Surg Radiol Anat (1999) 21: 165-168

Surgical and Radiologic Anatomy
Journal of Clinical Anatomy

Innervation of the medial epicondylar muscles: an anatomic study in 50 cases

C. Chantelot[1, 2], C. Feugas[1, 2], P. Guillem[1], D. Chapnikoff[1, 2], F. Rémy[2] and C. Fontaine[1, 2]

[1] Laboratoire d'Anatomie et d'Organogenèse, Faculté de Médecine, 1, place de Verdun, F-59045 Lille Cedex, Fance
[2] Service d'Orthopédie B, Hôpital Roger Salengro, CHRU de Lille, F-59037 Lille Cedex, France

Summary: The median nerve is classically distributed to the medial epicondylar muscles by two branches (superior and inferior) for the pronator teres muscle, a common trunk for the flexor carpi radialis and palmaris longus muscles, and a branch for the flexor digitorum superficialis muscle. The 50 dissections were made by two workers on 30 upper limbs of formolized cadavers and 20 limbs from fresh-frozen cadavers. The innervation of the pronator teres m. was classical in only 26% of cases, and the "normal" pattern for the flexor carpi radialis and palmaris longus mm. was found in only 40% of cases. The innervation of the flexor digitorum superficialis m. was the least subject to variations, a single branch being observed in 68% of cases. We found a solitary medio-ulnar anastomosis of Martin-Gruber to the flexor carpi ulnaris muscle. This study confirmed the great variability of the branches of the median nerve at the elbow, and the importance of identifying them in surgical procedures for transposition of the medial epicondyle.

Correspondence to: C. Chantelot

Innervation des muscles épicondyliens médiaux (nerf médian) : étude anatomique sur 50 cas

Résumé : Le nerf médian se distribue classiquement aux muscles épicondyliens médiaux par deux rameaux (supérieur et inférieur) pour le muscle rond pronateur, un tronc commun pour le muscle fléchisseur radial du carpe et pour le muscle palmaire long, et un rameau pour le muscle fléchisseur superficiel des doigts. Les 50 dissections ont été réalisées par deux opérateurs, il s'agissait de 30 membres supérieurs de cadavres formolés et de 20 provenant de cadavres frais congelés. L'innervation du muscle rond pronateur était classique dans seulement 26 % des cas. Pour le muscle fléchisseur radial du carpe et le muscle palmaire long, nous n'avons constaté une disposition habituelle que dans 40 % des cas. L'innervation du muscle fléchisseur superficiel des doigts était la moins sujette à variations, un rameau isolé a été observé dans 68 % des cas. Nous avons retrouvé une seule anastomose médio-ulnaire de Martin-Gruber destinée au muscle fléchisseur ulnaire du carpe. Cette étude a confirmé la grande variabilité des rameaux du nerf médian au coude, et l'importance de leur connaissance dans les interventions chirurgicales comportant une transposition de l'épicondyle médial.

Key words: Median nerve — Medial epicondylar muscles — Martin-Gruber

The distribution of the median n. is very variable [1, 8]. The anatomy textbooks usually describe only the most frequent pattern [5, 7, 10, 11, 15]. As stated in the literature the most classical distribution is two branches (superior and inferior) for the pronator teres m. (PT), a common trunk for the flexor carpi radialis m. (FCR) and the palmaris longus m. (PL) and a branch for the flexor digitorum superficialis m. (FDS) [1, 3, 4, 7, 9, 14]. Sunderland studied more precisely the distribution of the different branches of the median n. [14]. Canovas et al specified the different morphometric parameters of the nerve branches in 18 fresh cadavers and their study confirmed the great variability of these parameters [3]. Below the bend of the elbow the median n. innervates the medial epicondylar mm. This muscle group has its function in the mobility of the hand and wrist [6]. The medial epicondyle can be transposed surgically according to Steindler to improve the power of elbow flexion in the sequelae to paralysis of the brachial plexus. Either all of the medial epicondylar mm can be transposed [12] or the FDS can be left in place [2]. Also, the epicondylar block can replace the coronoid process of the ulna in recurrent dislocations of the elbow; during this transfer the nerve branches to the medial epicondylar mm. may be stretched. The aim of our study was to ascertain the variations of distribution of the median n. to the medial epicondylar mm.

