JHS(E)

The Journal of Hand Surgery (European Volume, 2010) 35E: 2: 115–119

MUSCLE FIBRES CROSSING THE LINE OF INCISION USED IN CARPAL TUNNEL DECOMPRESSION

N. HOLLEVOET, E. BARBAIX, K. D'HERDE, W. VANHOVE and R. VERDONK

From the Department of Orthopaedic Surgery and Traumatology, Ghent University Hospital, Belgium, and the Department of Basic Medical Sciences, Anatomy and Embryology Group, Ghent University, Belgium

Muscle fibres that cross the proposed line of incision of the flexor retinaculum at carpal tunnel decompression can be a source of confusion, particularly for the less experienced surgeon. We investigated how frequently muscle fibres crossed the line of incision on the palmar surface of the flexor retinaculum at carpal tunnel decompression in 143 hands, and dissected 103 cadaver hands to study the origin and insertion of these muscle fibres. The line of incision was defined as a longitudinal line between thenar and hypothenar eminences along the third web space, with the wrist in neutral radioulnar deviation and the fingers in extension. Muscle fibres crossing the line of incision were absent in 50% of the operated hands, 2–10 mm wide in 39% and more than 10 mm wide in 11%. In the cadaver hands the proportions were similar at 50%, 35% and 15%, respectively. The fibres were extensions of the thenar and hypothenar muscles and did not appear to represent a separate anomalous muscle.

Keywords: carpal tunnel syndrome, transverse carpal muscle, anatomical variations

INTRODUCTION

Anatomical variations can be encountered during surgery for carpal tunnel syndrome (Lindley and Kleinert, 2003; Mauer et al., 1993). An association of abnormal muscles with carpal tunnel syndrome has been reported for lumbrical muscles (Butler and Bigley, 1971), for flexor digitorum superficialis muscle bellies (Smith, 1971) and for the palmaris longus, e.g. a reversed palmaris longus (Meyer and Pflaum, 1987) or a palmaris longus profundus (Floyd et al., 1990). Transverse muscle fibres on the palmar surface of the flexor retinaculum have also been found at carpal tunnel release (Iob et al., 2000; Ragoowansi et al., 2002; Tuncali et al., 2005). It has been suggested that these transverse muscle fibres belong to a separate muscle, named transverse carpal muscle or musculus transversus carpi (Ragoowansi et al., 2002) and also that these fibres have a role in the aetiology of carpal tunnel syndrome (Iob et al., 2000; Tuncali et al., 2005).

When performing surgery for carpal tunnel syndrome with the open technique, it is advised to cut the flexor retinaculum on its ulnar border (Szabo and Koo, 2006). Usually no or only a few muscle fibres can be seen on the palmar surface of the flexor retinaculum on the line of incision. In some cases a large transverse muscle between thenar and hypothenar eminences is encountered and this may be confusing for inexperienced surgeons. It is not clear if the transverse muscles fibres are part of a musculus transversus carpi because the limited surgical exposure does not permit identification of the origin and insertion of these fibres.

The purpose of the study was to determine how frequently transverse muscle fibres cross the line of incision of the flexor retinaculum at carpal tunnel decompression. We also dissected cadaver hands to identify the origin and insertion of the transverse muscle fibres and to determine if they represent a separate musculus transversus carpi.

MATERIALS AND METHODS

Between December 2004 and June 2006, 143 hands were operated on for carpal tunnel syndrome, in 14 patients bilaterally. Patients who underwent revision surgery were not included in the study. One hundred and eight procedures were performed on women and 35 on men. The mean age of the patients was 56 years (range: 18–90). The diagnosis of carpal tunnel syndrome was made on clinical evidence and with electromyographic and nerve conduction studies. All patients were Caucasian.

Risk factors for carpal tunnel syndrome such as fractures of the wrist, rheumatoid arthritis, osteoarthritis, diabetes and thyroid disorders (Geoghegan et al., 2004) were noted. Open carpal tunnel release was performed under local anaesthesia and forearm tourniquet.

The skin was incised in the palm between the thenar and hypothenar eminences along the axis of the third web space. No incision was made in the skin of

the forearm. After dividing the subcutaneous fat and fascia we looked for transverse muscle fibres on the palmar surface of the flexor retinaculum and measured their width in mm with a sterile ruler. The width of the group of fibres was the distance between its proximal and distal borders in line with the planned incision in the flexor retinaculum. The line of incision was defined as a longitudinal line between thenar and hypothenar eminences along the third web space with the wrist in neutral radioulnar deviation and the fingers in extension. Any transverse muscle fibres were cut longitudinally together with the flexor retinaculum. Proximally the skin was elevated with a retractor to facilitate division of the proximal part of the flexor retinaculum.

