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Short Report

Morphometric studies of the muscular branch of the median nerve

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ABSTRACT

The branch from the median nerve to the thenar muscles has a proximal and lateral (recurrent) course and is vulnerable to lesions that affect these muscles. Because of its anatomical–clinical importance, this branch was studied in 60 palmar regions from 30 cadavers of adult individuals of both sexes, aged between 23 and 77 y. It arose from the lateral branch of the median nerve in 83.3% of the cases. Its origin was distal to the flexor retinaculum in 48.3%, at the distal margin of the retinaculum in 31.6%, in the carpal tunnel in 18.3% and proximal to the retinaculum in 1.7%; it pierced the retinaculum in 15%. The point of recurrence of the branch was localised topographically to 34.6 ± 3.6 mm from the distal wrist crease; the angle between its recurrent course and the longitudinal axis of the hand averaged 66.8°. In 50% of the cases the muscular branch innervated abductor pollicis brevis (APB), opponens pollicis (OP) and the superficial head of flexor pollicis brevis (FPB), in 40% it supplied only APB and OP, and in 10% a short muscular branch gave rise to independent branches in the palm and which supplied APB, OP and the superficial head of FPB. The so called 'accessory thenar branch' was found in 38.3%.

Key words: Peripheral nervous system; thenar muscles.

INTRODUCTION

The anatomy and function of the hand and recovery after injury have been a constant source of interest. As the thumb is the most important digit because of its capacity for opposition, defects or injuries to its innervation interfere with its action and consequently impair the efficiency of the hand as a whole.

The muscular branch of the median nerve, variously termed the 'thenar branch', 'motor branch' or 'recurrent branch', innervates the intrinsic muscles of the thumb: abductor pollicis brevis (APB), opponens pollicis (OP) and the superficial head of flexor pollicis brevis (FPB). It is generally described as arising from the lateral division of the median nerve and may pass through the flexor retinaculum. Compression at this site can lead to impaired function of the thenar muscles (Johnson & Shrewsbury, 1970; Poisel, 1975; Falconer & Spinner, 1985). The distribution of the branch has been documented by De Souza (1975), Mumford et al. (1987) and Olave et al. (1995). Because the descriptions in standard text-books are too general, the aim of the present work was to determine the origin of this branch, its course and topographical localisation in relation to reference points and muscles innervated, and to correlate the anatomical findings with clinical aspects.

MATERIALS AND METHODS

We dissected 60 palmar regions from 30 adult cadavers of either sex fixed in 10% formalin, whose ages varied between 23 and 77 y, in the Descriptive and Topographic Anatomy facilities of the Universidade Federal de São Paulo-Escola Paulista de Medicina, Brazil. Dissections were performed with the aid of a magnifying glass, followed by drawings and photographs. The measurements were made using a manual caliper with an accuracy of 0.05 mm.

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RESULTS

The muscular branch of the median nerve was found to originate from the main trunk, from its lateral subdivision or its intermediate branch when it divided into 3 branches, or from the proper palmar digital nerve of the thumb (lateral branch). In addition, the level of origin of this branch could be related to different regions of the flexor retinaculum. The site and level of origin are shown in Table 1.

An interesting variant was found on the left side of one of the individuals, when its origin was in the distal third of the forearm. The muscular branch arose from the median nerve, which had a high division, 51 mm proximal to the distal wrist crease and supplied APB and OP (Fig. 1).

The muscular branch ran from its origin up to the medial margin of FPB. The mean value for this distance for all hands (Table 2) was 6.2 ± 2.6 mm on the right and 4.5 ± 2.0 mm on the left. When the branch became ventral to the superficial head of FPB it had a close relationship to the flexor retinaculum,

Table 2. *Distance between the origin of the muscular branch and the medial margin of flexor pollicis brevis*

Distance (mm)	Right side		Left side	
	n	%	n	%
0–3.0	4	13.3	9	30
3.1–6.0	11	36.7	16	53.3
6.1–9.0	12	40	4	13.3
9.1–12.0	3	10	1	3.3
Total	30	100	30	100

n, number of cases; right mean 6.2 mm, S.D. 2.6; left mean, 4.5 mm, S.D. 2.0; $P > 0.05$.

Table 1. *Origin and level origin of the muscular branch of the median nerve*

Origin	Right side		Left side		Level of origin	Right side		Left side	
	n	%	n	%		n	%	n	%
Main trunk of median nerve	3	10	5	16.7	Distal to FR	14	46.7	15	50
Lateral branch of median nerve	26	86.7	24	80	Distal third of FR	10	33.3	1	3.3
Intermediate branch of median nerve	1	3.3	0	0	Distal margin of FR	6	20	13	43.3
Proper palmar digital nerve of thumb	0	0	1	3.3	Proximal to FR	0	0	1	3.3
Total	30	100	30	100	Total	30	100	30	100

n, number of cases; FR, flexor retinaculum.