Material and methods

The 50 dissections were performed by two workers (CC, CF) and were made on 25 cadavers (15 women and 10 men). There were 30 upper limbs from formolized cadavers (15 right and 15 left limbs) used only for this morphologic study. Twenty limbs obtained from fresh frozen cadavers were used (10 right and 10 left) to supplement the morphologic study and to define in a complementary study the effects of transposition of the medial epicondyle on the branches of the median n. in conditions similar to those encountered during surgical procedures by Steindler's technique.

The dissection was performed without optical magnification. The skin and subcutaneous tissue were removed from the limbs. After dividing the brachial and antebrachial fasciae, reinforced by the aponeurotic expansion of the biceps brachii m., the median n. was identified in the medial bicipital sulcus. At the bend of the elbow the median n. was concealed by the medial epicondylar mm., which were retracted medially to continue the dissection. Only the coronoid bundle of the PT was divided, to allow better dissection of the different nerve branches. The dissection was extended to the branch for the lateral heads of the flexor digitorum profundus m. FDP. The vascular structures were not preserved as we were concerned only with the innervation of the epicondylar mm. (Fig. 1). Each specimen was documented by a morphologic description, a diagram and a photograph.

Results

In all 50 cases the median n. traveled between the deep (coronoid) head and the superficial (epicondylar) head of the PT. No case of supra-epitrochlear process was found [13].

Innervation of the pronator teres m.

The innervation of the PT was effected in 13 cases by two well individualized

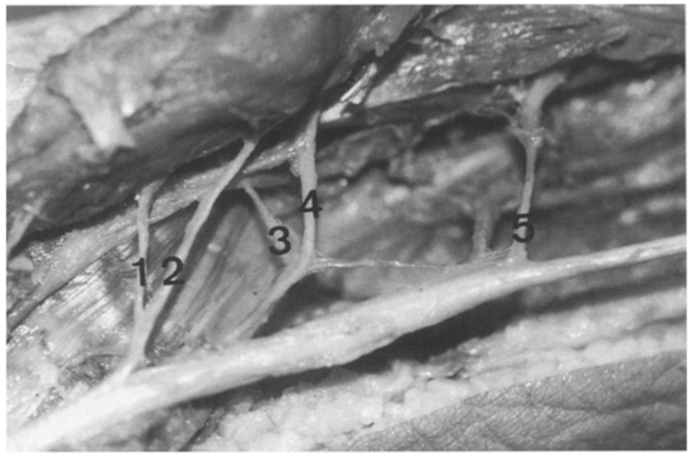

Fig. 1
Classical distribution of median n. at the elbow (2 branches for the PT, 1 common trunk for the FCR and PL, and a branch to the FDS)

branches (one superior and one inferior) and in 28 cases by a single branch to the PT. In one anatomic specimen we found a single superior branch and another arising from a common trunk with the nerve to the FDS. Two elbows had a common trunk for the nerves to the PT, FCR and PL mm. We found 1 case with three branches to the PT (Fig. 2). In 3 cases there was a single common trunk for the four superficial medial epicondylar mm. In 48 cases the first branch found was to the PT, but in 1 case there was a branch to the FCR and in another there was a first common trunk for the nerve to the FCR and PL mm. and a second common trunk for the nerves to the PT and FDS mm. Altogether, we found the classical distribution (one superior and one inferior branch) in only 26% of cases and there were 74% with anatomic variants, the chief of which was a single branch (56%).

Innervation of the flexor carpi radialis m.