One hundred and three embalmed cadaver hands (61 female, 42 male) were dissected. Forty-eight were paired hands and seven were unilateral. All cadavers were Caucasian. Age and medical history were not available.

The skin and subcutaneous tissue were removed from the thenar and hypothenar eminences and from the palmar aspect of the forearm. After removal of the palmar fascia the presence of muscle fibres was observed in the area between the thenar and hypothenar eminences. The width of the muscle fibres was measured with a ruler along the longitudinal line where the flexor retinaculum would be cut during surgery (on the ulnar border along the third web space). The width was defined as the distance between the proximal and distal border of the group of muscle fibres on the line of incision of the flexor retinaculum.

Because the width of muscle fibres on the line of incision of the flexor retinaculum of a living patient may be different from an embalmed cadaver and cannot be compared exactly, we categorised the hands into three groups: hands without muscle fibres crossing the line of incision, hands with up to 10 mm wide muscle fibres and hands with more than 10 mm wide fibres.

Statistical analysis was done with the SPSS software, v12. The Chi-square test was used to determine if muscle fibres crossing the line of incision were significantly more common in patients with carpal tunnel syndrome than in cadaver hands, if the presence of these muscle fibres was influenced by sex and side, and if there was a difference between patients with and without risk factors for carpal tunnel syndrome. The Kruskal-Wallis test was used to look for a significant difference in age between the three categories of muscle width. We wished to determine if large transverse muscles (more than 10 mm wide) are more frequent in younger patients with carpal tunnel syndrome.

Permission from the Ethical Committee of the Ghent Univeristy Hospital was obtained.

RESULTS

The frequency of transverse muscle fibres on the line of incision in operated and cadaver hands is presented in Table 1. No significant difference was found between operated and cadaver hands ($P = 0.66$).

For the operated hands, side and sex distribution in the three categories of muscle fibres are shown in Table 2. No significant differences were found. In the first two categories mean age of the patients was 56 years and in the third 58. This difference was not significant ($P = 0.75$). An example of a wide transverse muscle found during surgery is shown in Fig 1.

In 32 operated hands (22%) the following risk factors for carpal tunnel syndrome were present: diabetes (19), thyroid disorders (nine), distal radius fracture (two),

Table 1—Frequency of muscle fibres on the line of incision in operated and in cadaver hands

	Operated hands (n = 143)		*Cadaver hands (n = 103)*	
	n	%	n	%
No fibres	71	50	52	50
Muscle fibres ≤10 mm	56	39	36	35
Muscle fibres >10 mm	16	11	15	15

Table 2—Frequency of muscle fibres on the line of incision according to side and sex in operated hands

	Right (n = 85)		*Left (n = 56)*		*Female (n = 108)*		*Male (n = 35)*	
	n	%	n	%	n	%	n	%
No fibres	45	53	26	45	54	50	17	49
Muscle fibres ≤10 mm	31	36	25	43	43	40	13	37
Muscle fibres >10 mm	9	11	7	12	11	10	5	14

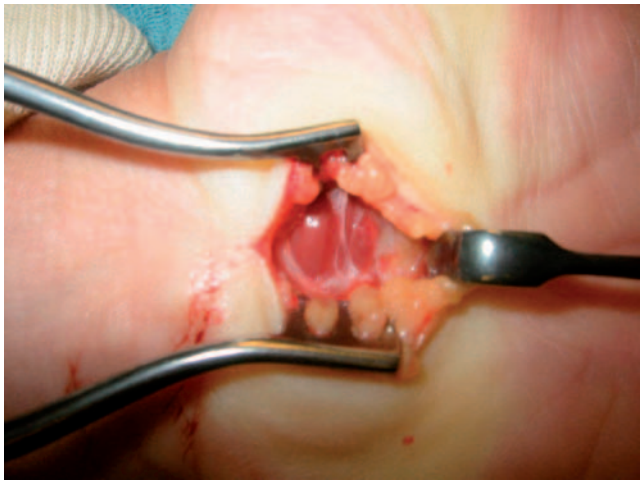

Fig 1 Presence of transverse muscle fibres during surgery for carpal tunnel syndrome.

silicone synovitis (one) and avascular necrosis of the lunate with secondary osteoarthritis (one). The presence of muscle fibres on the line of incision was not significantly different between patients with risk factors and patients with idiopathic carpal tunnel syndrome ($P = 0.40$).

In the cadaver hands, the presence of muscle fibres was not significantly related to side ($P = 0.94$) or gender ($P = 0.08$) (Table 3).

