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The Abductor Pollicis Longus Tendon as Grafting Material for Reconstructive Surgery of the Hand

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The abductor pollicis longus muscle (APL) is one of the most variable muscles in the hand and often presents with numerous distal tendons, known as accessory or supernumerary tendons. They are an often used source of grafting material for reconstructive hand surgery. The aim of the present study was to examine and describe different variations in the number and morphology of the tendons of the APL and to discuss their possible use as grafting material for reconstructive hand surgery. A total of 30 upper limbs from cadavers were used for the study. We found accessory tendons in 26 of the hands, of which 18 had only one accessory tendon, 6 hands had two, and 2 hands had three accessory tendons. Knowledge of variations in the number of APL tendons is important for successful hand reconstructive surgery, as well as in the context of pathologies, such as De Quervain's syndrome.

Key words: abductor pollicis longus, accessory tendons, grafting material, hand surgery

Introduction

The abductor pollicis longus (APL), an often variable structure in the human hand [8, 25], is responsible for abduction of the thumb and together with the extensor carpi ulnaris muscle acts as a dynamic collateral ligament of the wrist [20, 26]. It originates from the posterior surface of the interosseous membrane, the radius and the ulna, passes through the first extensor compartment of the wrist together with the extensor pollicis brevis muscle (EPB) and attaches to the base of the first metacarpal bone [26, 29]. Variations of the distal attachment of the APL have been well documented. They include insertion into the opponens pollicis muscle [17, 32] and the abductor pollicis brevis [4, 29, 30], attachment to the scaphoid [6] and trapezium bone [26], the carpometacarpal joint capsule [32], the flexor pollicis brevis muscle [33], etc. Moreover, data exist on the presence of supernumerary or accessory tendons of the APL [19, 24]. They may contribute to the development of De Quervain's syndrome, or stenosing tenosynovitis

of the first extensor compartment of the wrist, which is characterised by pain resulting from resisted gliding of the tendons of the APL and EPB within the fibro-osseous canal [3, 18, 22].

The use of grafting material is often needed in reconstructive hand surgery in cases of osteoarthritis or damage to tendons or ligaments [5, 8]. Most often, grafting material is used from the palmaris longus muscle or plantaris muscle [13, 14, 15, 28]. However, the palmaris longus in particular is a very variable muscle and may not always be present or suitable for grafting [11]. An alternative surgical technique is to use accessory tendons of the APL if such are present [28]. A key principle when using tendons as grafting material is to avoid donor site morbidity [5]. The APL is considered an excellent choice of grafting material for reconstructive surgery of tendons of the hand because of its multiple bellies, suitable size, relatively easy extraction and limited donor site morbidity [28].

The aim of the present study was to examine and describe different variations in the number and morphology of the tendons of the APL and to discuss their possible use as grafting material for reconstructive hand surgery.

Materials and Methods

We used a total of 30 upper limbs from Caucasian cadavers, fixed with 10% formalin, from the autopsy material available at the Department of Anatomy, Histology and Embryology at the Medical University of Sofia, Bulgaria. All examinations were approved by the Medico-Legal Office and the Local Ethic Committee. They were dissected and thoroughly examined for the presence of accessory tendons of the APL. The dissections were performed through a dorsal approach on the forearm. Skin and subcutaneous fat tissue were dissected layer-by-layer and the underlying fascia of the forearm was exposed. We then cut through the fascia and demonstrated the extensor retinaculum and the extensor muscles of the forearm. We carefully identified the first extensor compartment of the wrist and opened it to expose the APL and the EPB muscles. We then proceeded to identify the presence of accessory tendons of the APL and the point of their distal attachment. We used a calibrated caliper to measure the length, width and thickness of the accessory tendons and then calculated the mean values for all three parameters. Photographs of the discovered anomalies were taken.