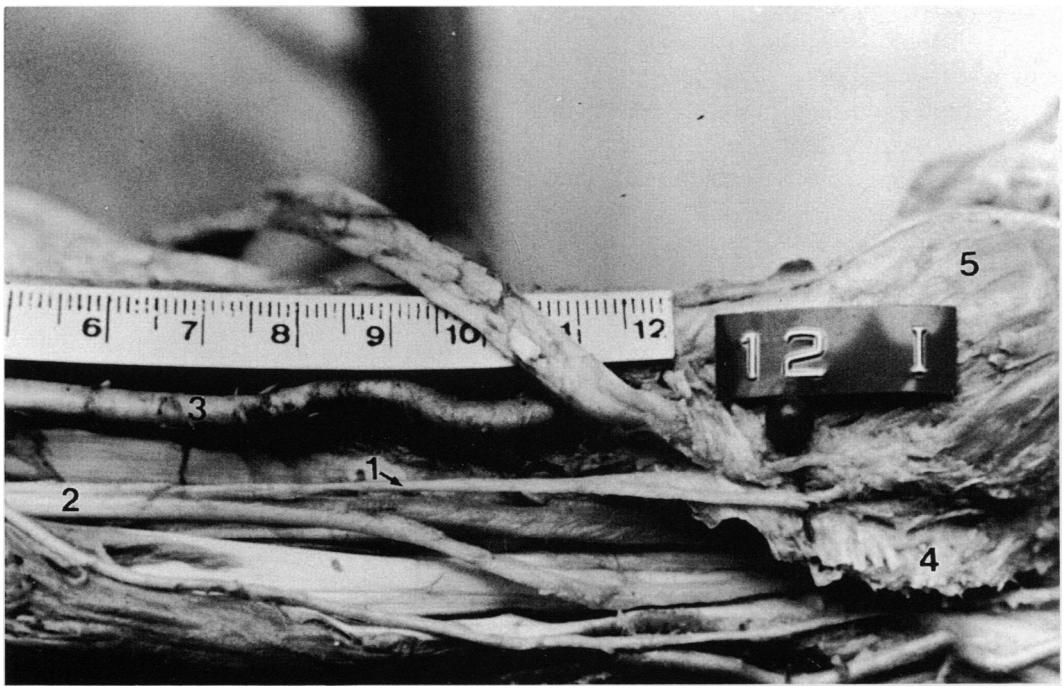

Fig. 1. Left hand. 1, Muscular branch of median nerve arising in the forearm; 2, median nerve; 3, radial artery; 4, flexor retinaculum; 5, abductor pollicis brevis.

Table 3. *Course of the muscular branch in relation to adjacent structures*

Course/structure	Cases n	%
Pierces FR	9	15
Pierces FTM	7	11.7
Pierces FPB	2	3.3
Passes around FR	41	68.3
Crosses in front of FR	1	1.7
Total	60	100

n, number of cases; FR, flexor retinaculum; FTM, fibrotendinous membrane; FPB, flexor pollicis brevis.

Table 4. *Location of the muscular branch in the palm in relation to the distal wrist crease*

Distance (mm)	Right side n	%	Left side n	%
28.1–31	8	28.6	3	10.7
31.1–34	4	14.3	10	35.7
34.1–37	8	28.6	8	28.6
37.1–40	7	25	6	21.4
40.1–X	1	3.5	1	3.5
Total	28	100	28	100

n, number of cases; right mean, 34.6 mm, S.D. 3.9; left mean, 34.6 mm, S.D. 3.2; $P > 0.05$.

encircling it or passing through it, and occasionally piercing a fibrotendinous membrane between the origin of FPB and the retinaculum (Table 3). The point where the muscular branch appeared in the superficial part of the palm was located relative to the distal flexor crease of the wrist. The mean value for this distance was 34.6 ± 3.9 mm with no significant difference between right and left hands (Table 4).

The recurrent angle was derived from the distance between the muscular branch and the axis of the hand. The distance was measured between its point of division into the small branches to APB and OP and the axis of the hand (proximal distance), and between the axis of the hand and the point where the muscular branch appeared, medial to the superficial head of FPB (distal distance). The mean distal distance was 3.4 ± 1.8 mm in both the right and left hands. The mean proximal distance was 6.6 ± 2.5 mm in the right and 7.0 ± 2.9 mm in the left hand with no significant difference between them. The mean value for the recurrent angle in relation to the axis of the hand was $66.8 \pm 7.9°$. The course between the point where the muscular branch appeared in the superficial part of the hand and the point of its division in the space between APB and FPB averaged 8.7 ± 3.0 mm on the right side and 9.2 ± 4.1 mm on the left.

