SHORT REPORT

Eur J Anat, 12 (1): 123-125 (2008)

Anomalous pronator quadratus muscle: a case report

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SUMMARY

The pronator quadratus (PQ) muscle is one of the deeper muscle of the front of the forearm which originates from the oblique ridge in the lower part of the anterior surface of the shaft of the ulna and its adjoining medial area. The muscle inserts into the lower part of the anterior surface of the radius. In the present study, we observed an anomalous PQ muscles on both sides of a 52- year- old male cadaver during routine dissection. The muscle had dual origin from the ulna as well from the radius, and the two different bands of muscles had different directions of fibres in the downwards direction. Anomalies pertaining to the PQ muscle are not well documented in standard anatomy textbooks and the only source of information regarding its variations are found in research reports. The dual origin of the PQ as observed in the present study may be important from an anthropological point of view. Anatomical knowledge of the variations of the PQ may be beneficial for hand surgeons.

Key words: Pronator quadratus – Muscle variation – Anomaly –Transplant

INTRODUCTION

The PQ muscle is a deeper muscle of the anterior compartment of forearm which arises from the oblique ridge on the anteromedial aspect of the distal part of the ulna and has its fibres running laterally and downwards, to be inserted into the anterior surface of the lower one fourth of the radius (Williams et al., 1995; Sinnatamby, 2000). Some of the deeper fibres of the muscle have been reported to insert into the triangular notch above the ulnar notch of the radius (Williams et al., 1995). The PQ is innervated by the anterior interosseous branch of the median nerve and acts in pronating the forearm (Sinnatamby, 2000). In fact, the PQ has been considered to be more powerful than the pronator teres muscle (Sinnatamby, 2005).

According to standard textbooks of anatomy, the PQ muscle has its fibres running downwards and laterally (Williams et al., 1995). The parallel fibres of the PQ follow a course obliquely downwards as a band. Interestingly, no anatomy textbook has ever mentioned any variation of the PQ. Recently, attempts have been made to explore the architecture of the forearm muscles because of their role in tendon transfer (Brand et al., 1981;

Submitted: December 26, 2007
Accepted: July 28, 2008

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Lieber et al., 1992). However, all these studies failed to address the PQ muscle as more than a single functional unit (Stuart, 1996).

Here, the peculiar existence of a double PQ with its fibres directed downwards medially and laterally, respectively, was observed on both sides of a male cadaver and may be regarded as a rare variation. Anomalous PQs may have a role in altering the biomechanics of the radioulnar joint and anatomical knowledge of normal and abnormal PQs may be beneficial for hand surgeons planning transplant surgeries.

Case report

During routine cadaver dissection, we observed anomalous PQs on both sides of a 52 year old male. We did not have any significant clinical history of the individual. There was no evidence of any surgery on the arm or forearm. The anomalous muscle was clearly delineated from the surrounding structures and was studied in detail. Appropriate measurements were taken and the specimen was photographed (Fig. 1).

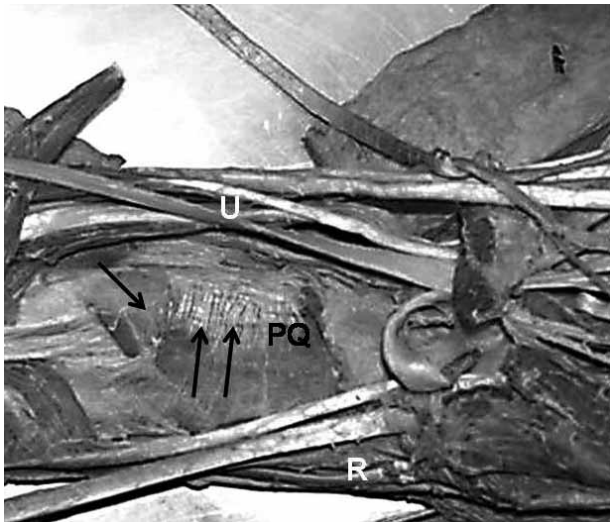

Fig. 1. Forearm of the dissected specimen. R: Radial side; U: Ulnar side; PQ: Pronator quadratus. The lower head with its lateral direction of fibres is shown with a double arrows. The upper head with its medial direction of fibres is shown with a single arrow.