Results

The presence of the tendon of the APL was observed in all of the examined upper limbs and attached in the usual way at the base of the first metacarpal bone (**Fig. 1a**). Accessory tendons were detected in 26 hands (86.7%), of which one accessory tendon was identified in 18 cases (69.2%) (**Fig. 1b**), 6 hands had two accessory tendons (23.1%) (**Fig. 1c**) and 2 hands had three accessory tendons (7.7%) (**Fig. 1d**). The presence of accessory tendons showed no side-to-side differences. None of the observed accessory tendons had a separate compartment. We also noted variations in the distal attachment of the supernumerary tendons of the APL. The insertion site of the accessory tendons was the trapezium in 10 cases (38%), the thenar muscles in 7 cases (27%) (**Fig. 1b**), the abductor pollicis brevis in 4 cases (15%), the base of the first metacarpal bone in 3 cases (12%) (**Fig. 1c**), double insertion to the first metacarpal bone and the thenar muscles in 1 case (4%) (**Fig. 1d**) and the opponens pollicis brevis in 1 case (4%). Mean length, width and thickness of the accessory tendons were 63.2, 4.9 and 1.9 mm, respectively.

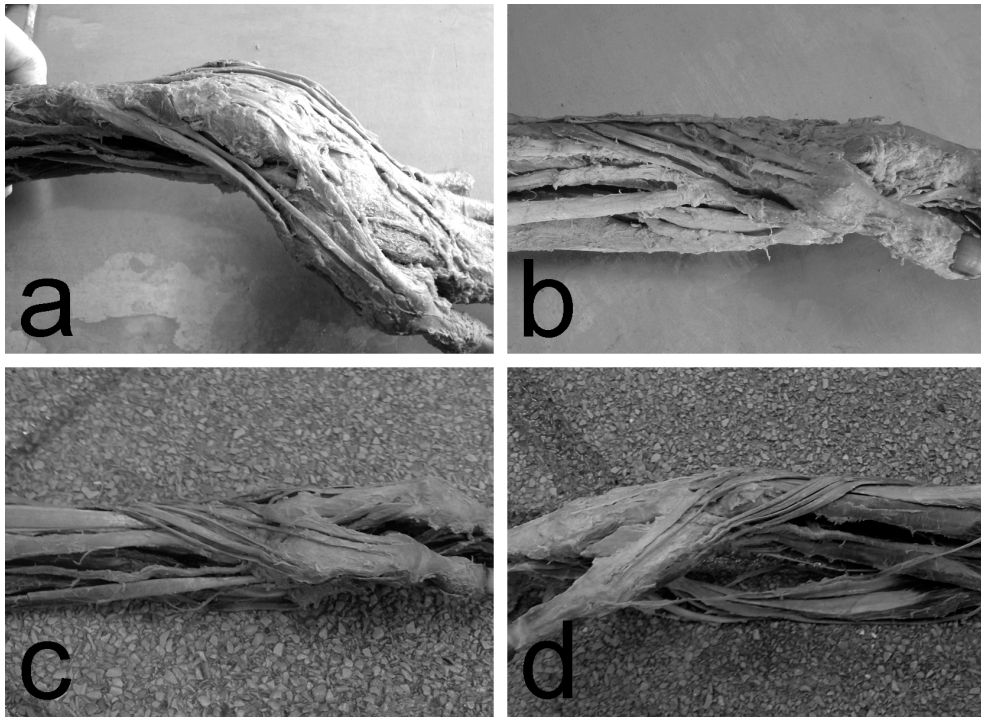

Fig. 1.a) Usual APL insertion to the first metacarpal bone; **b**) APL accessory tendon attached to the thenar muscles; **c**) Two APL accessory tendons attached to the first metacarpal bone; **d**) APL with three accessory tendons - the first two inserted to the first metacarpal bone and the third attached to the thenar muscles

In 4 of the examined upper limbs we did not discover the presence of supernumerary tendons of the APL. We also performed a thorough revision for the presence of any other variations in the anatomical structure of the examined upper limbs but such were not reported.