The muscular branch of the median nerve innervated APB, OP and the superficial head of FPB in 50% of cases (type I pattern), and APB and OP alone in 40% (type II). Independent branches were given to APB, OP and the superficial head of FPB, just to APB and OP, or to APB and the superficial head of FPB in 10% (type III).

An 'accessory thenar branch' was found in 23 cases, comprising 38.3% of the total cases. It supplied the superficial head of FPB in 36.7% and OP in 1.7%. In 17 cases it provided the sole innervation of the superficial head of FPB. We also found an anomalous nerve that reached the ventro-ulnar part of the lateral branch of the median nerve in relation to the origin of the muscular branch. The nerve arose from the lateral aspect of the trunk of the median nerve, 52.5 mm proximal to the distal flexor crease of the wrist. It descended almost vertically over the lateral part of the flexor retinaculum covered by APB and some fibres of FPB (Fig. 2).

DISCUSSION

The importance of the muscular branch of the median nerve is unquestionable, as it innervates the muscles of the thenar eminence, responsible for the efficiency of the thumb and multiple activities of the hand. We agree with most of the referenced authors that this nerve is derived from the lateral division of the median nerve (Henle, 1867; Gray, 1878; Tandler, 1929; Chiarugi, 1931; Testut & Latarjet, 1931; Spalteholz, 1965; Mumford et al. 1987). Duroux et al. (1953), however, documented this arrangement in 30% of instances and in 15% an origin from the proper palmar digital nerve for the radial side of the thumb. We did not find the muscular branch arising from the medial part of the median nerve as has been described in some studies (Entin, 1968; Benini, 1975). Knowledge as to this arrangement is of surgical importance in interventions in the carpal tunnel. An origin for the muscular branch in the carpal tunnel was reported in 66.7% of cases by Duroux et al. (1953), in 70% by Johnson & Shrewsbury (1970) and in 20% by Mumford et al. (1987). The results of our study conform to those of last authors. Others have also reported this origin but without expressing frequencies.

From the 60 samples studied, there is 1 which deserves special attention because it corresponds to a muscular branch arising in the distal part of the forearm. This origin was associated with a high

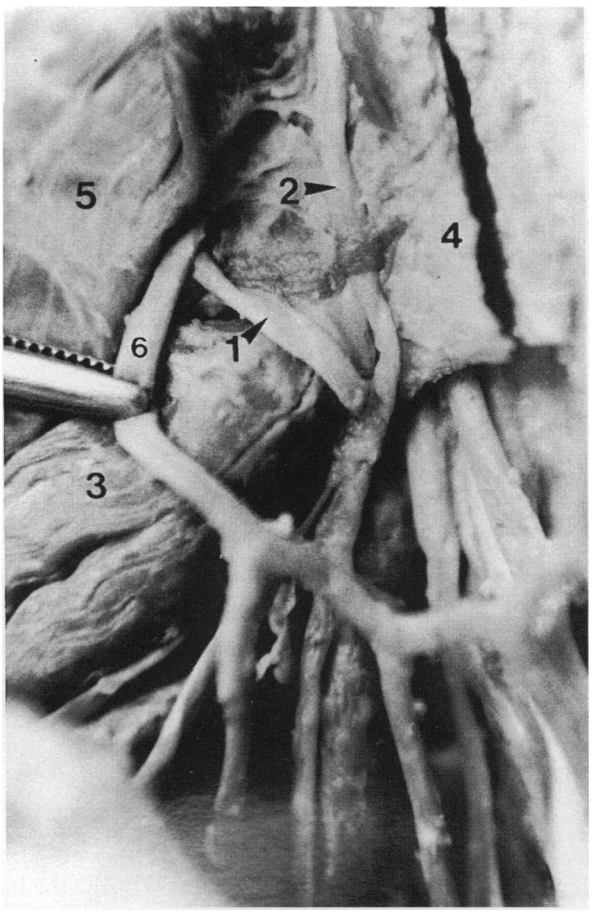

Fig. 2. Right hand. 1, Muscular branch of median nerve; 2, anomalous branch arising in antebrachial portion of median nerve; 3, superficial head of flexor pollicis brevis; 4, flexor retinaculum; 5, abductor pollicis brevis; 6, superficial palmar branch of radial artery.

division of the median nerve. We could find no previous report of a similar case. This important variation must be considered during surgical interventions in the distal forearm.