In 20 cases the innervation was effected by a common trunk with the nerve to the PT. An isolated branch to the FCR was found in 16 cases. We also noted 1 case of a common trunk for the nerves to the PT and FCR, 7 cases with a common trunk for the nerves to the FCR, PT and FDS, and 2 cases with a common trunk for the nerves to the PT, FCR and PT mm. (Fig. 3). In 1 case the innervation of the FCR came from 2 trunks, of which one was common with the FCR and another was common with the FDS and FDP. In 3 cases we

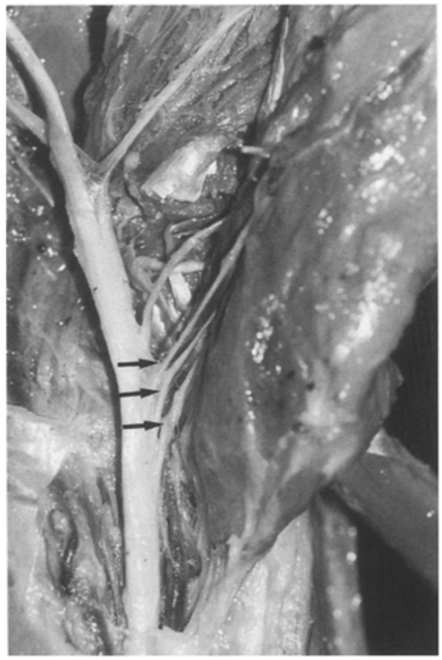

Fig. 2
The innervation of the PT is effected by 3 branches

found a single common trunk for the four superficial medial epicondylar mm. Altogether, we found the classical distribution (a common trunk for the FCR and PL) in only 40% of cases, a single branch in 32% of cases, and anatomic variants in 28%.

Innervation of the palmaris longus m.

In 20 cases the innervation was effected by a common trunk with the nerve to the FCR. Often the PL received a single branch (15 cases). We also found 2 cases with a common trunk for the nerves to

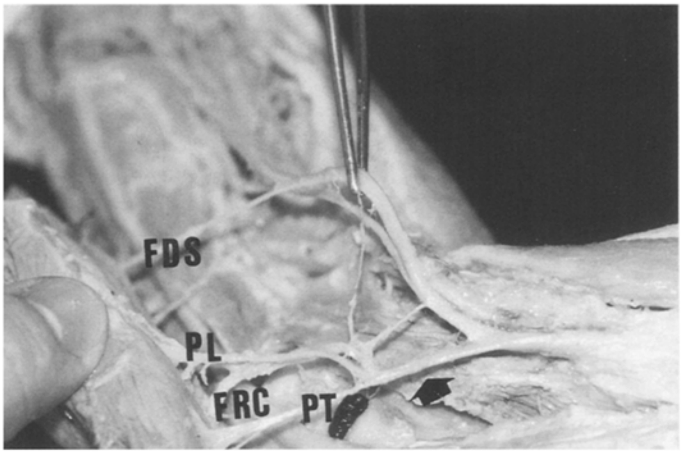

Fig. 3
A common trunk for the PT, FCR and PL

Fig. 4
A common trunk for the FDS and FDP

Fig. 5
The branch to the FDP appears at the level of the medial epicondyle, proximal to the branches to the FDS

the PT, FCR and PL, and 7 cases with a common trunk for the nerves to the FCR, PT and FDS. The PL shared its innervation with the FDS in 3 cases. In 3 cases there was a single common trunk for the four superficial medial epicondylar mm. As with the FCR, we found the classical distribution (a common trunk for the FCR and PL) in only 40% of cases, an isolated branch in 30%, and variants in 30% of cases.

Innervation of the FDS m.

We found a solitary well-marked branch in 34 cases. In 16 cases the FDS shared its innervation with one or more of the medial epicondylar mm.: in 7 by a common trunk for the nerves to the FCR, PL and FDS, in 3 by a common trunk for the nerves to the PL and FDS, in 3 by a single common trunk for the nerves to the four superficial medial epicondylar mm., and in 2 by a common trunk with the nerve to the FDP. In one case a large common trunk divided into two secondary trunks, one to the FCR and FDS, and in the other to the FDS and FDP (Fig. 4). Altogether we found the classical pattern (a solitary branch) in only 68% of cases.

