

A case of anomalous flexor carpi radialis brevis muscle and its clinical significance

Trowbridge S¹, Vidakovic H¹, Hammer N², Kieser DC³

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ABSTRACT

Aim: To present an atypical case of flexor carpi radialis brevis (FCRB) and its impact on minimally invasive procedures to the volar distal radius.

Methods: Minimally invasive volar plate fixation was performed on 16 standard embalmed cadaveric forearms in the University of Otago anatomy department. The forearms were then dissected to analyse the effect on the local anatomy and the position of the metalware.

Results: One case of a FCRB was identified, with an atypical split tendon and insertion into the transverse carpal ligament and base of the index and middle metacarpal. The surgical procedure caused radial muscle fibre tearing of the FCRB.

Conclusions: The FCRB is a rare anomalous muscle of the wrist. Its presence has a detrimental effect on minimally invasive procedures to the volar distal radius. Surgeons operating on the distal forearm should be aware of this anatomical variation to prevent inadvertent injury.

Key Words: Volar plate; Distal radius; Flexor carpi radialis brevis; FCRB; Tendon

INTRODUCTION

Flexor carpi radialis brevis (FCRB) is a rare anomalous muscle of the wrist. It was first described by this name in the mid-19th Century by John Wood, an anatomy demonstrator at King's College, London in a report on 'variations in human Myology' for the Royal Society (1). In the 21st Century its presence has been described mostly as a coincidental finding during cadaveric and operative dissection, and rarely as a symptomatic painful mass in the forearm (2-4).

FCRB has an estimated incidence of 2.6 - 7.5% (5). It originates from the volar-radial surface of the distal radius, distal to flexor pollicis longus (FPL) and proximal to the insertion of pronator quadratus (PQ). The insertion is typically the index or middle metacarpal base. However, significant variability has been described, including the ring metacarpal base, radial carpal bones, and palmar fascia (6). It is innervated by the anterior interosseous nerve (AIN) and its usual passage past the wrist is neighbouring the tendon of flexor carpi radialis (FCR), through its osteo-fibrous tunnel in the groove of the trapezium (5).

Previous case studies have encountered FCRB during a volar approach for fixation of the distal radius (5). Indeed, Yoon-Min and colleagues indicated the clinical importance of being aware of FCRB due to the trend towards volar plate fixation for distal radius fractures (5). However, there is a further trend towards minimally invasive, tissue preserving techniques through smaller incisions. These approaches are performed based on predicted anatomy and therefore anomalous structures are at risk, and assumed anatomical landmarks can be rendered unreliable.

Therefore, this report aims at describing a case of FCRB and its unique anatomical variation, and discussing its impact on minimally invasive volar plating of the distal radius.

METHODS

Ethics approval was attained from the University of Otago, Human Ethics Committee (H17/065). While alive, all donors gave their informed consent to the donation of their bodies for teaching and research purposes, and experiments were conducted in line with the declaration of Helsinki.

A cadaveric study on 16 New Zealand European upper limbs investigating a minimally invasive technique for volar plate fixation of the distal radius was performed. The procedure involved a 2 cm transverse volar-radial incision

centred over the flexor carpi radialis (FCR) tendon and based 4-5 cm proximal to the wrist crease. After the skin incision, the subcutaneous fat is bluntly dissected to expose the fascia encasing the FCR tendon. This fascia is longitudinally incised on the radial side of the FCR tendon. The FCR is then retracted toward the ulnar, while the bed of the FCR sheath is longitudinally incised. Flexor pollicis longus (FPL) is then identified and bluntly dissected along its radial border before being retracted toward the ulnar to expose the pronator quadratus (PQ). PQ is then incised in line with its fibres and submuscularly released from the underlying radius to allow passage of a volar plate, which is subsequently secured with screws.

After plate osteo-synthesis a volar dissection was performed in all samples to assess the quality of fixation and integrity of deep structures.

RESULTS

In one sample, the right upper limb of a 91 year-old male, an anomalous muscle was encountered dorso-radial to the FCR tendon at the level of the surgical approach (Figure 1).

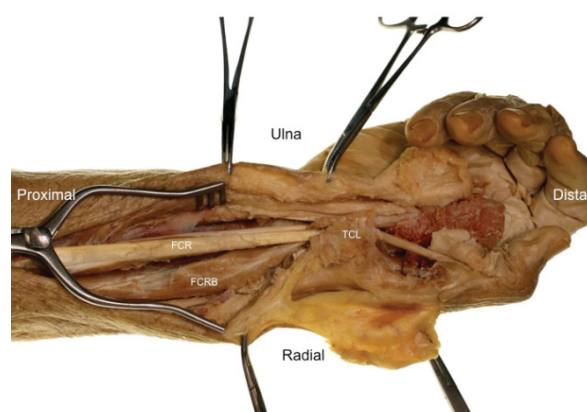


Figure 1) Representative photograph illustrating the position of the anomalous flexor carpi radialis brevis (FCRB) in relation to the flexor carpi radialis muscle (FCR). The transverse carpal ligament (TCL) is labelled and both tendons can be seen entering the FCR fibro-osseous tunnel

¹Department of Orthopaedic Surgery, Southern District Health Board, Invercargill, New Zealand; ²Department of Anatomy, University of Otago, Christchurch, New Zealand; ³Department of Orthopaedic Surgery and Musculoskeletal Medicine, University of Otago, Christchurch, New Zealand.

Correspondence: Dr. David Kieser, Department of Orthopaedic Surgery and Musculoskeletal Medicine, University of Otago, Canterbury District Health Board, 2 Riccarton Avenue, Christchurch 8011, New Zealand. Telephone: 0064 21 149 9829, Fax 0064 3 467 9709, e-mail: kieser david@gmail.com

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With complete dissection, a bipennate muscle with a short tendon originating from the volar surface of the radius, proximal to PQ, was identified. This muscle had a split tendon with a complex insertion into the base of the index and middle metacarpal, as well as a slip of tendon into the transverse carpal ligament (Figure 2).

