

## ENDGAMES



## CASE REVIEW

## A rugby player's finger injury

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A 16 year old right hand dominant schoolboy presented to the emergency department with a painful, swollen right ring finger. Three days earlier he had injured his finger playing rugby and he thought the injury occurred while he was tackling an opponent. Although he was able to finish the game he has had discomfort and reduced movement in the finger since.

Ecchymosis and tenderness were noted over the distal phalanx on the palmar aspect of his hand, as well as some swelling and tenderness at the base of the ring finger (fig 1). The finger had no neurovascular deficit and examination of the rest of the right hand was normal. No fracture was seen on a plain radiograph of the ring finger.



**Fig 1** The patient's right hand in a relaxed posture showing loss of normal cascade of the ring finger

## Questions

1. What key aspect of the clinical examination would confirm the diagnosis?
2. What is the name of this injury (the name provides a clue to its mechanism)?
3. Which finger is most commonly affected?
4. How are these injuries classified?
5. How are these injuries managed?

## Answers

1. **What key aspect of the clinical examination would confirm the diagnosis?**

*Short answer*

Inability to actively flex the distal interphalangeal joint (DIPJ) is pathognomonic of rupture of the flexor digitorum profundus (FDP) tendon. To test the FDP tendon function, isolate the DIPJ by holding the proximal interphalangeal joint (PIPJ) in extension, thereby preventing the action of the flexor digitorum superficialis (FDS).

*Discussion*

FDP tendon avulsion is diagnosed on physical examination—patients have a lack of isolated DIPJ flexion. To test for this, the DIPJ is isolated by holding the PIPJ in extension (fig 2). The finger will probably be painful and swollen. Ecchymosis may be present on the volar side of the finger. The affected finger is often in an extended position relative to the other fingers, with loss of the normal cascade (fig 1). Tenderness may be elicited over the volar distal phalanx at the site of avulsion and over the retracted tendon end proximally down the finger or in the palm. The retracted tendon may be palpable over the proximal phalanx or in the palm. PIPJ movement may be full if the tendon has retracted proximal to it, but if the tendon has retracted to the joint, the patient may have pain and a reduced range of movement at the PIPJ or occasionally a fixed flexion deformity. Therefore FDS function should be present. However, it may be painful or reduced if the FDP tendon end has retracted to the level of the PIPJ or the FDS decussation, where the FDS tendon divides and reunites to allow the FDP tendon to pass through it. FDS function is tested by holding the neighbouring finger DIPJs in extension, thereby preventing the action of the common FDP muscle belly (fig 3).



**Fig 2** Testing the little finger FDP (flexor digitorum profundus) tendon function by isolating the DIPJ (distal interphalangeal joint), which required holding the PIPJ (proximal interphalangeal joint) in extension to prevent the action of FDS (flexor digitorum superficialis)



**Fig 3** Testing the middle finger FDS (flexor digitorum superficialis) function by holding the neighbouring finger DIPJs (distal interphalangeal joints) in extension and thereby preventing the action of the common FDP (flexor digitorum profundus) muscle belly

Plain radiography can help identify a bone avulsion and its size, as well as an intra-articular fracture if present at the distal phalanx. The extent of tendon retraction may be estimated by the presence of a small bone fragment on a lateral radiograph of the hand. This fragment may be attached to the retracted tendon.<sup>1 2</sup> Larger fracture fragments will normally prevent retraction of the avulsed tendon through the pulley system. Further imaging modalities, such as ultrasound and magnetic resonance imaging, can be useful adjuncts in the evaluation and diagnosis of these injuries, especially in delayed presentations and chronic injuries, but are generally not needed.<sup>2-7</sup>

Awareness of this injury is important because these patients often present without serious pain or swelling, they have no open skin wound, and radiographs are often normal. Take care to examine patients carefully ensuring that they have a proper functioning FDP tendon.<sup>8</sup>

## 2. What is the name of this injury (the name provides a clue to the mechanism of injury)?

### Short answer

“Jersey finger” or “rigger jersey finger.” It classically occurs when a tackler has hold of an opponent’s jersey. The DIPJ is forcibly hyperextended when the FDP muscle is fully contracted, leading to tendon rupture at its insertion into the distal phalanx.

