Clinical case

Rupture of flexor tendon following volar plate of distal radius fracture. Report of five cases

Rupture de tendons fléchisseurs dans les suites d'une ostéosynthèse du radius distal par plaque palmaire. À propos de cinq cas

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Abstract

We report three cases of complete rupture of the flexor pollicis longus (FPL) tendon, one case of complete rupture of the index and middle finger flexor digitorum profundus tendons and one case of rupture of the flexor digitorum profundus tendon to the index finger after placement of a volar plate for distal radius fracture. We review the literature and discuss the aetiology of tendon ruptures and techniques to prevent tendon attition.

Keywords: Flexor tendon rupture; Radius fracture; Low profile plate

Résumé

Nous rapportons trois cas de rupture complète du long fléchisseur du pouce, un cas de rupture complète du fléchisseur profond de l'index et du médius et un cas de rupture complète du fléchisseur profond de l'index, survenues dans un délai variable après la mise en place d'une plaque d'ostéosynthèse palmaire pour le traitement des fractures de l'extrémité inférieur du radius. L'objectif de ce travail était après une revue exhaustive de la littérature, de discuter les étiologies de ces ruptures et d'appréhender les détails techniques pour prévenir la survenue de ces complications.

Mots clés : Rupture tendon fléchisseur ; Fracture radius ; Plaque d'ostéosynthèse

1. Introduction

Flexor tendon rupture is an extremely rare complication of distal radius fracture. Placement of a volar plate to reduce a distal radial fracture is a known cause of flexor tendon rupture, and there have been several case reports in the literature [1 – 6].

We describe three complete ruptures of the flexor pollicis longus (FPL) tendon, one complete rupture of the index and middle finger flexor digitorum profundus (FDP) tendons and one case of rupture of the FDP tendon to the index finger caused by attrition from a volar plate or screws. The aim of this paper was to report aetiologies of flexor tendon rupture and to discuss technical points to prevent these complications.

2. Case reports

Case 1

A 62-year-old, right-handed man sustained bilateral, comminuted, intra-articular fractures of both distal radii after a fall from five metres. He underwent open reduction and internal fixation of the right radius with a volar plate at another hospital. On the left side, he was treated with percutaneous

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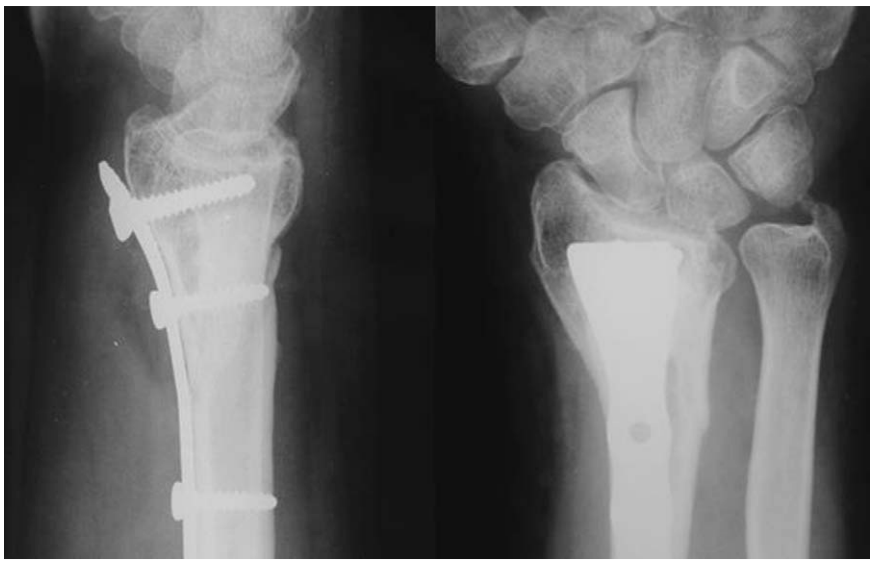

Fig. 1. Case 1: anterior-posterior and lateral radiograph of the wrist showing prominence of the distal edge of the plate. This volar concave design must be placed more proximally to avoid attrition lesion of the flexor tendon.