In the cadaver hands with up to 10 mm wide muscle fibres, 28 were ulnar extensions from thenar muscles reaching or crossing the ulnar side of the median nerve. In two cases the transverse muscle fibres were radial extensions of hypothenar muscles. In three cases thenar and hypothenar muscles blended together across the surface of the flexor retinaculum. In two hands muscle fibres of the palmaris brevis crossed the site where the flexor retinaculum would be cut during surgery. In one case an aberrant muscle, abductor digiti minimi longus (accessorius), crossed the flexor retinaculum in its proximal part.

In eight of the cadaver hands with more than 10 mm wide muscle fibres on the line of incision, no muscle-free zone was seen between thenar and hypothenar muscles.

Table 3—Side and sex distribution according to the presence of muscle fibres on the line of incision in cadaver hands

	Right (n = *52*)		*Left* (n = *51*)		*Female* (n = *61*)		*Male* (n = *42*)	
	n	%	n	%	n	%	n	%
No fibres	27	52	25	49	36	59	16	38
Muscle fibres ≤10 mm	18	35	18	35	19	31	17	41
Muscle fibres >10 mm	7	13	8	16	6	10	9	21

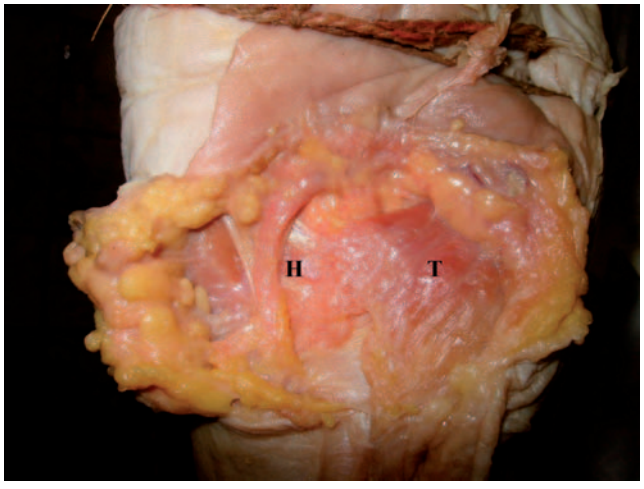

Fig 2 A hand in which there is no separation between thenar and hypothenar muscles. H = hypothenar muscles; T: thenar muscles.

An example is shown in Fig 2. In one hand the muscle was an ulnar extension of the thenar muscles. In three hands the muscle fibres were part of a large palmaris brevis muscle and in three other cases the muscle belly crossing the line of incision was part of an anomalous hypothenar muscle. In two cases this was the abductor digiti minimi longus. An example is shown in Fig 3. In one case a transverse muscle belly on the palmar surface of the flexor retinaculum coursed ulnarly between the ulnar artery and nerve and was connected with the muscle belly of the flexor digiti minimi (Fig 4).

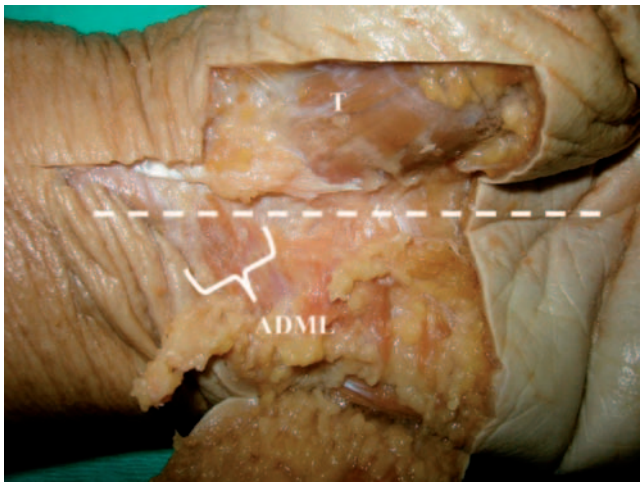

Fig 3 Muscle fibres originating from the abductor digiti minimi. T = thenar muscles; ADML = abductor digiti minimi longus. Dotted line: line where the flexor retinaculum would be cut during surgery.