Discussion

In the present study we examined the presence of accessory tendons of the APL and noted the variations in their attachment sites. Accessory tendons were discovered in 26 out of 30 upper limbs (86.7%). This high percentage correlates with data from the study of Gonzalez et al. (57 out of 66 upper limbs or 86.4%) [17]. This study found one accessory tendon in 9 cases (13.6%), two tendons in 46 cases (69.7%), three tendons in 9 cases (13.6%) and four tendons in 2 cases (3%) [17]. These data differ from the results obtained in the present study, in which we discovered the presence of one accessory tendon to be predominant, followed by presence of two and three tendons, respectively. We did not report presence of four accessory tendons in the examined upper limbs. According to Zancolli and Cozzi, APL tendon duplicity has been described in 56% to 98.5% of hands [34], which has been supported by the data obtained by Bravo et al. (85%) [5] and Loomis (92%) [23]. Our results with regard to attachment sites of the aberrant tendons

confirmed the data obtained in previous studies. Attachment to the trapezium was found in 41% of cases by Bravo et al. [5] and in 61% of upper limbs studied by Brandsma et al. [4]. Khoury et al. reported that when two tendons were present, they most often attached to the base of the first metacarpal bone, while in the case of three tendons, two of them attached to the base of the first metacarpal bone, while the remaining tendon attached to the thenar muscles [21]. These findings were illustrated and confirmed by the present study.

Although the APL muscle plays a key role in the abduction of the thumb, it cannot abduct the thumb by itself, which has been shown in cases of thenar muscles paralysis [9]. Another study has underlined the important function of the tendon of the APL in terms of preventing overextension of the metacarpo-phalangeal joint while performing a pincer grasp between the thumb and the index finger [26, 27]. Therefore, variations in the APL may have an important clinical and functional significance. The presence of supernumerary tendons, which appears to be the rule rather than an exception [10], can present with clinical symptoms such as De Quervain's syndrome, or stenosing tenosynovitis of the first extensor compartment [29]. They can also compromise the accuracy of steroid injection or make it difficult to achieve, thereby leading to a failure to treat De Quervain's syndrome properly [31].

The use of accessory tendons of the APL as grafting material has been well documented [5, 28, 29, 31]. Jackson et al. report that the first extensor compartment of the wrist almost always contains a tendon that can be used for grafting procedures [19]. The dimensions of the accessory tendons of the APL make them appropriate as grafts for reconstructive hand surgery [5]. Trapezial excision with APL tendon interposition arthroplasty in cases of arthrosis or osteoarthritis of the trapeziometacarpal joint (TMC) has been widely performed and good outcomes have been achieved [1]. In addition to tendon interposition, APL arthroplasty includes stabilization of the first metacarpal bone through suspension of its base between the tendons of the APL and the flexor carpi radialis muscle and introduction of an APL strip [1]. One reason for the decreased morbidity when using an accessory tendon of the APL is that TMC stability is still maintained [5]. The recommended length of the tendon in TMC arthroplasty is 5 cm [2]. The mean length of the accessory tendons measured in the present study was a little over 6.3 cm, which makes them an adequate grafting material. Chitnis and Evans report the use of the APL tendon in tendon transfer due to rupture or division of the extensor pollicis longus muscle, in order to restore extension of the thumb [7]. Furthermore, rerouting an accessory tendon of the APL in order to use it as insertion for tendon transfer is a possible mechanism for restoration of thumb abduction [19]. APL tendons, as well as the tendons of the radial wrist extensors may be used for restoration of impaired flexion of the fingers in case of flexor muscle loss, for correction of claw hand deformities and tendon transfer in rheumatoid hands [12, 16].

Conclusion

The presence of accessory tendons of the APL is an often encountered phenomenon and is generally considered to be beneficial, since injury to one of the tendons can be partially compensated by the function of the remaining tendons. However, they can also contribute to the development of certain pathologies, such as De Quervain's syndrome. The wide use of the supernumerary tendons of the APL as grafting material for hand reconstructive surgery clearly shows that knowledge of the different variations of this muscle is important for a successful postoperative result.

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