Kirschner wires. He had regular hand therapy after surgery. When the patient was first seen at our clinic, 9 months after the trauma, he could not flex the interphalangeal (IP) joint of the right thumb. All other flexor tendons were clinically intact and there was no sensory deficit. No anterior interosseous nerve palsy was evident. The radiographs confirmed union of the distal radius and there was no change in the position of the plate (Fig. 1). At surgical exploration, we found a complete rupture of the FPL tendon; the FDP tendons to the index and middle fingers were also frayed but not completely ruptured. The plate was removed and the FPL tendon repaired with a 3 cm tendon graft, harvested from palmaris longus. The other involved tendons were simply sutured. The patient began mobilisation of the thumb IP joint immediately after the operation. At the last follow-up, 10 months after the operation, the patient reported good function, with 70º of active IP joint flexion and 60º of active metacarpophalangeal (MCP) joint flexion in the thumb. The index finger demonstrated 90º active flexion at the MCP joint; 90º at the proximal interphalangeal (PIP) joint but no active flexion at the distal interphalangeal (DIP) joint. The middle finger showed 90º active flexion at the MCP joint, 90º at the PIP joint and 70º at the DIP joint. All digits had full active extension. The grip strength was 30 kg on the right and 20 kg on the left. Pinch strength was 10 kg on the right and 15 kg on the left.

Case 2

A 42-year-old, right-handed man sustained an anterior marginal fracture of the right radius. He underwent open reduction and internal fixation with a volar plate at another hospital. After surgery, he had regular hand therapy. After 6 months, he discovered that he was unable to flex the IP joint of the thumb. Clinical examination was otherwise normal. At exploration, we found a complete rupture of the FPL tendon and, as in the first case, the FDP tendons to the index, middle and ring fingers were frayed but not completely ruptured. The plate was removed and the FPL tendon repaired with a 3 cm tendon graft from palmaris longus (Fig. 2). The patient began mobilisation of the thumb IP joint immediately after surgery. At the last follow-up, 1 year after the operation, he reported good function, with active thumb IP joint movement from 30º to 90º

Fig. 2. Case 2: intraoperative picture showing: A. Complete rupture of FPL, the tendon gap is replaced by a fibrosis. B. FPL reconstruction with a Palmaris longus graft suturing by Pulvertaf technique.

flexion and 40º of MCP joint flexion (with full extension). He lacked full thumb IP joint extension when the MP joint was fully extended because the tendon graft was short. Opposition was good. He had full active movement of all the other digits. Grip strength was 39 kg on both sides; pinch strength was 18 kg bilaterally.

Case 3

An 82-year-old woman sustained an extra-articular fracture of the right distal radius. She underwent open reduction and internal fixation with a volar plate at another hospital. Three years later, she found she was unable to flex her right index and middle fingers. At exploration, we found that one screw had migrated and had ruptured the FDS and FDP tendons of the index and middle fingers. The plate was removed, and the flexor tendons were repaired primarily. Three months after the operation, the patient reported full active movement of the index and middle finger.

Case 4

A 35-year-old woman sustained an extra-articular fracture of the right distal radius with marked displacement. She underwent open reduction and internal fixation with a volar plate at another hospital. Ten years later, the patient suddenly found she was unable to flex her right index finger. At exploration, we found a rupture of the index FDP tendon. The plate was removed, and the flexor tendon repaired, suturing it end to side to the FDP tendon of the middle finger. At the last follow-up, 1 year after the operation, the patient reported good function, with active index finger flexion of 90º at the MCP joint, 90º at the PIP joint and 30º at the DIP joint.

Case 5

A 60-year-old man sustained an extra-articular fracture of the left distal radius after an accident in 1998. He underwent open reduction and internal fixation with a volar plate at another hospital. His past medical history included long-term treatment with steroids following a kidney transplant 10 years before. When the patient was first seen at our clinic, 4 years after the trauma, he could not flex the IP joint of the right thumb and he mentioned that 2 years earlier, he had had an episode of temporary loss of strength of the thumb, which had subsequently partially recovered spontaneously. On clinical examination, all the other flexor tendons were intact and there was no sensory deficit. The radiographs confirmed union of the distal radius with no change in the position of the plate (Fig. 3). At exploration, we found that the head screws were prominent and the plate placed distally causing the rupture of the FPL tendon with a large gap. The FDP tendons to the index and middle fingers were also frayed but not completely ruptured. The plate was removed and given the patient's medical history, the FPL tendon was reconstructed with a simple tenodesis. The other involved tendons were sutured. After 15 months of follow-up, the hand strength and function showed no difference compared to the contralateral hand.

Fig. 3. Case 5: lateral radiograph of the wrist showing prominence of the head screws and the plate distal to watershed line.

