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C7 contribution to the ulnar nerve. Literature review

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ABSTRACT

Introduction. Classic anatomical literature frequently describes C7 contribution to ulnar nerve (UN) formation as a casual event. However, surgical practice and dissections frequently reveal a recurrent presence of a lateral cord component of the UN. This study aimed to seek through literature to establish the frequency and degree of this contribution.

Methodology. We ran a literature review searching on Pubmed, MEDLINE, Embase and Web of Science databases for ulnar nerve anatomy and described discursively the results.

Results and discussion. We found 9 articles that described quantitatively and qualitatively the contribution of C7 on the formation of the UN. The prevalence described ranged from 2 to 100%, depending on the methodology used and population characteristics. When present, studies described a contribution from 9,9% to 30,4%, sending even more fibres than T1 root on average.

Conclusion. The C7 root can be considered a frequent and important component of the ulnar nerve, explaining UN territory repercussions on C7 radiculopathies. This knowledge is important on surgical approaches, maybe avoiding iatrogenic lesions and negative outcomes.

INTRODUCTION

The anatomical literature reports the origin of the ulnar nerve (UN) as the medial fascicle (C8-T1), but often receiving fibers from the ventral branch of C7. It is also mentioned its path through the axilla, initially

medial to the axillary artery and between this and the vein, continuing distally medial to the brachial artery up to the middle third of the arm, where the UN punctures the medial intermuscular septum and leans medially as it descends anteriorly to the medial head of the triceps muscle towards the interval between the medial epicondyle and the olecranon, with the superior ulnar collateral artery. Its relationship with the brachial artery and medial epicondyle makes it easy to map in its proximal path; a line from the medial epicondyle to the lateral margin of the pisiform bone represents its distal path[1,2,3,4,5].

Although its path and function are known, there are few records in the literature about the frequency and the way C7 contributes to the formation of the UN. It should also be noted that there are differences between the anatomical study and the electromyographic diagnosis of the nerve. The objective of this study was to seek, through a literature review, to clarify the frequency and the degree of C7's contribution to the formation of the UN.

Methods

An integrative review of the literature was carried out, seeking articles that described qualitatively and/or quantitatively the formation of the UN from the brachial plexus. For this, we searched at MEDLINE, Embase and Web of Science, using the descriptors "Ulnar Nerve" and "Anatomy", with no language or publication date restrictions. The results of the search were discursively described.

Results and discussion

Hur et al. (2013) analyzed 100 brachial plexus (BP) from Korean adult cadavers. The extracted samples were immersed in Guanidine-HCl for 2 weeks. After the contribution of C7 was proven, 20 samples were processed with a routine histological staining (H&E) procedure to count the number of myelinized axons using Imbroglio Modometer software. In all 100 BPs, there was a contribution of C7 to the formation of the ulnar nerve. Moreover, it was unanimous the ramification of the C7 fascicles in the distal portion of the fascicles that compose the lateral root of the median nerve, decussing with the medial root of the median nerve. The contribution of C7 to the ulnar nerve was 1.452 ± 429 (9.9%) myelinized axons, C8 was 11.448 ± 1.473 (78.3%) and T1 was 1.720 ± 382 (11.8%) in the 20 samples processed in H&E[6].

In contrast, Fuss (1989) investigated 158 BPs and reported in his study a 56% contribution of C7 to the formation of the ulnar nerve, highlighting that this collaboration may be accompanied by fibers of the median nerve (type 1) or may occur separately (type 2). Considering the 56:44% relationship between ulnar nerves with and without lateral root, the author highlights that both possibilities should be considered as normal variations[7].

Pyun, Kang and Kwon (2010), after dissection of 38 BPs, reported 13.1% contribution of C7. It is worth mentioning that, for having performed an associated electrophysiological study, this study showed a high prevalence of alterations in the electromyography of M. flexor ulnar carpi in patients with C7 radiculopathy (13/17 = 76.5%)[8].

Kumar and Ranganath (2014) also described only 1 (2%) out of 100 BPs with the contribution of the lateral cord of C7 to the formation of the UN; more precisely, the branches for the UN came from the union of the medial and lateral roots of the median nerve[9].

Guru et al. (2015) dissected 50 upper limbs to observe UN variations. In all, 4 variations were observed, all on the right side. The notable contribution of the BP side cord to the formation of the UN was observed unilaterally in 2 (4%) members. The contributing branch passed from the lateral side to the medial side deeply to the formation of the median nerve and joined the ulnar nerve at its lateral aspect. In the two remaining cases, the ulnar nerve had abnormal communications with the neighboring nerves, radial nerve, and medial cutaneous nerve of the forearm nerve[10].