## Discussion

Avulsion of the insertion of the FDP tendon was first described in adults in 1891.<sup>3 9</sup> In 1977 Leddy and Packer described this mechanism of injury in American football players,<sup>10 11</sup> and since then the injury has been referred to as jersey finger or rigger jersey finger. The FDP tendon is avulsed from the distal phalanx during active flexion of the fingers that are grasping an opponent’s jersey. The FDP muscle is at maximal contraction when the pull of the opponent causes forced hyperextension of the finger’s DIPJ.<sup>11</sup> DIPJ hyperextension causes the tendon to rupture at its weakest physiological point—its insertion on to the distal phalanx.<sup>12</sup> Rupture through the substance of the tendon is rare.<sup>10-13</sup> Jersey finger is the most common type of closed flexor tendon injury. The age range of patients sustaining this injury is 12-79 years (mean 30.9), with very few patients under 14 years affected.<sup>1-20</sup> Despite its name, many different and non-sporting mechanisms can cause sudden hyperextension of the DIPJ while the FDP muscle is contracted and lead to FDP tendon avulsion.<sup>1</sup>

## 3. Which finger is most commonly affected?

### Short answer

The ring finger is affected in more than 75% of cases probably because of the ring finger’s prominence during flexion compared with the other fingers—it is longest in grip, which may subject it to greater forces.

## Discussion

This injury can occur in any finger but the ring finger is affected in more than 75% of cases.<sup>2 21</sup> When flexed, the ring finger is about 5 mm more prominent than the other fingers,<sup>9 16</sup> and this may subject the ring finger to greater forces during grip. Leddy and Packer suggested that the anatomical arrangement of the extensor tendons may be a predisposing factor to FDP tendon injury in the ring finger.<sup>10</sup> When the middle and little finger metacarpophalangeal joints (MCPJs) are flexed to 90°, the ring finger cannot be passively extended fully owing to intertendonous connections between the extensor tendons. This restriction of passive extension may increase susceptibility to injury during hyperextension.<sup>10</sup> It has been suggested that the bipennate lumbricals on either side of the ring finger FDP have a tethering effect on the tendon that also increases its susceptibility to injury.<sup>14</sup> This may be combined with the fact that the ring finger FDP tendon shares a common muscle belly with the middle and little fingers, giving the ring finger little independent range of movement.<sup>2-14</sup> A cadaveric study in 1978 found the insertion of the FDP tendon into bone was significantly weaker for the ring finger than for the middle finger.<sup>22</sup> These different theories suggest that the susceptibility of the ring finger to a jersey finger injury is probably multifactorial.<sup>13</sup>

## 4. How are these injuries classified?

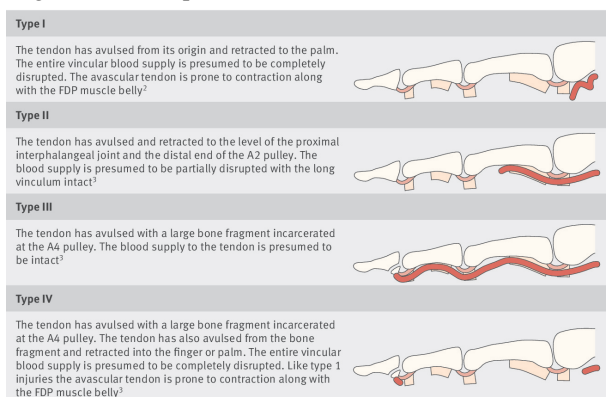
### Short answer

The extent of tendon retraction proximally and the type of tendon avulsion. Tendon avulsion can affect the soft tissue only or a bone fragment as well.

