Volar Locking Plate Fixation of Distal Radius Fracture with a Flexor Carpi Radialis Brevis and a Hypoplastic Pronator Quadratus

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Learning Point of the Article:

A flexor carpi radialis brevis (FCRB) appears in several percent of patients with distal radius fracture treated surgically. The patient with an FCRB may have a hypoplastic pronator quadratus (PQ). It makes the covering of the volar locking plate by the PQ difficult.

Abstract

Introduction: Recently, distal radius fracture (DRF) has been treated with internal fixation using volar locking plates and several reports describing patients with a flexor carpi radialis brevis (FCRB) appeared. However, no studies have so far investigated the location of the FCRB relative to the volar locking plate.

Case Report: We herein report three cases of DRF with an FCRB. Two patients had a bilateral FCRB, and an FCRB was detected in 5 of 174 limbs (2.9%). In all cases, the FCRB had a muscle belly and was retracted to the radial side and volar plate fixation was performed without difficulty. The pronator quadratus (PQ) under the FCRB was thin. In one case, the PQ was hypoplastic and restoration was impossible. The distance from the plate to the FCRB and that from the plate to the flexor pollicis longus (FPL) tendon were examined postoperatively using ultrasound. In the case in which the PQ could not be restored, the FPL tendon was located close to the plate and the FCRB was in contact with the plate.

Conclusion: As volar locking plate fixation of a DRF with an FCRB and a hypoplastic PQ may cause the restoration of the PQ impossible, the operation should be performed more carefully and follow-up is necessary to avoid post-operative FPL tendon injury and FCRB tendinopathy due to friction with the plate.

Keywords: Flexor carpi radialis brevis, distal radius fracture, ultrasound, hypoplastic pronator quadratus.

Introduction

Recently, distal radius fracture (DRF) has been treated with internal fixation using a volar locking plate. The opportunities to expand the volar side of the forearm are increasing, and several reports about flexor carpi radialis brevis (FCRB) have appeared. These reports often describe the pronator quadratus (PQ) as hypoplastic[1, 2, 3]. However, there are few reports on the covering condition of the plate, and there have been no reports on ultrasound examination after volar locking plate fixation of DRF in patients with an FCRB. We herein report three cases of DRF in patients with an FCRB; operation views and ultrasound findings.

Case Report

Between 2011 and 2017, 168 patients (171 limbs) with DRF were surgically treated. Three of these patients were found to have an FCRB. They had no previous problems with their affected wrist. The operation was performed with a trans-flexor carpi radialis (FCR) approach. The fracture was reduced, and volar plate fixation was performed. We investigated the following points: (1)The operation views and(2) the post-operative ultrasound examination of the distal radius, the shortest distance from the plate to the dorsal border of the FCRB, and the shortest distance from the plate to the dorsal

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Author's Photo Gallery


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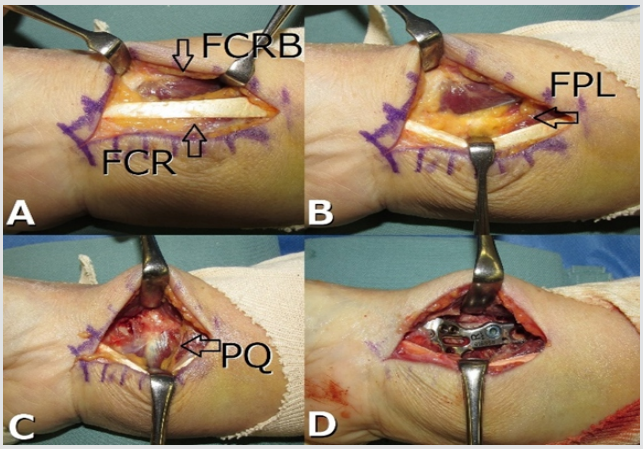

Figure 1: The surgical findings in Case 3(a, b): The trans-flexor carpi radialis(FCR) approach. The flexor carpi radialis brevis (FCRB) lay radial to the FCR and flexor pollicis longus. The FCRB had a muscle belly. (c): The FCRB was retracted radially and the hypoplastic pronator quadratus was exposed.

