

## Volar Plate Avulsion Fractures

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### **Issues this article will address**

- The mechanism of injury giving rise to volar plate avulsion fractures and their recognition/diagnosis
- Pros and cons of two conservative management techniques – early active motion with or without buddy strapping, and immobilisation in varying degrees of flexion/extension

### **Salient Points**

- Small volar plate avulsion fractures of the proximal interphalangeal (PIP) joint are common.
- Their prognosis is generally good, but complications do occur.
- Conservative management is appropriate for injuries involving less than 30% of the joint surface. It can be divided into two broad categories – early active motion with or without buddy strapping, and immobilisation in varying degrees of flexion/extension.
- Currently, there is no good evidence to suggest either treatment modality is superior.
- Present New Zealand guidelines advocate initial extension block splinting with early review, although this technique has not been extensively evaluated.

**Key words:** Proximal interphalangeal joint • Volar plate • Avulsion fracture • Early mobilisation • Immobilisation splinting

## Introduction

Injuries to the proximal interphalangeal (PIP) joint are common in the emergency setting,<sup>[1,2]</sup> although there are no good data to define the proportion of these injuries that are associated with avulsion fractures of the volar plate (Figs 1 and 2).

The PIP joint functions a simple hinge and gains most of its stability from surrounding soft tissue structures.<sup>[1,3]</sup> The capsule is reinforced in a box-like fashion by the collateral and accessory collateral ligaments laterally, and the volar plate anteriorly.<sup>[1]</sup> The volar plate is largely responsible for stability of the joint in the anterior-posterior (AP) plane, and resists hyperextension.<sup>[1,3]</sup> It forms a strong distal attachment to the periosteum of the middle phalanx,<sup>[3,4]</sup> while the proximal portion attaches to the capsule and thus has more intrinsic “give”.<sup>[1]</sup> Consequently, avulsion of the volar plate following injury is likely to occur at the distal attachment.<sup>[1-4]</sup>

The mechanism of injury is typically that of forced hyperextension.<sup>[1-3]</sup> This is commonly caused by axial force applied to the finger tip when a ball hits it.<sup>[1-3]</sup> Diagnosis, following history and examination, is easily made with the aid of a lateral x-ray projection of the joint.<sup>[1,4]</sup> The accepted management for this injury is conservative, but the recommended treatment protocol is contentious.



**Fig. 1.** Typical volar plate fracture.

## Typical Case Presentation

- **History:** A 15-year-old girl presents with injury to her left middle finger.
- **Previous medical history:** Normally fit and well; no other relevant history; no regular medications; no known drug allergies.
- **History of presenting complaint:** Playing netball that morning – ball struck tip of left middle finger. Painful immediately, with swelling and reduced range of motion (ROM). No history of dislocation/relocation.  
Right hand dominant. Currently a secondary school student; plays representative netball. Rest-ice-compression-elevation (RICE) treatment commenced by her coach immediately.
- **Observation/examination:** Normal capillary refill at fingers, and normal sensation. Normal digital cascade. Full extension, flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) intact for all digits. Swelling at left middle finger, maximally at PIP joint, with bruising evident at volar surface of joint. Joint alignment appears normal. Tender over PIP joint and middle phalanx, volar > dorsal. Reduced ROM secondary to pain, but no instability at PIP joint. No rotational defect.
- **X-ray:** No dislocation; nothing abnormal detected on AP view. Small 3 mm x 2 mm avulsion fragment from middle phalanx at volar surface of PIP joint on lateral view.
- **Impression:** Injury to PIP joint of the left middle finger, with small volar avulsion fracture at the PIP joint. Probable volar plate injury.
- **Management plan:** Zimmer splint applied to dorsal finger fixed to the proximal phalanx allowing flexion at the PIP joint but limiting extension, with PIP joint in 30 degrees of flexion. High arm sling, and simple analgesia.  
Referral to a hand therapist for assessment and splinting.  
At 1-week review, patient comfortable in thermoplastic dorsal extension block splint fashioned by hand therapist. Swelling and pain at finger reduced; good range of flexion; no instability. Extension block splinted for a further 2 weeks, mobilised with buddy strapping for 2 weeks.



**Fig. 2.** Detail of a volar plate avulsion fracture.

## Management Considerations

Injuries to the PIP joint have a relatively benign appearance, and are generally thought to do well.<sup>[1]</sup> Management of small avulsions in the context of a stable joint has traditionally been immobilisation in flexion, with a period of strapping and mobilisation following this.<sup>[5]</sup> Avulsion fragments involving greater than 30% of the articular surface are considered unstable and should be referred for surgical intervention.<sup>[3,6]</sup> For clarification, only small, stable avulsion fractures are considered here, and the intention is to review current opinion regarding the conservative treatment of this injury.

