

# Aberrant tendinous variation of the pronator quadratus muscle: A case report

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## SUMMARY

A 46-year-old right-hand dominant female underwent a distal radius corrective osteotomy for fracture malunion. A standard flexor carpi radialis incision to the volar wrist was used. In the deep dissection, the fibers were oriented in a transverse fashion consistent with the typical appearance of pronator quadratus (PQ) fibers. However, the muscle belly of the PQ was not visualized. After further dissection, we concluded that this tendinous structure was an aberrant anatomic variation of the PQ muscle. Although anatomical variation of other tendons and muscles of the forearm, hand and wrist are common, this is the first case report describing an aberrant tendinous pronator quadratus. Although aberrant tendons are usually not pathological, these variations may contribute to specific medical conditions. Many forearm tendons are commonly used as donor tendons for reconstructive surgeries in the hand, wrist and fingers. Knowledge of anomalous tendons of the hand and forearm is clinically relevant and may prevent uncertainty on the surgical approach.

**Key words:** Aberrant tissue – Forearm – Anatomy and histology – Surgery – Distal radius fracture

## INTRODUCTION

The pronator quadratus (PQ) is crucial for forearm and hand movement. It is a small, square-shaped, deep anterior compartment forearm muscle that assists the pronator teres in forearm pronation. It originates from the anterior distal ulna and inserts on the anterior shaft of the radius. The pronator quadratus is known to have two heads, the superficial and the deep (Choung et al., 2016; Johnson and Shrewsbury, 1976). While the superficial head is the forearm pronator, the deep head acts as a stabilizer of the distal radio-ulnar joint (Choung et al., 2016; Johnson and Shrewsbury, 1976). Surgically, the PQ is commonly encountered when repairing distal radius fractures, as accessing these areas first requires elevation of the PQ. Anatomical variations of muscles and tendons in the flexor and extensor compartments of the hand and wrist are common and often en-

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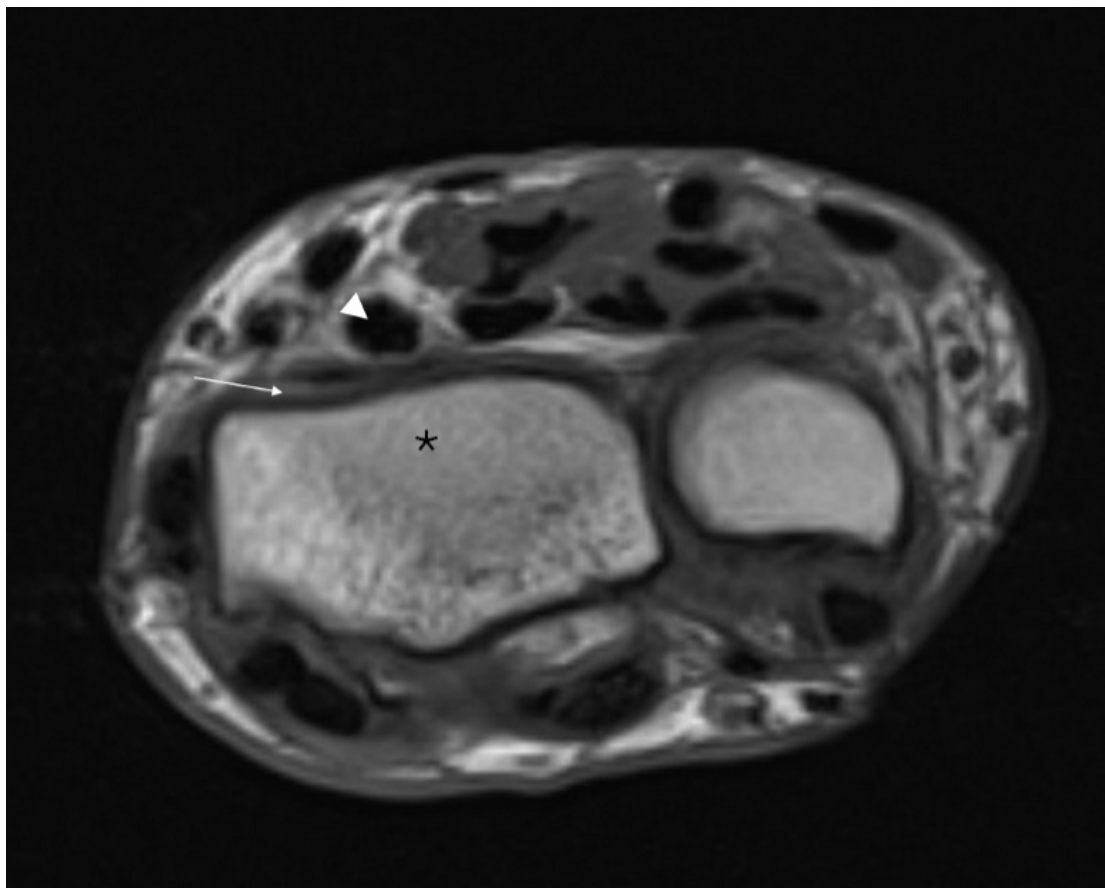
countered during elective surgical dissection. These anatomical variations range from accessory muscles to variant muscle bellies, tendon insertions, intratendinous fibrous bands, or tendon slips (Straus, 1941; Vanhoenacker et al., 2018).