Emamhadi et al. (2016) dissected 64 fresh BPs in order to evaluate possible anatomical variations, excluding damaged specimens or ante mortem surgical interventions. During the investigations, it was found collaboration of the lateral cord of BP for the formation of the UN in 3 (9.38%) of the 32 cadavers[11].

Koo and Lee (2007) analyzed the composition of the terminal branches of BP, dissecting 32 upper limbs. Regarding the UN, four different patterns were observed. The most frequent type was C7, C8 and T1 (75% of cases). In the average diameter, C8 was the thickest, measuring 2.64 ± 0.57 mm, and T1 was the thinnest with 0.06 ± 0.56 mm[12].

The oldest studies found, performed with even more rudimentary cadaveric dissection techniques, were those of Harris (1904)[13] and Linell (1921)[14], which showed the presence in, respectively, 86% and 57% of the brachial plexus of an exchange of fibers between the medial and lateral plexus strands, specifically the C7 fibers contributing to the formation of the ulnar nerve.

Author, Date	Sample (n)	Methodology	Qualitative Analysis	Quantitative Analysis
Hur et al., 2013	100 BPs	H&E + Imbroglio Modometer	100 (100%, C7)	1,452 ± 429 (9,9%) axônios
Koo, Lee, 2007	32 BPs	Cadaveric dissection	24 (75%, C7)	1,18 ±0.59 mm
Fuss, 1989	158 BPs	Cadaveric dissection	56% (lateral cord)	N/A
Pyun et al., 2010	38 BPs	Cadaveric dissection	13,1% (lateral cord)	N/A
Kumar, Ranganath, 2014	50 BPs	Cadaveric dissection	1 (2%,lateral cord)	N/A
Guru et al., 2015	50 BPs	Cadaveric dissection	2 (4%, lateral cord)	N/A
Emamhadi et al., 2016	64 BPs	Cadaveric dissection	3 (9,38%,lateral cord)	N/A
Ramchandran et al., 2006	1 BP	Case Report	1 (lateral root of the median)	N/A
Linnel, 1921	42 BPs	Cadaveric dissection	57%, C7	N/A
Harris, 1904	60 BPs	Cadaveric dissection	86%, C7	N/A

Figure 1. Summary of the findings of the review on C7 contribution

It is noticeable that the studies that performed quantitative analysis, especially Hur et al. (2013) and Koo and Lee (2007), showed a higher prevalence of C7 contribution than the studies with cadaveric dissection, except for those of Harris (1904) and Linnel (1921) [6,12,13,14]. This can be justified by an eventual iatrogenic loss of the lateral contribution during dissection or by the sophistication of quantitative methods.

In this context, it is frequent a sub-quantification of the contribution of C7 to the nerve during dissection, justifying the absence of root representation in most of the classic anatomic literature [1,2,3,4,5]. In practice, however, the repercussions of C7 radiculopathies on electromyographic variables in part of the UN territory can be seen, as Pyun et al. (2010) have shown[8].

This knowledge becomes essential in neurosurgical practice, since unadvised dissection can cause iatrogenicity. The authors themselves came across the contribution of the lateral cord to the formation of the UN during surgical dissection in the treatment of a brachial plexopathy (Figure 2), which motivated this review.

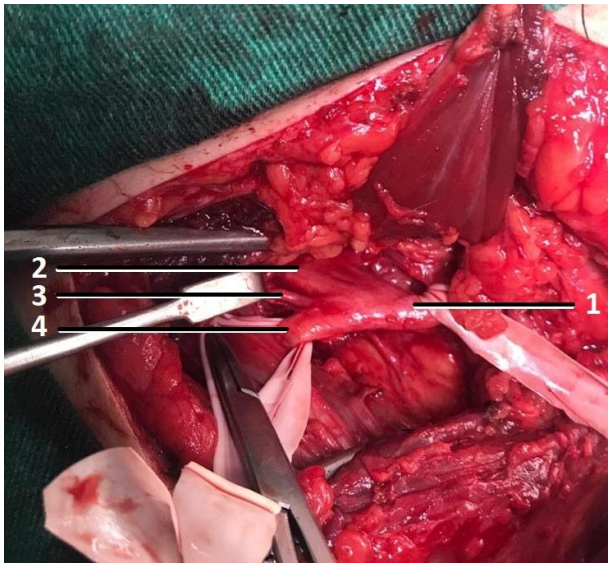

Figure 2.

Conclusion

The C7 root can be considered a frequent component of the ulnar nerve, although its contribution may be underestimated in less sophisticated dissection studies. There is even a high incidence of C7 radiculopathy causing repercussions in the nerve territory. Knowledge of this participation is indispensable for peripheral nerve surgery, avoiding iatrogenic lesions and possible negative outcomes for the patient.

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