Two distinct bands of muscles were observed to originate from the radius and the ulna respectively. The fibres of the two muscles were observed to traverse downwards medially and laterally, respectively. The maximum width of the two muscles measured 2.5 cm and 1.3 cm, respectively. The thicker band (shown with double arrows in Fig. 1) crossed the thinner band (shown with a single arrow in Fig. 1) superficially. Both muscles were innervated by the anterior interosseous branch of the median nerve. No other associated anomalies were observed.

Discussion

It is a widely accepted fact that the PQ muscle extends as a single band from the oblique ridge in the lower part of the anterior surface of the shaft of ulna and its adjoining medial area, thereby inserting into the lower part of the anterior surface of the radius (Williams et al., 1995; Sinnatamby, 2000; Gaddum-Rosse and Rosse, 1997). The peculiar existence of a double PQ with different directions of fibres, as seen in the present case, is a rare entity.

Anomalies of the PQ are rare. The muscle may also be absent in some cases (Braus and Elze, 1960; Kahle et al., 1985). PQ anomalies have been found in other primate species but split into two different functional parts, as seen in gorillas and chimpanzees, in which a stronger deep head is present, in order to resist the constant loading spreading to the distal radius and ulna (Stuart, 1996). In the baboon, the anterior neurovascular bundle even traverses between the two heads, while in other apes and humans it is deep to the deep head (Stuart, 1996). In a search of the literature, we have found only two reports, confined to the double heads of the PQ (Johnson and Shrewsbury, 1976; Koebke et al., 1984). One of these studies reported that in the case of the existence of two PQ heads, the superficial head initiates pronation while the deep head stabilizes the distal radioulnar joint (Johnson and Shrewsbury, 1976). Neither of these research reports mentioned a different direction of fibres, as seen in the present study. In this context, we believe that the usual direction of fibres from the ulna to the radius laterally may have allowed the usual pronation but the direction of fibres from the radius to the ulna as seen in the other head may have helped the opposite movement; i.e. supination. We speculate that under these circumstances, pronation at the radioulnar joint would have become less powerful in this case.

The role of the PQ in designing flaps is important for any hand surgery. The PQ muscle and its pedicle is approached from the anterior route which includes any existing scars (Fontaine et al., 1992). It extends 12-15 cm from the wrist crease. The PQ muscle has its fibres running parallel to insert into the

radius in the distal quarter of the forearm (Papp et al., 1993). It has been reported that the insertion may sometimes reach the wrist bone and, although rarely, the thenar muscles (Papp et al., 1993).

It has been reported that pronator quadratus can be raised as a flap at the end of a neurovascular bundle 70-80 mm long (Fontaine et al, 1992). Some studies have stressed that pre-operative angiography may have to be performed in order to verify the patency of the arterial axes of the forearm, which may spoil a flap after it has been raised from the forearm (Fontaine et al., 1992). Another study described a potential muscle bone graft from the anteromedial cortex of the distal radius with an intact anterior interosseous artery (Rath et al., 1990). It has been also described that PQ grafts can be used to restore vascularity to proximal carpal row following aseptic necrosis (Braun, 1987). Pronator quadratus pedicled bone grafting to obtain proximal row radiocarpal fusion has also been reported (Leung and Hung, 1990). The use of a combined osteomuscular flap of the PQ and an attached segment of radius has been shown to afford excellent results in proximal pseudoarthrosis of the scaphoid bone, and this has been reported to stabilize the bone with good vascularization via the PQ muscle (Papp et al., 1993). Thus, the normal and abnormal anatomy of the PQ is important for all hand surgeons.

Conclusion: In the present study, we highlight the morphological and clinical aspects of anomalous PQs. We also discuss the possible outcome concerning alterations of the movement at the radioulnar joint as a result of two different directions of fibres of the PQ. Further detailed electromyographic studies would be required to fully explore these circumstances.

Acknowledgements

We wish to convey our sincere thanks to Ms Hairi Ghazalli for her valuable help in the dissection of the cadaver.

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