Innervation of the flexor digitorum profundus and flexor carpi ulnaris mm.

The median n. branches to the FDP arose in 2 cases from a common branch with the nerve to the FDS. In one case we found a branch to the FDP arising from the median n. at the level of the medial epicondyle proximal to the branches to the FDS (Fig. 5). In one case we found a solitary branch to the flexor carpi ulnaris m. (FCU) given off by the median n. via a common trunk with the nerves to the FCR and PL. This common trunk corresponded to a variant of the communicating medio-ulnar branch of Martin-Gruber (Fig. 6).

Diagrams of the commonest innervations

Figure 7 lists the chief patterns encountered. The distributions not listed involved only a single specimen.

Discussion

This study of 50 dissections of the median n. at the elbow confirmed the great variability of the distribution of the nerves to the medial epicondylar mm. The pattern usually described occurred in fewer than 50% of cases: 2 branches (superior and inferior) for the PT, a common trunk for the FCR and PL mm., and a branch for the FDS m. Like Canovas and Sunderland, our purely descriptive study confirmed the frequent absence of any regular pattern of the median n. at the elbow [3, 14]. Their studies attempted to give a morphometric account of the different branches [3, 14]. We attempted in this study to list only the anatomic variations. Many of our cadavers were formolized, thus leading to too much change in the tissues to allow a good morphometric study. A precise measurement of the different branches in fresh cadavers would be helpful by better preserving the mechanical quality of the tissues. We noted variations

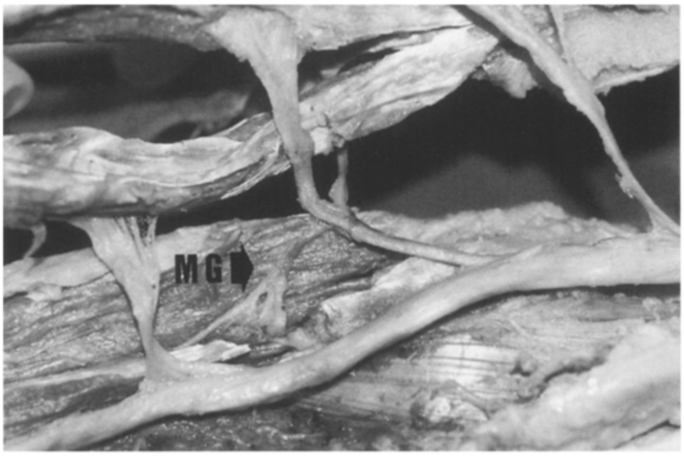

Fig. 6 Medio-ulnar communicating branch of Martin-Gruber supplying the FCU

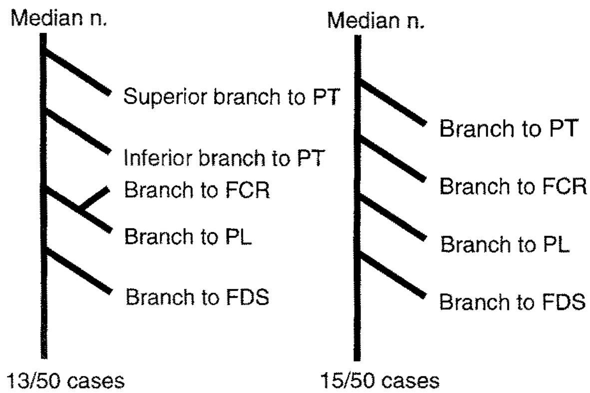

Fig. 7 Principal distributions of median n.

not described in earlier studies, possibly linked to the greater number of dissections performed. A solitary branch destined exclusively to the FDS was the only pattern common to 68% of the subjects. Unlike other studies, in 16 cases the FDS shared its innervation with one or more of the medial epicondylar mm. We found a Martin-Gruber medio-ulnar communicating branch allowing innervation of the flexor carpi ulnaris m.

