

Accessory tendons of the extensor carpi radialis muscles

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SUMMARY

Accessory tendons of the extensor carpi radialis longus and the extensor carpi radialis brevis muscles were studied in 80 upper limbs belonging to 40 preserved cadavers. We observed accessory tendons in 27 cases (33.8%). The accessory tendons in 4 cases (5%) belonged to a supernumerary muscle (extensor carpi radialis intermedius), in 4 cases (5%) to a cleft of the tendons and in 19 cases (24%) to an intermedius tendinous slip. In 18.5% of the forearms, the tendinous slip arose from the extensor carpi radialis longus and in 8% from the extensor carpi radialis brevis. The tendinous slip which arose from the extensor carpi radialis longus was inserted on the base of the third metacarpal bone deep to the insertion of the extensor carpi radialis brevis whereas the tendinous slip which arose from the extensor carpi radialis brevis was inserted on the base of the second metacarpal bone at the radial side of the insertion of the extensor carpi radialis longus. The presence of the two tendinous slips of different origins in the same arm occurred in 4 cases (5%); in these cases the slip from the extensor carpi radialis brevis crossed superficially to the slip from extensor carpi radialis longus. There were no significant differences according to sex or side.

Key words: Extensor carpi radialis longus - extensor carpi radialis brevis - muscular anomalies - muscular variations.

INTRODUCTION

The development in hand surgery of tendoplasty or tendon transfer operations using supernumerary or accessory tendons of the radial wrist extensors has increased the need for accurate knowledge of these anatomical variations (Zancolli, 1975; Albright and Linburg, 1978; Wood, 1988).

Accessory tendons of the extensor carpi radialis muscles were first described by Wood (1867-68) who classified three types: 1) cleft tendons, 2) tendons belonging to a supernumerary muscle named "extensor carpi radialis intermedius" (ECRI) and/or "extensor carpi radialis accessorius" or 3) supernumerary tendons named "intermediate tendinous slips" (ITS). These variations have also been reported by other classical anatomists such as Macalister (1875), Testut (1894), Le Double (1897) and Curnow (1953).

Clefts of the extensor carpi radialis longus (ECRL) tendon have been described with a prevalence ranging from 2.1% (Wood, 1868) to 11% (Albright and Linburg, 1978) while clefts of the extensor carpi radialis brevis (ECRB) have a lower prevalence (1.1% - Kosugi et al., 1987a and 2.2% - Wood, 1988).

The ECRI has been reported to originate in the ECRL and/or ECRB, and to be inserted on the 2nd or 3rd metacarpal bone. It has a wide range of incidence from 1.38% (Wood 1868) to 24% (Albright and Linburg, 1978). The extensor carpi radialis accessorius has occasionally been reported to originate in the ECRL, and to be inserted in the thumb (Wood, 1867-68; Gruber, 1877).

ITS have been given a range of names: cross-slips (Macalister, 1875), accessory tendinous bands (Zancolli, 1975) or accessory tendons (Albright and Linburg, 1978). Their incidence

range from 17.19% (Wood, 1867-68) to 37.32% (Kosugi et al., 1987a,b).

The purpose of this paper is to study the morphological pattern and incidence of the accessory tendons of the two extensor carpi radialis muscles.

MATERIAL AND METHODS

Eighty upper limbs belonging to forty preserved cadavers were dissected in the Department of Anatomy at Cambridge University during the academic year 1994-1995. The age of the cadavers ranged from 65 to 94 (mean: 83 years; 22 male and 18 female).

Only ECRL and ECRB muscles were considered. In all cases, long oblique muscles to the thumb were removed to facilitate identification of the accessory tendons.

RESULTS

The normal arrangement of the ECRL and ECRB as described in anatomical text books occurred in 56 cases (70%) whereas the presence of accessory tendons of these muscles was observed in 27 cases (33.8%). These accessory tendons were classified in three groups: clefts, those belonging to supernumerary muscles and intermedius tendinous slips.

1. *Cleft*: the variation named "cleft" is defined as a bifurcation of the tendons of the ECRL and ECRB. This variation occurred in 4 forearms (Table 1). In 2 cases, it was associated with the ECRL (Fig. 1a) and in another 2 cases was associated with the ECRB. In 1 case, clefts of the ECRB and ECRL were observed in the same forearm (Fig.1c).