Previously, Jadhav et al. proposed a classification system for anatomical variations in PQ, based on the number of heads present (single, double or triple) (Jadhav et al., 2014). Double head PQ specimens are the most common, and nine subtypes have been described based on the types of heads (superficial and deep), their shapes, and their primary points of attachment. In their study of sixty forearm cadavers, only one aberrant tendinous PQ was reported, in which the distally superficial head had a tendinous insertion on the radius and proximally, its deep head had additional attachment on the radius (Jadhav et al., 2014). In this report, we discuss an abnormality of the pronator quadratus muscle at the distal radius encountered during a volar approach to the wrist for a corrective osteotomy.

## CASE REPORT

A 46-year-old right-hand dominant female presented with a right intraarticular distal radius fracture with dorsal angulation after a fall. Otherwise, the patient was relatively healthy. She had no previous injury to her right upper extremity, and no known family history of any bone, soft tissue, or connective tissue disorders.

She was initially treated conservatively with cast immobilization for six weeks. The fracture went on to healing with a dorsal angulation. Wrist pain following the fracture persisted despite attempted treatment with brace immobilization and corticosteroid injection to the carpal tunnel. Other than the pain, the wrist was functional with normal range of motion and strength. Median nerve symptoms were not recorded after the fracture. Magnetic resonance imaging (MRI) seven months post-injury showed healing distal radius fracture with minimal residual edema at the fracture line and persistent dorsal angulation. Upon retrospective



**Fig. 1.-** Axial T1 MRI image of the patient's wrist, demonstrating the aberrant thin tendinous pronator quadratus, rather than the usual robust muscle mass (white arrow) lodged between the distal radius (black asterisk) and deep flexors (white arrowhead).

review of the MRI, it was evident that the pronator quadratus was a thin sliver of tendon between the deep flexors and distal radius, rather than the characteristic muscle mass (Fig. 1). At 17 months post injury, the patient was still symptomatic, and dorsal angulation of the distal radius measured 24 degrees. Given her ongoing pain, the patient was elected to proceed with a distal radius corrective osteotomy with iliac crest bone grafting.

A standard flexor carpi radialis (FCR) incision to the volar wrist was used. The sheath over the FCR tendon was incised and the tendon was retracted ulnarly. The floor of the FCR tendon sheath was sharply incised and the muscle belly of flexor pollicis longus (FPL) was bluntly dissected. Deep to FPL, a tendinous structure was identified that traversed between the anteromedial borders of the distal ulna and radius. The fibers were oriented in a transverse fashion consistent with the typical appearance of PQ fibers. However, the muscle belly of the PQ was not visualized (Figs. 2, 3).