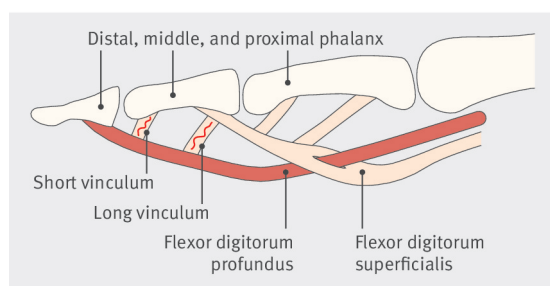
## Discussion

Leddy and Packer classified FDP tendon avulsion injuries on the basis of the extent of proximal retraction of the tendon and

the type of tendon avulsion (tendon only, tendon with a small bone fragment, tendon with a large bone intra-articular fragment; fig 4).<sup>2 10</sup> The tendon can retract completely into the palm or become caught in the pulley systems along the finger.<sup>2 10</sup> The further the tendon retracts the greater the likelihood of damage to the blood supply owing to rupture of the vincular system, which carries the blood vessels that supply the tendon (fig 5).<sup>2</sup> The Leddy and Packer classification system was modified by Smith in 1981 with the addition of a type IV injury (fig 4). The type IV injury is a rare combination of bone fragment avulsion from the distal phalanx and tendon avulsion from the bone fragment into the palm.<sup>10 23</sup>



**Fig 4** Classification of FDP (flexor digitorum profundus) tendon avulsion injuries



**Fig 5** Diagram of blood supply to the flexor digitorum profundus tendon through the vincular system

5.

## How are these injuries managed?

### Short answer

Most are treated surgically. Early intervention (by 7-10 days) is essential when the tendon is retracted as far as the palm. Delay can lead to FDP contraction and scarring of the pulley system, making primary repair impossible. Tendon avulsions require primary tendon to bone repair. Bone fragments can be fixed with small fragment screws.

### Discussion

Prompt diagnosis and surgical repair of FDP avulsions is preferable in all types of FDP avulsion to facilitate optimal return of function of the DIPJ.<sup>3</sup> GPs therefore need a high index of suspicion when patients present with a loss of active flexion at the DIPJ and should refer these patients directly to the local on-call orthopaedic registrar for further assessment.

Non-operative management is rare and is reserved for cases where surgery is contraindicated because of patient comorbidities. In occasional cases that present late, surgery is

thought to offer little benefit and non-operative management is preferred.

In type I injury the tendon has retracted into the palm, and it is presumed to be avascular and vulnerable to contraction.<sup>2</sup> Early intervention (by 7-10 days) with primary repair will achieve the best outcomes. Beyond this time primary repair can be attempted but is likely to become increasingly difficult and may not be possible.<sup>2</sup> In these cases other surgical options are available, as discussed below.

For repair of type I injuries two incisions are made. The first, a Bruner-type or midlateral incision, is made over the FDP tendon insertion site. The second incision is made over the A1 pulley or proximal to this to retrieve the tendon.<sup>2</sup> Once the retracted tendon is identified it can be passed back through the finger pulley using various aids—for example, a paediatric feeding tube.<sup>2</sup> Several primary repair techniques have been described to reattach the avulsed FDP end to the distal phalanx. Bunnell described a repair using a distal pull-through suture tied over a dorsal nail plate button.<sup>24</sup> The suture is usually removed after 8-10 weeks. Although this technique is widely used, potential complications include infection, nail deformities, and failure due to the reliance on early healing of the tendon to the bone.<sup>2</sup> With the development of techniques to fix the tendon directly to the bone, the tendon can be repaired using internalised components. Outcomes of the use of Mitek suture anchors and a transverse intraosseous loop technique (TILT) have been reported to be good when undertaken promptly after injury.<sup>25 26</sup> Hand therapy is key to a good outcome, with early active mobilisation in a dorsal hood splint being widely used after all surgical options.

In Type II injuries the tendon is maintained within the sheath by an intact long vinculum.<sup>2</sup> With presumed partial preservation of the blood supply contraction of the tendon is less likely. Repair is recommended within three weeks.<sup>27</sup> Repair techniques are similar to those used for type 1 injuries.