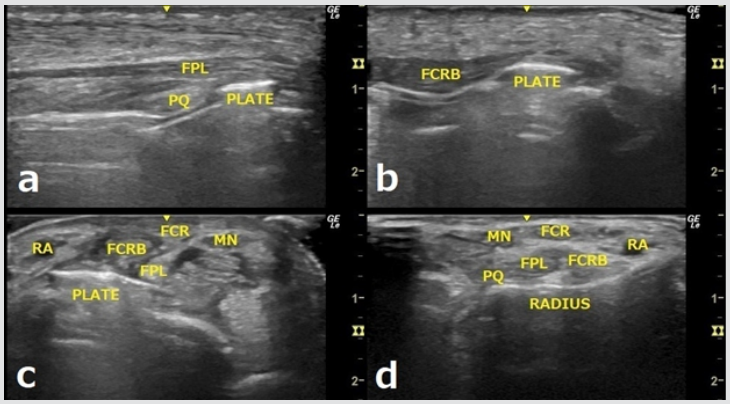

Figure 2: Case3 ultrasound 3months after surgery.(a,b): Longitudinal view of the right forearm after internal fixation. The shortest distance from the plate to the flexor pollicis longus was 0.05 mm, and the flexor carpi radialis brevis (FCRB) was in contact with the plate. (c):Axial view of the right forearm after internal fixation. The FCRB muscle belly was above the plate. The pronator quadratus (PQ) was unclear. (d): Axial view of the left forearm (unaffected side). An FCRB was observed. The PQ under the FCRB was unclear.

border of the flexor pollicis longus (FPL) tendon. In the ultrasound examination, we used an L4-12r-RS6 system (GE Healthcare, Japan); the examination was performed with the patient in supine position, with their forearm supinated, and their wrist and fingers in a neutral position.

Results

The results of the examinations are shown in Table 1. In all cases, the operation was performed with a trans-FCR approach (Fig.1). The FCR sheath was released and the FCR tendon was retracted to the ulnar side and the gliding floor was cut open. This would usually reveal the FPL and PQ. However, in these cases, an anomalous muscle belly appeared which was thought to be an FCRB. The FCRB had a tendon portion and a muscle belly, running radiodorsal from the FCR, radial from the FPL, and volar from the PQ. The PQ was thin under the FCRB, and in Case 3, the PQ was hypoplastic. The FCRB was retracted to the radial side and the PQ was cut at the center of the radius. Volar plate fixation was performed as planned without difficulty. In Cases 1 and 2, the PQ and the intermediate fibrous zone (IFZ) were restored and the floor of the FPL was reconstructed. However, in Case 3, the PQ was hypoplastic and restoration was impossible. At 3months after operation, the FPL tendon was close to the plate (0.05 mm) and the FCRB was observed to be in contact with the plate on ultrasound (Fig.2). In Cases 1 and 3, an FCRB was also observed on the unaffected side on ultrasound. As the FPL was likely to rupture in Case 3, removal of the plate was performed at 9months after operation although there was no pain or no crepitation. The floor of the FPL tendon had been covered by membranous tissue, and the FPL tendon was not injured. The plate was removed easily. The FCRB looked intact, but the part of the FCRB in contact with the plate looked degenerative and excised to examine histologically. Histologic examination showed tendon and striated muscle with degeneration (fibrosis) and atrophic change.

Discussion

In this report, FCRB was observed in 2.9% of 174 limbs (5/174 limbs, 3/168 patients); this prevalence was similar to the previous reports (Table 2)[3, 4, 5, 6, 7, 8, 9, 10]. Cases 1 and 3 had bilateral FCRBs, while Case 2 had a unilateral FCRB. In the first cadaveric study of the FCRB, which was reported by Fano, in 1851, the FCRB was described as a "radiocarpien"since then, there have been other reports based on cadaver studies [4, 5, 6]. The first reports on the FCRB in vivo appeared after 2000, while the first reports related to surgery for DRF in patients with an FCRB were published after 2010 [1, 3, 7, 8, 9, 11, 12]. The reported prevalence was 0.9–8.7% and cases were unilateral or

Table 1: Clinical details, findings, and outcomes

Case No.	Age/Sex	Side	Affected side	FCRB appearance	PQ appearance	Cover of plate end	Ultrasound	
							Plate to FPL (mm)	Plate to FCRB (mm)
1	72/F	Bilateral	Right	Muscle belly	Thin	Possible	0.63	0.89
2	67/F	Unilatera	Left	Muscle belly	Thin	Possible	0.94	0.45
3	77/F	Bilateral	Right	Muscle belly	Hypoplasia	Impossible	0.05	0