2. *Accessory tendons belonging to a supernumerary muscle (Extensor carpi radialis intermedius (ECRI))*: The ECRI was detected in 4 forearms (Table 1) in two different presentations: arising from the deep surface of the ECRL muscle (1 case) and from the dorsal surface of the ECRB muscle (3 cases). In this latter form, after a lateralward course, the ECRI was inserted on the base of the 2nd metacarpal bone, with the tendon of the ECRL (Fig. 1b).

The ECRI originated from the deep surface of the ECRL, showing a medialward course over the radius, and was finally inserted on the third metacarpal bone together with the ECRB tendon (Fig. 1c). This case was associated with a cleft of the ECRL and ECRB tendons.

3. *Intermedius Tendinous slips (ITS)*: these are connections between the ECRL and the ECRB (Table 1).

The ITS from ECRL to ECRB originates in the lateral side of the ECRL, coursing deep and medial to this muscle to join the tendon of ECRB, where the long oblique muscles of the thumb cross over the tendons of the radial wrist extensors. The ITS was inserted within the same tendinous sheath of the ECRB tendon on the base of the third metacarpal bone (Fig. 2a).

The ITS from ECRB to ECRL originates in the superficial surface of the ECRB to join the tendon of the ECRL where the long oblique muscles of the thumb cross the tendons of the radial wrist extensors. The ITS passes distally to insert on the radial side of the ECRL on/at the base of the second metacarpal bone (Fig. 2b).

In 4 cases, the two above-mentioned variations appeared in the same arm (Fig. 2c). In all cases, the ITS arising from the ECRB crossed superficial to the supernumerary tendon originated from the ECRL.

VARIATION	N° CASES	RIGHT		LEFT	
		♂	♀	♂	♀
Bifurcation of tendons	4 (5%)	2	1	1	0
ECRB	2 (2.5 %)	1	1	0	0
ECRL	2 (2.5%)	1	0	1	0
Extensor carpi radialis intermedius	4 (5%)	1	1	2	0
Intermedius tendinous slips	19 (23.8%)	6	3	6	4
ECRL → ECRB	11 (13.8)	4	1	5	1
ECRB → ECRL	4 (5%)	1	2	0	1
ECRL ↔ ECRB	4 (5%)	1	0	1	2

Table 1.—Distribution of the accessory tendons of the extensor carpi radialis muscle in 80 forearms. ECRB, extensor carpi radialis brevis; ECRL, extensor carpi radialis longus

Fig. 1.— **a:** Right forearm showing a cleft (*) of the extensor carpi radialis longus. A partial fusion of the extensor carpi radialis bellies is also present. **b:** Left forearm showing an extensor carpi radialis intermedeus (I) arising between the extensor carpi radialis longus (L) and brevis (B) and inserting on the base of the second metacarpal bone. **c:** Left forearm showing an extensor carpi radialis intermedeus (I) arising from the deep surface of the extensor carpi radialis longus (L) and inserting on the third metacarpal bone, associated with a cleft of the tendons of the two extensor carpi radialis muscles. ED, extensor digitorum; r, radial artery; er, extensor retinaculum.



Fig. 2.— **a:** Right forearm showing one accessory tendinous slip running from the extensor carpi radialis longus (L) to the tendon of the extensor carpi radialis brevis (B) and inserting on the base of the 3rd metacarpal bone (head arrows). **b:** Right forearm showing one accessory tendinous slip running from the extensor carpi radialis brevis to the tendon of the extensor carpi radialis longus and inserting on the base of the 2nd metacarpal bone (head arrows). **c:** Right forearm showing two accessory tendinous slips from the extensor carpi radialis brevis and longus to their parent tendon (head arrows). ED, extensor digitorum; r, radial artery; er, extensor retinaculum.



There were no significant differences according to sex or sides in any of the accessory tendons described.

DISCUSSION

The normal arrangement of the ECRL and ECRB described in standard anatomical textbooks has a variable incidence, ranging from 50% (Albright and Linburg, 1978) to 70% for ECRL and 81% for ECRB (Kosugi et al., 1987a,b). In our series, we observed an incidence of 71%.

Since Wood's works, classification of the accessory tendons of ECRL and ECRB have been reported with a wide range of terminology, which makes comparison of the results of the different series extremely difficult (Wood, 1867-68; Albright and Linburg, 1978; Kosugi et al., 1987a,b; Wood 1988). In an attempt to simplify the numerous individual classifications, we have classified accessory tendons in three groups based on Wood's terminology: 1) clefts, 2) tendons from supernumerary muscles and 3) intermediate tendinous slip. Using this classification we have reviewed all the results in the literature since Wood.