Type III injuries have a large bone fragment incarcerated in the A4 pulley. Because there is little tendon retraction, primary surgical repair can be performed up to six weeks after the injury,<sup>2</sup> although early intervention is preferable to avoid stiffness of the DIPJ. Treatment depends on the fragment size. Small fragment screws can be used to reduce larger intra-articular fragments. Transosseous sutures can also be used. Very small or extra-articular bone fragments can be excised without shortening the tendon, allowing the use of tendon to bone repair techniques (discussed above).

Type IV injuries require a combination of techniques used for type I-III injuries. Again, treatment depends on the size and the intra-articular nature of the bone fragment. As in type 1 injuries, prompt tendon repair is required (by 7-10 days).

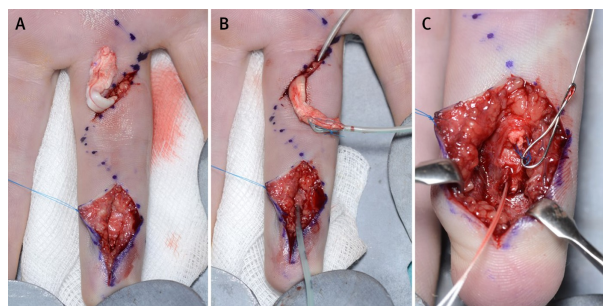
The hand should be splinted in a dorsal blocking hood postoperatively and hand therapy is key to a good outcome. Although variations occur, the hood prevents extension of the wrist and of the MCPJs beyond 70° flexion; it extends over the top of all the fingers and includes the whole hand. Active mobilisation should start 3-5 days postoperatively with passive and active range of movement based on the local protocol.<sup>28</sup> Return to full activities, including sports that involve grasping, is normally possible by 12 weeks after surgery.<sup>26</sup> Mid-substance tendon injuries occasionally have enough intact and healthy tendon to be repaired directly end-to-end using the usual core suture techniques.<sup>2 3</sup>

It is not uncommon for patients to present late or for diagnosis to be delayed. Patients presenting beyond the time recommended to achieve satisfactory repair are managed according to the

patient's demands and symptoms. Primary repair should be attempted despite delays to surgery but with types I, II, or IV the pulley system scars down such that primary tendon reattachment may not be possible. In such cases reconstruction options include two stage tendon grafting or arthrodesis of the DIPJ.

## Patient outcome

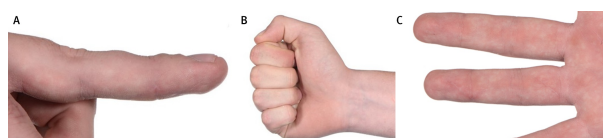
No abnormality was seen on radiography and our patient was diagnosed as having a type II FDP tendon avulsion. At the time of surgery, five days after the injury, the tendon was found to be retracted to the distal end of the A2 pulley. The tendon was reattached to the distal phalanx with two micro bone anchors (fig 6). He was rehabilitated according to the local protocol of six weeks in a dorsal hood under the care of the hand therapists (fig 7). He went on to make a full and uneventful recovery (fig 8).



**Fig 6** Intraoperative pictures. (A) Empty tendon sheath at the site of FDP (flexor digitorum profundus) insertion. Avulsed FDP retrieved distal to the A2 pulley; note the haematoma on the tendon as a result of vinculum avulsion. (B) The FDP tendon end is passed up the pulley system with the aid of a paediatric feeding catheter. (C) The tendon end is now distal to the A5 pulley. The blue prolene suture is in the distal end of the tendon and the white suture is from the Mitek anchor fixed to the distal phalanx



**Fig 7** Hand in dorsal hood for flexor tendon rehabilitation, which involves early active mobilisation under the supervision of a hand therapist. (A) Lateral view of the dorsal hood showing the block to full extension. (B) Anterior view of dorsal hood



**Fig 8** Clinical result three months after the operation showing a full active range of movement in extension (A, C) and flexion (B) and mature scar on the ring finger (C)

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Patient consent obtained.

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