The course taken by the muscular branch after its origin is slanting and laterally directed up to the medial margin of the superficial head of FPB when it originates proximal to the distal margin of the flexor retinaculum, and almost horizontal when it originates at the margin or distal to it. We found no information on the distance that this nerve runs between its origin and the medial margin of FPB and only a few authors have described the total length of the nerve. Thus Duroux et al. (1953) reported that the muscular branch measures from 2 to 5 mm, which is at variance with our results. Johnson & Shrewsbury (1970) pointed out that the total length of the nerve is from 9 to 13 mm, which is compatible with our findings.

In 10% of our cases the branch did not reach, or reached only the medial margin of FPB; these nerves had a total length of 3.2–5 mm. Such muscular branches split precociously into terminal branches producing more than 1 branch in the palm (Olave et al. 1995). The existence of 2 muscular branches has been described previously in 1 of 36 cases (Duroux et al. 1953), 3 out of 50 (Bonnel et al. 1980) and 1 in 20 (Mumford et al. 1987). Sometimes this has been described as a duplication of the thenar branch although some cases may not be a real duplication but a very proximal division (Benini, 1975).

Based on our results the muscular branch may pass to the palmar space through the flexor retinaculum or through a fibrotendinous membrane at the origin of FPB or, as in most cases, around the retinaculum or FPB. Passage through the flexor retinaculum was reported in 80% (Johnson & Shrewsbury, 1970), 5.7% (Benini, 1975), 23% (Poisel, 1975), 35% (Bonnel et al. 1980), 60% (Falconer & Spinner, 1985) and 20% (Mumford et al. 1987). Other authors pointed out that when this branch originates in the carpal tunnel, it may sometimes pierce the flexor retinaculum (Bennet & Crouch, 1982; Lanz, 1977). We agree with most of the previous authors, but the high results recorded by Johnson & Shrewsbury (1970) and Falconer & Spinner (1985) may be result of including in the flexor retinaculum part of the fibrotendinous tissue of the thenar muscles, basically from the superficial head of FPB, which has part of its origin from this retinaculum. Passage through these fibres may lead to compression of the muscular branch and consequent dysfunction of the muscles innervated by it.

Relatively little information is available with regard to the topographical localisation of the muscular branch in the palmar space. Bonnel et al. (1980) reported that the apparent origin of this nerve is located at 2 levels: an upper at 40 to 50 mm and another lower one at 20 to 40 mm from the bistyloid line (the line between radial and ulnar styloid processes). In our series, the mean distance was 34.6 mm in relation to the distal wrist crease with no significant difference between the right and left hands.

Concerning the angle made by the nerve when it arises laterally, Mumford et al. (1987) pointed out that it forms an angle of 30° to 45° in relation to the median nerve. We believe it is important to know with accuracy the distances in relation to certain points of reference such as the distal wrist crease and the longitudinal axis of the hand, and the angle that this branch forms in making its course, so as to avoid injuries from surgical intervention in this region.

With respect to the distribution of the muscular branch in the thenar muscles, it is normally described as being destined for APB, OP and the superficial

head of FPB (Tandler, 1929; Testut & Latarjet, 1931; Brash & Jamieson, 1943; Le Gros Clark, 1949; Paturet, 1951; Orts Llorca, 1967). Nevertheless, there are articles which have reported these 3 muscles as being innervated by this branch in 63.3% (De Souza, 1975), 90% (Falconer & Spinner, 1985), 45% (Mumford et al. 1987) or that the muscular branch innervates only APB and OP in 36.7% (De Souza, 1975), 10% (Falconer & Spinner, 1985) and 35% (Mumford et al. 1987). Our patterns I and II (Olave et al. 1995) are in agreement with De Souza (1975) and Mumford et al. (1987). Our pattern III in which we included the short branches that split precociously into terminal branches, have varied destinations, both for the first and last innervated muscles (Olave et al. 1995).

The so-called 'accessory thenar branch' (Mumford et al. 1987) or 'accessory recurrent branch' (Homma & Sakai, 1992) usually supplied the superficial head of FPB, and OP in 1 case. It has been reported that the innervation of the superficial head of FPB originates from the palmar digital nerve in 32.2% (De Souza, 1975) or from the collateral radial nerve of the index finger in 25% (Caetano, 1982). Other authors found this 'accessory branch' in 15 out of 20 samples (Mumford et al. 1987) and in 5 out of 6 samples (Homma & Sakai, 1992). In the 22 cases in which we found this branch, it was the exclusive innervation of the superficial head of FPB in 17 cases.

Finally, the results of this study suggest that the muscular branch of the median nerve has too broad a denomination in the Nomina Anatomica, as besides being constantly present, it supplies at least 2 of the thenar muscles and in half of cases 3 of these muscles, a reason why it could properly be termed the 'recurrent thenar branch', a term which is more descriptive and informative. In this way, it would easily be identified, distinguishing it from other muscular branches described in the Nomina.

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