

Anatomical variations of the median nerve in the carpal tunnel

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Summary. *The median nerve was explored in 100 hands and the variations classified by the Lanz system. Only 47.7% of hands showed the standard anatomy described in textbooks. Rare variations were also found. Knowledge of the variable anatomy of the nerve could help to avoid incomplete decompression at operations for carpal tunnel entrapment and injury to the thenar branch of the nerve. The possibility of double thenar innervation must be considered in preoperative evaluation and in the follow up of median nerve injuries.*

Résumé. *L'objet de ce travail est d'évaluer la fréquence des variations du nerf médian dans le canal carpien. Le nerf médian a été étudié sur 100 mains et les variations ont été classées selon le système de Lanz. Quarante-sept, sept % des mains seulement étaient conformes à la description classique (anatomie de Gray). Dans le groupe 2 les auteurs ont observé une variation rare, décrite en 1904 par Chevrier. La connaissance des variations anatomiques du nerf médian permet d'éviter les complications les plus communes: décompression incomplète et lésions iatrogéniques de la branche thénarienne. Lors de l'évaluation pré-opératoire ainsi que lors de la révision post-opératoire il faut envisager la possibilité d'une double innervation thénarienne.*

Introduction

Anatomical variations of the median nerve may influence symptoms and are an important consideration during operative treatment [4, 5, 18, 21, 22, 25, 27, 30, 34]. The classical description of the nerve in the carpal tunnel is given in Gray's Anatomy [33].

We carried out an anatomical study at operations for carpal tunnel entrapment and median nerve injuries, together with cadaveric dissections, to determine the incidence of the known variations and their possible clinical variations.

Patients and methods

Carpal tunnel release was carried out in 65 patients. In addition, we operated on 10 median nerve injuries and carried out 25 cadaver dissections. We used the Lanz classification [14] to group the variations encountered (Fig. 1):

Group 0 – an extraligamentous thenar branch which curves back at the distal margin of the transverse ligament before entering the muscles.

Group 1 – variations of the thenar branch:

subgroup 1A – a subligamentous branch starts beneath the ligament and then bends around it [14].

subgroup 1B – a transligamentous branch passes through a foramen in the distal part of the transverse ligament [24].

subgroup 1C – the thenar branch leaves the ulnar side of the median nerve [3].

subgroup 1D – the supraligamentous thenar branch bends around the distal margin of the transverse ligament and then runs on the surface of the ligament before entering the muscles [20].

Group 2 – the presence of an accessory thenar branch in the distal part of the tunnel.