The volar plate was first described in 1904,<sup>[2]</sup> and its detailed anatomy and function have subsequently been recognised.<sup>[1-3]</sup> Complications following avulsion vary from ongoing pain, swelling and stiffness, to hyperextension instability and recurrent subluxation, and traumatic arthritis.<sup>[1-5,7]</sup> Flexion contracture also occurs and is thought to be due to immobilisation in flexion, with subsequent poor healing causing capsular fibrosis.<sup>[5]</sup>

Within the literature, there are two schools of thought regarding the conservative management of this injury. One group of authors advocate early range of movement, while a

another group recommend a period of immobilisation by splinting prior to mobilisation of the affected finger.

In a study in which 74 volar avulsion fractures of the PIP joint were treated either by buddy strapping and active mobilisation only, or by immobilisation with a dorsal splint in 30 degrees of flexion, most injuries did well regardless of management.<sup>[8]</sup> There was, however, an advantage demonstrated for the mobilising buddy-strapped group. This was reflected in an earlier return to normal range of movement, shorter time to regain normal use of the finger, and a slightly better functional outcome – 96.6% of this group had an “excellent” outcome as compared with 93% of the splinted group. The authors concluded that: “providing the joint is stable, simple neighbor strapping is recommended for these injuries”. However, this was a retrospective study with no randomisation of patients. Other weaknesses included poor standardisation of treatment, a small sample size, and the possible introduction of bias as final assessment of the functional outcome was performed by the authors who were not blinded.<sup>[9]</sup>

In a prospective trial, Gaine et al.<sup>[4]</sup> studied early immediate mobilisation of volar plate avulsion fractures. Treatment also included physiotherapy and ultrasound. 162 consecutive cases were followed for at least a year, with a good functional outcome achieved in 98% of patients. This was not a randomised trial with a comparative intervention as all patients were treated with immediate active mobilisation at initial assessment in the hand clinic. Although the patients were referred by an outside source and were not seen initially at the clinic, there was no discussion of the initial treatment employed prior to the study assessment;<sup>[9]</sup> some of these injuries may therefore have been splinted prior to assessment for study inclusion.

In another study, Incavo et al.<sup>[5]</sup> employed a technique of immobilisation of the joint in full extension for 7 to 10 days using aluminium or orthoplastic splints, followed by a period of buddy strapping for a period of up to 6 weeks. The rationale was to avoid flexion contracture, while also attempting to minimise the risk of hyperextension instability. Good functional results were reported with no cases of hyperextension instability, but interestingly one case of flexion contracture. Again, this was not a randomised, controlled trial, and it had a small sample size of 45 patients and an alarming loss to follow-up of greater than 50%.

Similarly, others have emphasised the importance of immobilisation in order to prevent problems of hyperextension laxity. In a prospective study of hyperextension injuries to PIP joints of the fingers and MCP joints of the thumb, all injuries were treated with a dorsal splint in 30 degrees of flexion for 1 to 3 weeks before buddy strapping and mobilisation.<sup>[2]</sup> Not all

injuries were associated with an avulsion fracture – only 16 had an associated avulsion. This heterogeneous population makes interpretation difficult in the context of our clinical question, but the study did show some interesting results. Most patients had no hyperextension instability or avulsion fracture (these people tended to do very well and had only “transient” symptoms), but all patients who had hyperextension instability on initial examination had a poorer outcome. The extent of initial swelling or bruising and the size and displacement of the avulsion fragment had no influence on the outcome. The authors concluded that “an avulsion fracture does not necessarily imply a bad prognosis, and if the joint is stable the fracture will heal uneventfully”.<sup>[2]</sup>

In a review of this topic by Freiberg et al.,<sup>[1]</sup> immobilisation by splinting in 30 to 40 degrees of flexion was recommended for a period of 3 to 4 weeks, followed by buddy strapping and mobilisation. It was also suggested that the amount of flexion may be varied from 10 to 40 degrees in proportion to displacement of the avulsed fragment. However, no references or evidence was provided by the authors to support their statements.

Current management guidelines in New Zealand<sup>[6]</sup> suggest an extension block splint in 30 degrees of flexion for any “actual or suspected” volar plate injury, with review in 7 to 10 days. This type of splint would seem a good compromise, limiting full extension but allowing flexion of the joint, thereby protecting against hyperextension instability and preventing contracture or stiffness associated with flexion immobilisation. Its use in the context of avulsions involving 20 to 40% of the articular surface has been described,<sup>[7]</sup> but there appears to be nothing in the literature detailing its use or efficacy in the treatment of small avulsions.

## **Conclusion**

Avulsion fractures of the volar plate at the PIP joint are common. In general, they have a good treatment outcome, although complications do occur. Treatment should aim to prevent complications, while maximising functional outcome. There are a range of opinions regarding conservative treatment, from early active motion with or without buddy strapping to immobilisation in varying degrees of flexion/extension. Currently, there is no good evidence to suggest that either early mobilisation or initial splinting and immobilisation is superior. Further randomised controlled trials are needed to fully assess this, with perhaps the inclusion of extension block splinting. The implications for current practice are therefore unclear. However, it would seem reasonable to continue managing these injuries using extension block splinting in the initial stages followed by a period of buddy strapped mobilisation.

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