Apart from traumatic causes, few disorders of the median n. at the elbow have been reported. The median n. may be compressed during its passage between the deep (coronoid) and superficial (epicondylar) heads of the pronator teres m. [1]. According to Beaton and Anson [1] the nerve travels between these two muscle heads in only 82% of cases. Also, Spinner et al have reported the possibility of compression of the median n. by an accessory aponeurotic expansion of the biceps brachii m. [13]. We did not find any of these anomalies in our 50 specimens.

The aim of our study was to assess the fate of these branches during transposition of the medial epicondyle by Steindler's method for restoration of elbow flexion [13]. In this operation the medial epicondylar mm. are transposed to the anterior aspect of the humerus 4 to 6 cm above the elbow crease; the mobilization of all the nerve branches may cause their stretching and thus a paralysis or reduced power of the transferred muscles. Mobilization of the epicondylar block is often difficult and the dissection must allow for all these variations to prevent a lesion of one of the motor branches. Partial mobilization of the medial epicondyle leaving the FDS in place, as described by Brunelli [2], appears dangerous unless one is certain in advance that the branch to the FDS does not arise from a common trunk with another nerve branch destined for one of the transposed muscles.

Conclusion

The study confirmed the great variability in the distribution of the median n. to the medial epicondylar mm. Many specimens showed a distribution differing from the classical pattern. Based on the studies of Canovas and Sunderland, it would be useful to make a morphometric study of the median n. at the elbow before and after Steindler's transposition to assess its effects on the different nerve branches.

References

1. Bonnel F, Mansat M (1989) Nerfs périphériques (anatomie et pathologie chirurgicale). Masson, Paris, Tome 1, pp. 110-132
2. Brunelli GA, Vigasio A, Brunelli GR (1995) Modified Steindler procedure for elbow flexion restoration. J Hand Surg 20A: 743-746
3. Canovas F, Mouilleron P, Bonnel F (1998) Biometry of the muscular branches of the median nerves to the forearm. Clinical Anatomy 11: 239-245
4. Gunther SF, Di Pasquale D, Martin R (1992) The internal anatomy of the median nerve in the region of the elbow. J Hand Surg 17-A: 648-656
5. Hovelacque A (1927) Anatomie des nerfs crâniens et rachidiens et du système grand sympatique chez l'homme. Doin, Paris, pp. 441-448
6. Kapandji IA (1991) Physiologie articulaire (membre supérieur). Maloine, Paris, pp. 80-137
7. Lazorthes G (1955) Le système nerveux périphérique. Masson, Paris, pp. 233
8. Linell E (1921) The distribution of the nerves in the upper limb, with reference to variabilities and their clinical significiance. J Anat 55: 79-112
9. Liu J, Pho R, Pereira B, Lau HK (1997) Distribution of primary motor nerve branches and terminal nerve entry points to the forearm muscles. Anatomical Record 248: 456-463
10. Paturet G (1954) Traité d'anatomie humaine. Masson, Paris, Tome 2, pp. 472-477
11. Rouvière H, Delmas A (1984) Anatomie humaine. Masson, Paris, Tome 3, pp. 232-233
12. Steindler A (1919) Operative treatment of paralytic conditions of the upper extremity. J Orthop Surg 1: 608-624
13. Spinner RJ, Carmichael SW, Spinner M (1991) Partial median nerve entrapment in the distal arms because of an accessory bicipital aponevrosis. J Hand Surg 16A: 236-244
14. Sunderland S, Ray L (1946) Metrical and non-metrical features of the muscular *rameaux* of the median nerves. J Comp Neurol 85: 191-203
15. Testut L (1899) Traité d'anatomie humaine, Doin, Paris, pp. 167-168

Received December 10, 1998 / Accepted in final form March 12, 1999