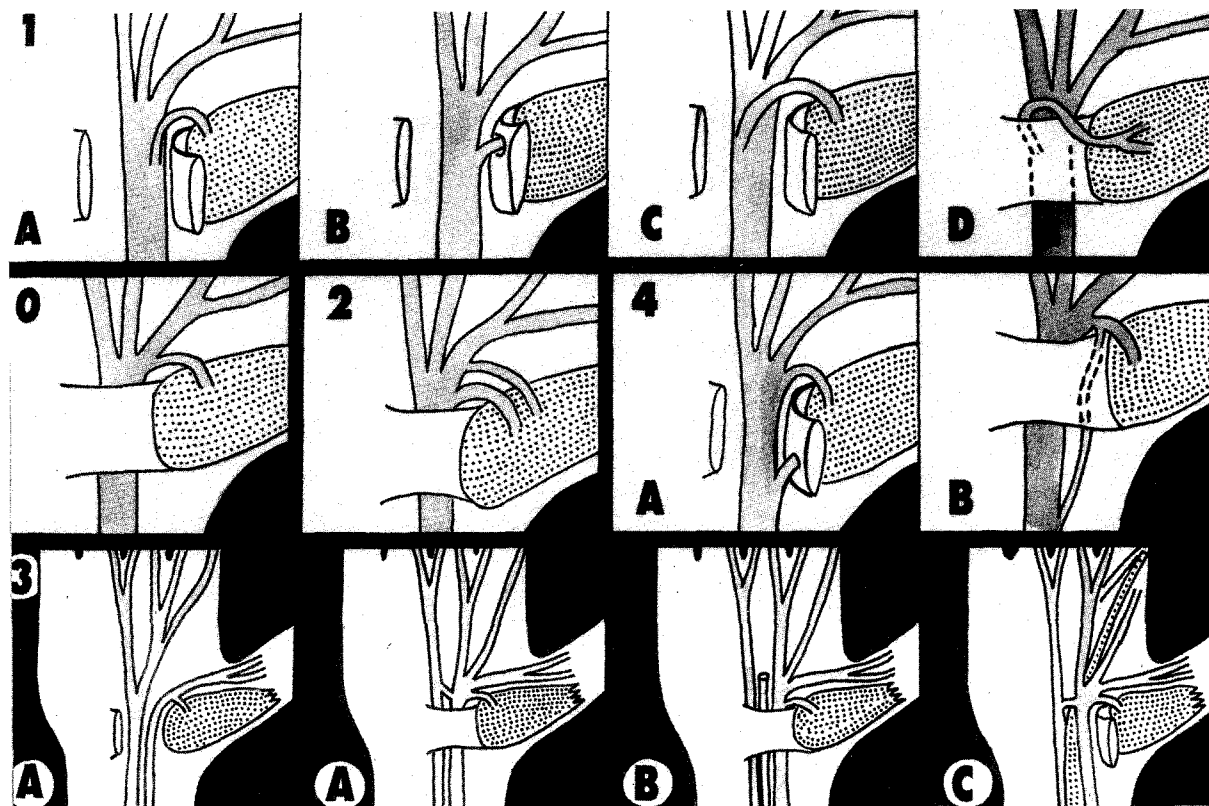


Fig. 1. The Lanz classification of anatomical variations of the median nerve at the wrist. Group 1 – Thenar branch variations: subgroup 1A – subligamentous; subgroup 1B – transligamentous; subgroup 1C – ulnarwards; subgroup 1D – supraligamentous. Group 0 – Extraligamentous thenar branch. Group 2 –

Distal accessory thenar branch. Group 4 – Proximal accessory thenar branch; subgroup 4A – direct in the thenar muscles; subgroup 4B – joining another branch. Group 3 – High division: subgroup 3A – without an artery or muscle; subgroup 3B – with artery; subgroup 3C – with lumbrical muscle

Group 3 – a high division of the median nerve:
 subgroup 3A – a high division of the median nerve which is not separated from the main branch by a muscle or artery [2, 10].
 subgroup 3B – a high division associated with a median artery [2].
 subgroup 3C – an accessory lumbrical muscle is present between the two branches of a high division of the median nerve.

Group 4 – an accessory branch is present in the proximal part of the tunnel:
 subgroup 4A – an accessory branch running directly in the thenar muscles proximal to the carpal tunnel [16].
 subgroup 4B – a proximal accessory branch joins another branch [23].

Results

In the 65 patients on whom a carpal tunnel release was carried out, the variations of the median nerve were classified as follows (Table 1): 31 were in group 0; 13 in subgroup 1A; 12 in subgroup 1B; 3 in subgroup 1C, and there was one case in subgroup 1D.

A rare variation was found in group 2 in which a distal accessory thenar nerve branched 5 mm from its origin and extended into the second interdigital space (Fig. 2).

Table 1. Classification of the variations of the median nerve related to the source of the anatomical findings. Entrapment (n = 65) = the cases of carpal tunnel operation. Injury (n = 10) = median nerve injuries. Dissection (n = 25) = cadaveric dissection

Group	0	1				2	3			4		Total
Subgroup		A	B	C	D		A	B	C	A	B	
Entrapment	31	13	12	3	1	2	0	0	0	3	0	65
Injury	5	1	1	1	1	0	0	1	0	0	0	10
Dissection	12	3	3	1	0	5	0	0	0	1	0	25
Total	48	17	16	5	2	7	0	1	0	4	0	100

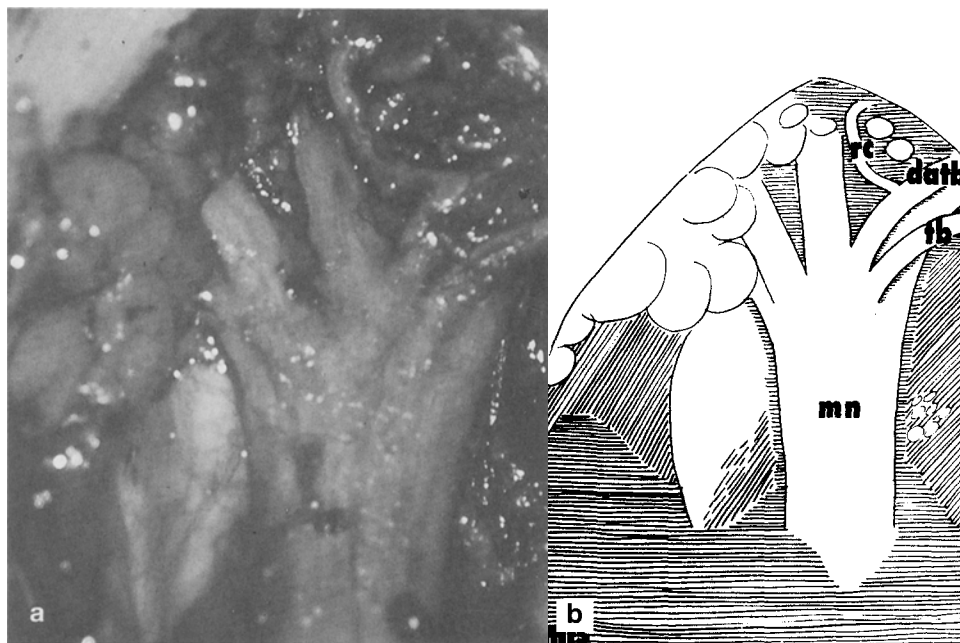


Fig. 2. a Operative photograph showing a distal accessory thenar nerve branching 5 mm from its origin and extending into the second interdigital space and forming the Riche-Cannieu anastomosis. b Explanatory diagram: *mn* = median nerve; *tb* = thenar branch; *datb* = distal accessory thenar branch; *rc* = Riche-Cannieu connection