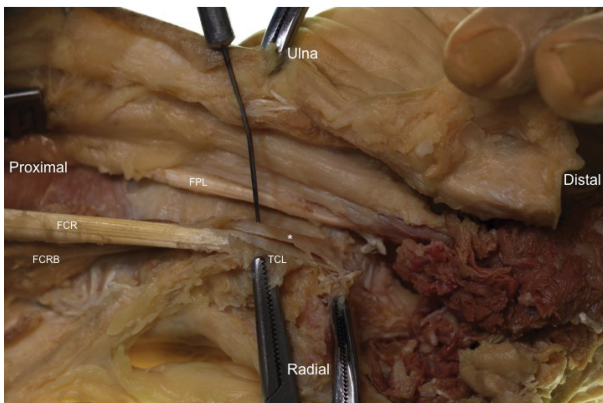


Figure 2 Photograph with the transverse carpal ligament (TCL) reflected to open the flexor carpi radialis (FCR) fibro-osseous tunnel. The flexor carpi radialis brevis (FCRB) tendon (*) is seen to run within this tunnel with its insertion identified as the TCL and the base of the index and middle metacarpal. The flexor pollicis longus (FPL) running through the carpal tunnel is labelled for orientation

Innervation was likely attained from a branch of the AIN that arose proximal and superficial to PQ and penetrated the deep surface of the muscle. Its vascular supply was not clear, but primarily arose from the radial artery and anterior interosseus artery. There were no other local anatomical abnormalities identified and the PQ was not underdeveloped.

In this case, the approach utilised for minimally invasive fixation led to damage to the radial border of this muscle with tearing of radial sided muscle fibres (Figure 3).

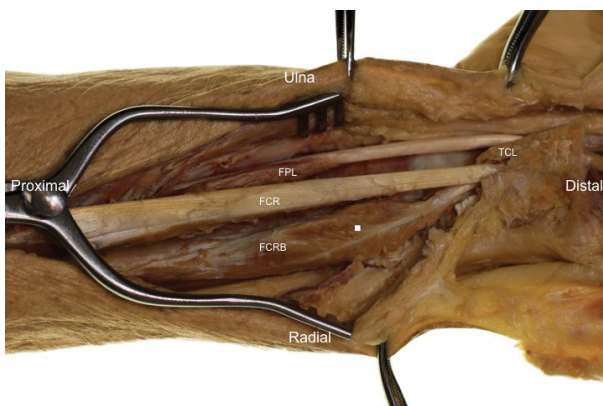


Figure 3 Representative photograph illustrating the muscular fibre damage (white square) of the flexor carpi radialis brevis (FCRB) muscle. The flexor carpi radialis (FCR), flexor pollicis longus (FPL) and transverse carpal ligament (TCL) are labelled for orientation

DISCUSSION

This case illustrates an anomalous muscle consistent with a flexor carpi radialis brevis (FCRB). Its origin, position, innervation and blood supply are consistent with previous reports on this muscle, but with an atypical, and previously undescribed split tendon inserting into the transverse carpal ligament and base of the index and middle metacarpal. There was no evidence of under development of PQ, which has commonly been described in previous studies (2).

Distal radius fractures are one of the most common fractures and are becoming an ever-increasing burden in aging populations due to increased falls and osteoporosis (7,8). These injuries can be treated by manipulation and casting, external fixation, k-wiring or plate fixation (8). Volar plating offers the greatest biomechanical advantage to most distal radius fractures and is therefore commonly performed (8-10). However, this involves a large incision, with significant soft tissue mobilisation and PQ elevation (11). Thus minimally invasive techniques to perform this procedure have been advocated (11-13).

This case has highlighted the translational importance of this anatomical variation and illustrated that the presence of a FCRB can have a detrimental effect on minimally invasive surgery of the volar distal radius. Surgeons should therefore be aware of this anatomical variation to prevent injury during the surgical procedure. If visualisation is limited, we would advocate extension of the incision to aid exposure. However, surgeons should recognise this anomalous muscle because the deep landmarks, particularly the identification of flexor pollicis longus (FPL), will be obscured.

Some FCRB muscles have been reported to present as painful forearm masses, however, most remain asymptomatic and incidentally identified (14-15). Although the clinical signs of a FCRB are not described, previous authors have serendipitously identified this anatomical variation intra-operatively and successfully utilized it during base of thumb reconstruction for first carpo-metacarpal osteoarthritis rather than using the FCR tendon (16). It has also been recognised on ultra-sound and MRI imaging as a normal appearing small muscle arising from the radius and inserting into the trapezium or base of index and middle metacarpals (14-18). However, its relative rarity¹, (16) and the lack of higher-level evidence to support its use in hand and wrist reconstruction surgery, we feel negates routine cross-sectional imaging for pre-operative planning.

This study is limited to a single case in a cadaveric study. We would support the intra-operative difficulties in living tissue being described as standard embalmed cadaveric tissue offers limited soft tissue pliability. Unfortunately the contra-lateral limb was not available for this study and therefore we were unable to determine if this was a symmetrical finding. Further research is also required to render the true incidence of FCRB and its bilaterality in patients. In addition, the ethnic variances are unknown and therefore warrant further investigation.

CONCLUSION

The FCRB is a rare anomalous muscle of the wrist. Its presence has a detrimental effect on minimally invasive procedures to the volar distal radius. Surgeons operating on the distal forearm should be aware of this anatomical variation to prevent inadvertent injury.

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