3. Discussion

Closed rupture of the finger flexor tendons is rare, and the most common aetiology is tendon attrition. A number of causes of flexor tendon attrition have been described in the literature: Colles' fracture [7], malunion of distal radial fracture [8], arthrodesis of the MCP joint of the thumb [9], scaphoid non-union [10], Kienbock's disease [11], dislocation of the lunate [12,13], fracture of the hook of the hamate [14], attrition over an accessory carpal bone, and congenital abnormalities of the carpal bones such as bipartite capitates [15].

Flexor tendon rupture after internal fixation with a volar plate in distal radius fractures has been reported by several authors (Table 1). The cause of tendon rupture is related to the design of the plate, pre-exisiting weakness of the tendons [1], malposition of the implant [6], or prominent screw heads.

The placement of a distal volar plate increases the risk of damage to a flexor tendon, especially as the wrist extends [5]. A plate with a concave design (Fig. 4) increases the risk of tendon attrition if it is placed very distally because the distal edge of the plate will not be in direct contact with the bone (Fig. 1). The degree of volar concavity of the plate should be considered when assessing the ''ideal'' level of placement over the radius.

Table 1
Cases of flexor tendon rupture by volar osteosynthesis of radius fracture, reported in the literature and our cases.

Authors	Year	No. of cases	Age (average)	Sex (M/F)	Tendons	Delay to rupture (months)	Plate type
Fuller [4]	1973	2	47.5	1/1	FDP I FPL	33	Non locking volar plate
Bell et al. [1]	1998	4	66.5	0/4	FPL	7.2	Non locking volar Synthes T buttress plate
Nunley et Rowan [6]	1999	1	72	0/1	FPL	10	Dorsal plate
Cognet et al. [2]	2004	4	73	1/3	FPL FDP I FDS I	6	T plate, DCP plate and non locking volar plate concave design
Klug et al. [5]	2007	1	59	0/1	FPL	13	Titanium Synthes volar locking plate
Cross et Schmitd [3]	2008	2	54	0/2	FPL	7	Hand Innovation plate and Acumed plate
Valbuena et al.[a]	2008	5	54	3/2	FPL FDP I FDP M	43.8	Non locking volar plate and non locking volar plate concave design

FPL: flexor pollicis longus; FDP: flexor digitorum profundus tendon; FDS: flexor digitorum superficialis tendon; I: index finger; M: middle finger.
[a] Cases presented in this paper.

The correct localisation of the plate depends of the type of fracture, the design of the plate and the recommendation of the manufacturer.

The low-profile plates reduce the risk of tendon injury. Nevertheless, Cross and Schmith [3] reported flexor tendon ruptures with a locked, low-profile volar plate due to placement anterior to the volar distal radial rim and distal to transversal ridge of the volar radius (watershed line). The watershed line is a theoretical line marking the most volar aspect of the volar margin of the radius, which is distal to the distal limit of the pronator fossa. Orbay and Touhami [16] stressed its importance as a surgical landmark for correct placement of a volar plate. Volar plate placement distal to the watershed line risks damage to the flexor tendons.

In three of the cases which we report, the FPL tendon ruptured over the prominent distal edge of the plate after an average 63 months (range 6 – 48 months), and the FDP tendons to the index and middle fingers were found to be frayed but not ruptured.

Fig. 4. Volar plate concave design.

In another case, we found ruptures of the FDP tendons to the index and middle fingers after 36 months due to attrition of the tendon over a screw used to fix a volar plate. Finally, we found a rupture of an index finger FDP tendon 10 years after plate fixation of the distal radius. All patients were treated primarily in other institutions, low profile plates were not used, and the pronator quadratus muscle was not used to protect the tendons.

There are many potential methods available to repair these lesions including tendon grafts, end to side repair and tendon transfers. We treated two cases with tendon graft harvested from palmaris longus. After a period of rehabilitation, we obtained good active finger flexion and good functional recovery. In the third case, we performed a simple direct repair as we felt the patient's age meant that rehabilitation was likely to be slow following more complex surgery. Similarly in the fourth case, we performed an end to side repair. If a tendon graft or repair is not possible, tenodesis is a useful technique, as we used in our last case.

To prevent tendon impingement, the use of low profile implants has been recommended, placing the implant proximally and completely covering it with a pronator quadratus muscle flap [16].

A new system of bio-absorbable plates and screws should be an excellent alternative to avoid tendon attrition.

We recommend early removal of volar plate when the distal edge is prominent, if the plate is placed distal to watershed line or if it becomes so as a result of collapse of the fracture. Chronic steroid medication represent also an indication for early plate removal. Ruptured tendons can be repaired with good results by grafting or end to side repair, as demonstrated in this report.

4. Conflicts of interest

The authors declare that they have no conflicts of interest.

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