One patient had an injury to the ulnar part of a high division of the median nerve and a partial lesion of the median artery which bled profusely (subgroup 3B).

All the patients in group 4 were in subgroup 4A and we did not find any examples of subgroup 4B.

In the cadaveric dissections, there were 5 out of 25 (20%) variations classified as group 2; compared to only 2 out of 65 (3.1%) in the group of those operated on (Table 1).

Discussion

The transligamentous branch (subgroup 1B), which was found in 13 patients, passes through its own foramen in the carpal ligament, and this may be compressed [26, 34]. The patient may complain of thenar weakness and wasting, but without sensory disturbance when this solitary recurrent branch is affected. Exploration of the thenar branch is indicated when there is weakness and wasting, and it should be decompressed.

During carpal tunnel release, care must be taken to avoid injury to the motor branch [15] in subgroups 1A, 1C and 1D which comprise onequarter of the cases. A longitudinal incision placed to the ulnar side could prevent damage to the thenar branch.

The smaller number of patients who were operated on and were in group 2 compared to the number in this group in the cadaveric dissections suggest the need for more precise surgical ex-

ploration. Incomplete carpal tunnel decompression is the most common complication occurring in up to 20% [6, 11, 13, 18, 29, 31], but this could be prevented by accurate dissection. The accessory distal thenar branch is often sensory and should be preserved because of the risk of producing a painful neuroma [1, 17, 18].

A distal accessory thenar nerve branching 5 mm from its origin and extending to the second interdigital space is a variation found in group 2 (Fig. 2). A separate branch of the median nerve to the superficial head of flexor pollicis brevis, which

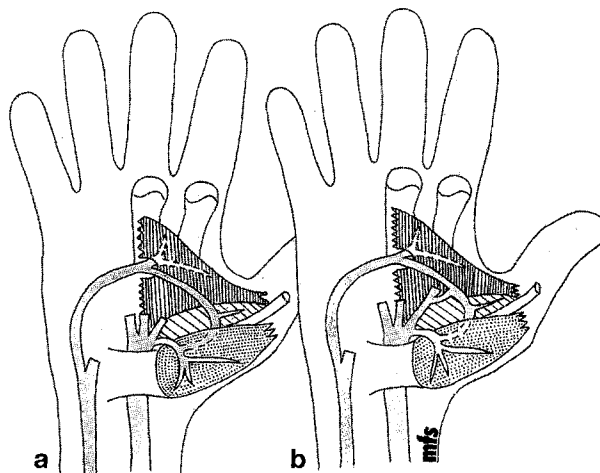


Fig. 3. Diagram showing: a The Riche-Cannieu anastomosis between the thenar branch of the median nerve and the deep branch of the ulnar nerve. b The accessory thenar branch arising from the first common digital nerve and making a loop with the thenar branch and the deep branch of the ulnar nerve

sends a branch to the Riche-Cannieu anastomosis, has been described.

A connection between the motor branch of the median nerve and the deep branch of the ulnar nerve has been described as the Riche-Cannieu anastomosis. It has been reported as being a common arrangement of thenar innervation (Fig. 3), occurring in 27 out of 35 cases, and 4 out of 6 cases in two series [7, 8]. The anastomosis is usually partly superficial and partly deep to the thenar muscles. An accessory thenar branch has been reported as coming from the first common palmar digital nerve in 5 cases out of 6, with the thenar branch and the deep ulnar branch making a loop in 4 cases out of 6 (Fig. 3b) [8]. The nature, incidence and direction of the fibres' pathway is not resolved [19]. The communication provides a path for cross or double innervation of the muscles anywhere in the hand, and may be the way fibres from the ulnar nerve reach the muscles [9]. Incorrect judgement about the function in the median nerve after injury at the wrist is likely to occur in about one-third of cases [12].

Useful motor function is recovered in 81% of cases of low median nerve grafting, but this good result may not be entirely due to nerve regeneration. Double thenar innervation occurs frequently.

It is important to bear in mind the possible existence of a double median nerve and a proximal accessory thenar branch (groups 3 and 4) during operations on median nerve injuries at the wrist.

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