After further dissection and elevation of the tendinous structure off the radius, the muscle belly of the PQ was still not appreciated. Given the fibers of the structure originated on the anterior distal ulna and inserted on the anterior shaft of the radius, we concluded that this tendinous structure was an aberrant anatomical variation of the PQ muscle.

With regards to the patient's overall prognosis, her post-operative radiographs showed resolution of the previous apex volar angulation with placement of the volar surgical plate with bone graft material packing. At the five months post-operative follow-up, her range of wrist motion was functional, with extension to 50 degrees and flexion to 60 degrees, and full pro-supination. She unfortunately had some ongoing wrist discomfort post-operatively and difficulty with thumb extension suspicious for extensor pollicis longus (EPL) rupture. This necessitated surgical exploration and tenosynovectomy of the 3rd and



**Fig. 2.-** Aberrant tendinous pronator quadratus.

4th extensor compartments. The EPL was found to be intact but scarred due to the proximity to the osteotomy site. Prominent bone spur resection and EPL tenolysis were performed along with posterior interosseous nerve (PIN) neurectomy. Her ongoing wrist pain and thumb mobility issues subsequently resolved.

## COMMENTS

To our knowledge, this is the first case report to describe an aberrant tendinous pronator quadratus. The tendinous structure was encountered during a standard volar “modified Henry” approach to the wrist. While a differential diagnosis of this structure may include a disused atrophic PQ, our impression is that the described structure was tendinous rather than diseased muscle. Clinically, an atrophic PQ muscle would not have been a surprising finding in this patient given the proximity to her radial fracture, which reasonably

could have caused associated soft tissue injury in surrounding ligaments, tendons and muscles. However, while an atrophic PQ muscle would appear decreased in size and mass, it would retain its muscular characteristics such as fleshy colour and consistency due to myoglobin storage within muscle cells. The structure visualized was whitish in colour, with a fibrous appearance suggestive of primarily collagen composition. Additionally, the patient had no predisposing factors or clinical exam findings to suggest post-injury muscle atrophy. For these reasons, we concluded the structure is of tendinous origin.

Anatomical variation of tendons and muscles of the forearm, hand and wrist are common. The palmaris longus tendon is absent or very small in 15-20 percent of the population. Supernumerary tendons such as accessory abductor digit minimi, which has an estimated prevalence up to 47 percent, or extensor carpi radialis intermedius which