1. *Clefts*. In 4 forearms we found the ECRL and ECRB tendons to be totally bifurcated. In the case of the ECRL, this variation has been reported with a prevalence ranging from 2.1% (Wood, 1868) to 11% (Albright and Linburg, 1978). We observed it in 2.5% of cases. The bifurcation of the ECRB tendon has been described with a prevalence of 1.1% (Kosugi et al., 1987a) and 2.2% (Wood, 1988), while we found it in 2.5% of cases.

2. *Accessory tendon from supernumerary muscles*. The two extra muscles associated with the radial wrist extensors are: the extensor carpi radialis accessorius inserting in the thumb, reported occasionally (Wood, 1867-68; Gruber, 1877), and the ECRI inserted with the ECRL or the ECRB on the second and third metacarpal bone (Wood, 1867). We observed the presence of ECRI in 4 forearms, but did not find the extensor carpi radialis accessorius in any of the cadavers.

The ECRI was originally described by Wood (1867-68), who reported its prevalence to be 1.4%. More recently, its prevalence has been found to be higher by several authors (12.6%, Wood, 1988 and 24%, Albright and Linburg, 1978). In spite of this, in our series we found a prevalence of 5%, which is closer to the results of Wood and the classical anatomists (Macalister, 1875; Testut, 1894; Le Double, 1897), who considered the ECRI to be a very infrequent muscle.

The course of the ECRI muscle was found to arise between the ECRL and the ECRB and to be

inserted on the ECRL or ECRB (Wood, 1867-68). However, more recently, origins from the radial side of the ECRL or from the ulnar side of the ECRB have also been described (Wood, 1988). In three forearms we found the ECRI to originate in the ECRB (close to the ECRL) and to be inserted with the tendon of the ECRL on the 2nd metacarpal but we did not find any ECRI muscles arising from the radial side of ECRL (Wood, 1988). However, in one forearm, we found an ECRI (associated with a cleft of the ECRL and ECRB tendons) arising from the deep surface of the ECRL and ending in the third metacarpal bone with the ECRB. To our knowledge, this type of variation has not been reported in the literature.

3. *Intermediate tendinous slips*. These tendons have been reported to arise from one extensor carpi radialis muscle and to be inserted with the other extensor. They were first named ITS and considered incomplete forms of the ECRI muscle or rather its representative tendon (Wood, 1867-68). Since then, different terms have been applied: cross slips (Macalister, 1875), accessory tendinous bands (Zancolli, 1975; Wood, 1988), extra tendons (Albright and Linburg, 1978), and accessory slips or accessory tendons (Kosugi et al., 1987a,b). The prevalence of the ITS in the literature has been found to range from 17.2% (Wood, 1867-68) to 37.3% (Kosugi et al., 1987a,b). In our series, the observed prevalence was 23.8%.

The ITS from the ECRL to the ECRB have been reported with a prevalence ranging from 9.3% (Wood, 1988) to 26% (Albright and Linburg, 1978). We found them in 13.8% of the forearms. According to Curnow (1876), this is the most common presentation.

In the different series, the prevalence of the ITS from the ECRB to the ECRL has been reported to be 6.8% (Wood, 1868), 13% (Wood, 1988), 13.8% (Kosugi et al, 1987b), 21% (Albright and Linburg, 1978). We found them in 5% of the forearms.

Like Albright and Linburg (1978), we found that all the ITS inserted on the base of the second metacarpal bone invariably lay on the ulnar side of the ECRL, while those inserted on the base of the third metacarpal bone lay deep to the tendon of the ECRB.

The above-mentioned ITS patterns have been named by some authors as cross connections (Wood, 1867-68; Welcker, 1876; Albright and Linburg, 1978; Yoshida, 1994) and only Wood (1867) referred to its frequency (1.9%). We found it in 5% of forearms. When this cross-connection was present, the ITS from the ECRB were superficial to the ITS from the ECRL (Wood, 1868; Welcker, 1876).

Zancolli (1975) stated that only extra tendons associated with supernumerary muscles and having an independent action can be used for trans-

fers in patients with tetraplegia. However, it has since been shown that this is not crucial and the ITS can be used to obtain flexion of the wrist or flexion of the fingers (Albright and Linburg, 1978).

The extensor carpi radialis and brachioradialis muscles differentiate from one common muscle mass (Lewis, 1901). The excess splitting of the common mass would explain the appearance of extra muscles (ECRI), cleft of tendons or ITS connecting both ECRB and ECRL.

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