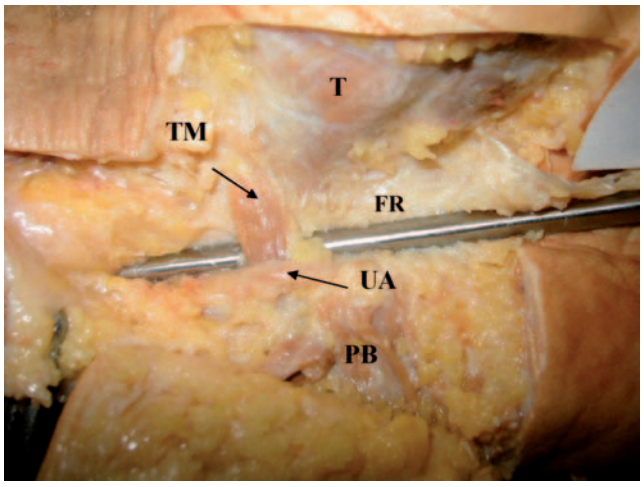

Fig 4 A transverse muscle originating from the flexor digiti minimi brevis. T = thenar muscles; TM = transverse muscle fibres; FR = flexor retinaculum; UA = ulnar artery; PB = palmaris brevis muscle.

DISCUSSION

Iob et al. (2000) found that in 11% of 1,280 hands undergoing carpal tunnel release transverse muscle fibres were present within the flexor retinaculum or parallel to it. Although the description of the course of the fibres in that paper is not very clear, we assume transverse muscle fibres on the palmar surface of the flexor retinaculum were studied. Similarly, we noted transverse muscle fibres more than 10 mm wide on the line where the flexor retinaculum was cut in 11% of the operated hands.

Tuncali et al. (2005) believed that the transverse muscle fibres represented a separate muscle. However, the usual operative exposure is insufficient to determine the exact origin of fibres running on the surface of the flexor retinaculum. To our knowledge, there are no reports of a separate transverse muscle found during cadaver dissection, and we found no such muscle.

Mauer et al. (1993) operated on 1,420 hands for carpal tunnel syndrome and noted one case of an atypical opponens pollicis muscle with insertion medial to the median nerve. Lindley and Kleinert (2003) looked for aberrant anatomical structures in 526 operated hands. In two hands thenar muscle origins were ulnar to the midaxis of the ring finger. Insertion of thenar muscles ulnar to the midaxis of the ring finger may be more common than reported in these studies. During dissection of cadaver hands we frequently found thenar muscles reaching or crossing the ulnar border of the median nerve and in some hands the palmar surface of the flexor retinaculum was almost completely covered with muscle (Fig 2).

Anatomical variations of hypothenar muscles are well documented (Tountas and Bergman, 1993). They can be associated with compression of the ulnar nerve but usually not with carpal tunnel syndrome (De Smet, 2002). However, a case of median nerve symptoms caused by a muscle belly of the abductor digiti minimi has been reported (Jackson and Harkins, 1972). Some of the anomalous hypothenar muscles cross the palmar surface of the flexor retinaculum and might be seen during surgery for carpal tunnel syndrome. Our anatomical dissection disclosed four such cases. In three hands the anomalous muscle was the abductor digiti minimi longus or accessory abductor digiti minimi. These anomalous muscles have been described in detail and they run an oblique rather than a transverse course (Dodds et al., 1990; Sañudo et al., 1993; Tountas and Bergman, 1993). We observed one hand in which the muscle fibres ran transversely and were part of the flexor digiti minimi brevis (Fig 4). An anomalous hypothenar muscle with a transverse course has been reported by Georgiev et al. (2007) and named deep abductor-flexor of the little finger. A hypertrophic palmaris brevis muscle may also be seen as a transverse carpal muscle during surgery for carpal tunnel syndrome (Tuncali et al., 2005).

Anomalous muscles can cause carpal tunnel syndrome but may be an incidental finding during carpal tunnel decompression. In younger patients and manual workers, the possibility of nerve compression by aberrant muscles should be considered (De Smet, 2002). It is not clear whether a structure outside the carpal tunnel can cause carpal tunnel syndrome. It has been suggested that contraction of the transverse muscle fibres may reduce the diameter of the carpal canal (Iob et al., 2000). However, we found that hands with muscles more than 10 mm wide were not more frequent in patients than in cadavers.

Limitations of our study are that the line of incision of the flexor retinaculum is based on a line along the third web space, which is not a precise anatomical landmark. We compared operated hands with cadaver hands but we did not have any information on the age and medical history of the cadavers. Furthermore, we did not look for other known risk factors such as obesity in the patient group (Geoghegan et al., 2004). The size of the hands in relation to the width of the transverse muscles, which may also affect the results, was not measured in our study.

