05.008)
- [L5] Simulated volar articular bony defects of 20% were stable, whereas those with 60% and 80% defects were unstable during digital motion. [104] (10.1016/j.jhsa.2013.09.025)
- [L4] Flexion contractures and stiffness are common, and obtaining full range of motion is rare, making early motion a key treatment element for success. [106] (10.2106/jbjs.rvw.o.00019)
- [L4] [110] (10.1016/s0363-5023(00)70026-8)
- [L4] [111] (10.1016/j.jhsa.2017.03.030)
- [L5] Restoration of stability allowing early motion and a smooth articular surface are the goals of treatment. [115] (10.1016/j.jhsa.2015.08.023)

- [L4] The use of a bivalve finger fracture orthosis demonstrated an alternative approach to surgical treatment for PIP fracture dislocation injuries in this patient, proving successful in reducing challenges associated with the injury. [118] (10.1016/j.jht.2014.08.002)
- [L4] Our preliminary results compare well with published series and are encouraging, especially when our cases had a very much delayed time of presentation to surgery and a greater degree of articular loss. [121] (10.1142/s2424835518710029)
- [L4] The mean active range of motion of the PIP joint was 95 degrees in acute cases and 80 degrees in chronic patients. [122] (10.1016/0363-5023(93)90265-5)

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