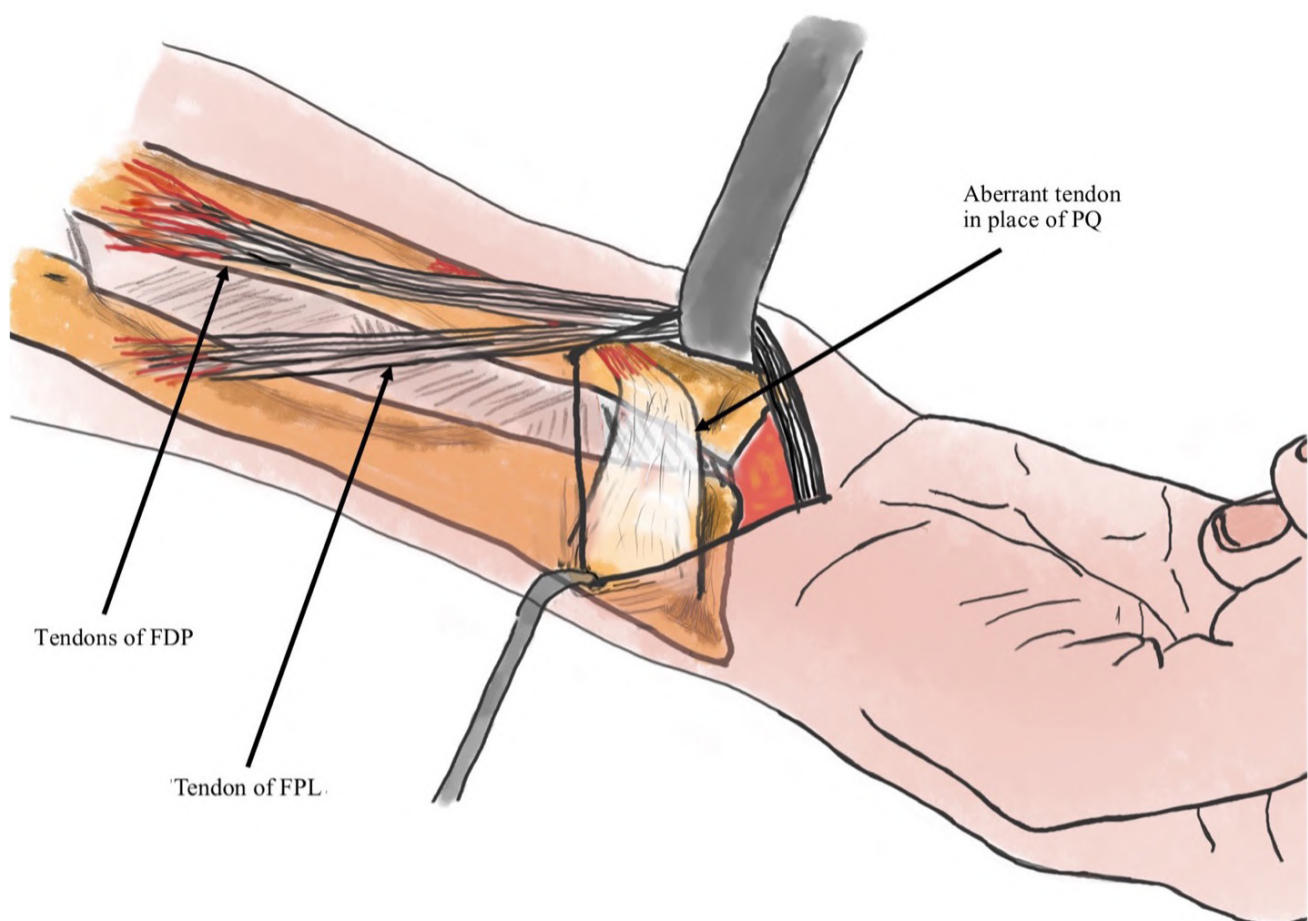


Fig. 3.- Schematic of aberrant tendon found intraoperatively in place of pronator quadratus (PQ).

has an estimated prevalence of 12 percent, have also been described (Wood, 1988; Vanhoenacker et al., 2018). Other previously reported aberrations of the distal upper extremity have included anomalous flexor digitorum superficialis of the second digit, anomalous palmaris profundus, extensor digitorum brevis manus, accessory extensor carpi radialis, and extensor pollicis longus accessories (Coskey et al., 2023).

Although aberrant tendons are usually not pathological, these variations may contribute to specific medical conditions. With regards to the PQ, anatomical variations of the deep and superficial head have been previously identified (Stuart, 1996). Most recently, Mochizuki et al. (2013) described an abnormality in orientation of the muscle heads, whereby the deep head of PQ coursed to the dorsal surface of the ulna in an abnormal configuration. The aberrant course resulted in restrictive rotational range of motion of the forearm. In our patient, there was no evidence of restricted range of motion at the wrist. Her chronic localized wrist pain did not significantly improve after her distal radius osteotomy and elevation of the tendinous PQ structure. Thankfully, her symptoms did ultimately improve after subsequent tenosynovectomy of the extensor compartment and neurectomy of the PIN. Therefore, it is unclear whether or not the patient's aberrant PQ anatomy could have been contributing to her wrist pain, although it seems unlikely.

In conclusion, we believe to have identified an aberrant tendinous variation of the pronator quadratus muscle. Awareness of tendon and muscle variations of the hand and wrist is pertinent when assessing and surgically managing the diseased limb. Some of these anatomical aberrations are common and known to hand surgeons while other aberrations are rare. When variability is present within the tendon or muscle morphology, it is essential to further delineate the anatomical course intraoperatively and identify the anatomical variation. This can help adapt surgical strategy appropriately and prevent damage to vital structures.

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