Hand surgeons are accustomed to finding transverse muscle fibres running across the flexor retinaculum. But these fibres might cause the inexperienced surgeon to deduce that the incision was too far to the radial side and lead to a more ulnar approach that could damage the ulnar artery and nerve (Lindley and Kleinert, 2003). A wide transverse muscle can be associated with an abnormal course of the motor branch of the median nerve, e.g. an ulnar-sided exit (Mannerfelt and Hybbinette, 1972) or a preligamentous course (Hurwitz, 1996). In these cases the motor branch is at risk during division of the flexor retinaculum. In a study on patients operated on for carpal tunnel syndrome an incidence of 9% has been reported (Hurwitz, 1996). Some claim that transverse muscle fibres may be difficult to manipulate during minimally invasive decompression (Tuncali et al., 2005). Whether division of wide transverse muscle fibres influences postoperative recovery would require further study. We found no indication that transverse muscle fibres are related to causation of carpal tunnel syndrome.

References

Butler B, Bigley EC. Aberrant index (first) lumbrical tendinous origin associated with carpal tunnel syndrome. J Bone Joint Surg Am. 1971, 53: 160–2.

De Smet L. Median and ulnar nerve compression at the wrist caused by anomalous muscles. Acta Orthop Belg. 2002, 68: 431–8.

Dodds GA, Hale D, Jackson WT. Incidence of anatomic variants in Guyon's canal. J Hand Surg Am. 1990, 15: 352–5.

Floyd T, Burger RS, Sciaroni CA. Bilateral palmaris profundus causing bilateral carpal tunnel syndrome. J Hand Surg Am. 1990, 15: 364–6.

Geoghegan JM, Clark DI, Bainbridge LC, Smith C, Hubbard R. Risk factors in carpal tunnel syndrome. J Hand Surg Br. 2004, 29: 315–20.

Georgiev GP, Jelev L, Surchev L. Undescribed variant muscle – deep abductor-flexor of the little finger, in relation to ulnar nerve compression at the wrist. Ann Anat. 2007, 189: 276–82.

Hurwitz PJ. Variations in the course of the thenar motor branch of the median nerve. J Hand Surg Br. 1996, 21: 344–6.
Iob I, Battaggia C, Rossetto L, Ermani M. The carpal tunnel syndrome: anatomo-clinical correlations. Neurochirurgie. 2000, 46: 355–7.
Jackson DW, Harkins PD. An aberrant muscle belly of the abductor digiti quinti associated with median nerve paresthesias. Bull Hosp Joint Dis. 1972, 33: 111–15.
Lindley SG, Kleinert JM. Prevalence of anatomic variations encountered in elective carpal tunnel release. J Hand Surg Am. 2003, 28: 849–55.
Mannerfelt L, Hybbinette CH. Important anomaly of the thenar motor branch of the median nerve: a clinical and anatomical report. Bull Hosp Joint Dis. 1972, 33: 15–21.
Mauer UM, Rath SA, Richter HP. Intraoperative anatomische und pathologische Besonderheiten bei 1,420 Erstoperationen bei Karpaltunnelsyndrom. Handchir Mikrochir Plast Chir. 1993, 25: 124–6.
Meyer FN, Pflaum BC. Median nerve compression at the wrist caused by a reversed palmaris longus muscle. J Hand Surg Am. 1987, 12: 369–71.
Ragoowansi R, Adeniran A, Moss ALH. Anomalous muscle of the wrist. Clin Anat. 2002, 15: 363–5.
Sañudo JR, Mirapeix RM, Ferreira B. A rare anomaly of abductor digiti minimi. J Anat. 1993, 182: 439–42.
Smith RJ. Anomalous muscle belly of the flexor digitorum superficialis causing carpal tunnel syndrome. Report of a case. J Bone Joint Surg Am. 1971, 53: 1215–16.
Szabo RM, Koo JT. Compression neuropathies of the median nerve. In: Slutsky DJ, Hentz VR (Eds.) *Peripheral nerve surgery. Practical applications in the upper extremity*. Philadelphia, Churchill Livingstone, 2006: 219–41.
Tountas CP, Bergman RA. *Anatomic variations of the upper extremity*, 1st Edn. New York, Churchill Livingstone, 1993: 170–5.
Tuncali D, Barutcu AY, Terzioglu A, Aslan G. Transverse carpal muscle in association with carpal tunnel syndrome: report of three cases. Clin Anat. 2005, 18: 308–12.

Received: 10 August 2008
Accepted after revision: 30 December 2008
Nadine Hollevoet, Ghent University Hospital, De Pintelaan 185, B-9000 Ghent, Belgium. Tel.: +32 93323933; fax: +32 93324975.
E-mail: nadine.hollevoet@ugent.be.

doi: 10.1177/1753193409102465 available online at http://jhs.sagepub.com