PQ: Pronator quadratus, FCRB: Flexor carpi radialis brevis, FPL: Flexor pollicis longus

Table 2: The prevalence of FCRB

Author	Year	Comment	Limbs	Number	Prevalence
Macallister[4]	1864	Cadaver	7/177		4.0%
Wood[4]	1867	Cadaver	8/106		7.5%
Le Double[4]	1897	Cadaver	7/170		4.1%
Inoue[5]	1934	Cadaver	2/100	2/50	2.0%
Shibata *et al*.[5]	1976	Cadaver	2/133	1/67	1.5%
Yoshida *et al*.[6]	1983	Cadaver	4/450	3/225	0.9%
Mantovani *et al*.[7]	2010	DRF	6/172		3.5%
Ho *et al*.[8]	2011	DRF	4/46		8.7%
Lee *et al*.[9]	2014	DRF	2/71		2.8%
Nagata *et al*.[3]	2016	DRF	5/123		4.1%
Mimura *et al*.[10]	2017	CTS	7/515	6/379	1.4%
Present report	2018	DRF	5/174	3/168	2.9%

DRF: Distal radius fracture, FCRB: Flexor carpi radialis brevis, CTS: Carpal tunnel syndrome

bilateral. In our three cases, the FCRB had a muscle belly. Traction of the FCRB caused no wrist motion and it may be useless to wrist flexion, as was noted by Ho and Yeo [8]. The PQ under the FCRB was thin, and in Case 3, it was hypoplastic. In the previous reports, an FCRB has muscle bellytype and tendon type, and a hypoplastic PQ with an FCRB has been reported, similarly to our Case 3 [1, 2, 3]. We examined the location of FCRB, FPL tendon, and plate after operation. In Case 3, the PQ could not be restored, the FPL tendon was close to the plate (0.05 mm) and the FCRB was in contact with the plate. To avoid flexor tendons injury, Orbay and Touhami advocated the restoration of the PQ and the IFZ [13]. However, there are few reports on the coverage of the volar locking plate by the PQ in a patient with an FCRB. Nagata et al. reported five cases in which the PQ could be restored after volar locking plate fixation [3]. In Cases 1 and 2, because the PQ– although thin –was repaired, friction between the FPL tendon or the FCRB and the plate would likely have been mild. However, in Case 3, the plate could not be covered by the hypoplastic PQ. Thus, the distance from the plate to the FPL tendon was very short (0.05 mm), and the FCRB was in contact with the plate. FPL tendon rupture might occur in the future. Thus, we removed the plate. On the other hand, the muscle belly-type FCRB was full of muscle belly and there was little gliding at the wrist; thus, the probability of a tear due to friction may be lower in comparison to the FPL. Smith and Kakar reported the ultrasound findings in a case in which a patient experienced an FCR tear and FCRB tendinopathy after lifting a heavy file at work [12]. Kordahi et al. reported the case of a patient with radial side wrist pain with a partial FCRB tear [14]. Nagata et al. histologically confirmed FCRB tenosynovitis, based on the examination of tissue specimens that were excised when they removed the plate of a patient with the left wrist pain when actively flexing [3]. However, these reported tendinopathies occurred in patients with a tendon-type FCRB. In cases involving a muscle belly-type FCRB, like our cases, the FCRB might occupy the palmar space of the radius and the PQ might be hypoplastic, as Dodds and Nagata et al. described [2, 3]; then, the restoration of the PQ might be impossible. In such cases, restoration of the PQ is more important to prevent friction between the FPL tendon and the plate. Suturing the hypoplastic PQ and the FCRB to avoid FPL tendon rupture may be valid; however, we did not employ this approach.

Conclusion

DRF patients with a muscle belly-type FCRB and a hypoplastic PQ should be carefully followed after internal fixation with a volar locking plate because the covering of the plate by the PQ might be impossible.

Clinical Message

The patient with an FCRB may have a hypoplastic PQ. When DRF with an FCRB was treated using volar locking plate, the covering of the plate by the PQ might be impossible. Covering the plate is important but difficult, follow-up is necessary to avoid the FPL rupture.

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