ANATOMICAL STUDY OF SENSORY ANASTOMOSSES IN THE HAND

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ABSTRACT
Objective: The aim of this study is to evaluate the prevalence, topography and morphometry of sensitive nervous anastomoses in the hand. Methods: Thirty anatomic parts irrespective of race, gender and age have been dissected. Measurements of anastomoses' length, origin and terminus regarding the transverse carpal ligament were noted. The anastomoses were classified according to the scheme proposed by Meals & Shaner and modified by Bas & Kleinert.

Results: Type 1 anastomosis was the most prevalent. The distance between the origin of the anastomosis to the distal limit of the transverse carpal ligament was 0.7 cm in average.

Conclusion: This study showed that Berretini anastomosis is high prevalent, usually beginning in the ulnar and distal nerve until the transverse carpal ligament. Level of Evidence IV, Case Series.

Keywords: Anastomosis, surgical. Median nerve. Ulnar nerve.

INTRODUCTION
Anastomosis between the median and ulnar nerves are the most common form of anomalous innervation, causing variations in the innervation of the intrinsic muscles of the hand.1,2 Anastomoses are reported in the proximal forearm, rarely distal and in the palmar region between the recurrent branch of the median nerve and the deep branch of the ulnar branch.3 From the anatomical drawings of Berretini, in 1741, began the first reports and studies of nerve anastomosis between the ulnar and median nerves in the hand at the level of the third commissure, known as the “turning point” region4,6 or “ramus communicans cum nervi ulnari” on Terminologia Anatomica.7 In the late 19th century began the first detailed descriptions of the anastomosis by Berretini. Meals and Shaner,6 Dogoan et al.8 were the first to classify this communication according to their anatomical directing, and Ferrari and Gilbert9 (Figure 1) described its anatomical and angular measurement compared with the transverse carpal ligament. Despite the knowledge of its existence, there are few anatomical reports about the sensitive communicating branches between median and ulnar nerves.

The authors aimed to assess the prevalence of sensitive nerve anastomoses in the hand, as well as to specify their topography and morphology in relation to the transverse carpal ligament.
ulnar nerve; type III corresponds to the perpendicular transverse communication between the median and ulnar nerves, however, is not possible to determine which nerve corresponds to the point of origin; and, finally, type IV refers to multiple communicating branches, anatomically complex, from both the median and ulnar nerves. Photographic images were recorded using a digital camera with fourfold magnification.

For statistical analysis software SPSS V17, Minitab 16 and Microsoft Excel 2010 were used. For descriptive statistics, we calculated mean, median, standard deviation, coefficient of variation, quartile one and quartile three, minimum and maximum values and confidence intervals. For analytical statistics, the independent variables were compared using the Mann-Whitney test and the degree of association between these variables was assessed by Spearman’s correlation test. We decided to use non-parametric tests (less than 25 samples) and we have adopted for statistical significance p < 0.05.

RESULTS

Nerve communication between the median and ulnar nerves (Berretini anastomosis) was found in 13 (43.3%) of the 30 dissected anatomical specimens. (Figure 4) In the remainder, there was not any type of nerve anastomosis in the palm of the hand. (Figure 5) All communications originate from the ulnar nerve. The average distance between the origin of the anastomosis and the distal end of the transverse carpal ligament was 0.67 cm in the right side and 0.73 cm in the left side. The average distance between the end of the anastomosis and the distal edge of the transverse carpal ligament was 2.25 cm in the right side and 2.51 cm in the left side, and the average length was 2.92 cm in the right side and 3.24 cm in the left side. No statistically significant difference was observed between both sides. Table 1 shows the descriptive values for the 13 subjects in whom the anastomosis was found.

According to the classification of Meals and Shaner\(^6\) modified by Bas and Kleinert,\(^10\) anastomosis type I were observed in ten anatomical parts (76.9%), (Figure 6); Type III in one (7.7%), (Figure 7); Type IV in two (15.4%), (Figure 8); of the 13 cases presenting anastomosis, as shown in Table 2. No anastomosis type II was found.
Table 1. Complete descriptive values to full length Berretini anastomosis, distance between origin and end of the anas-
tomosis and the distal end of the transverse carpal ligament.

| Descriptive     | Length | Origin | End   |
|-----------------|--------|--------|-------|
| Mean            | 3.09   | 0.70   | 2.39  |
| Median          | 2.9    | 0.6    | 2.6   |
| Standard Deviation | 1.53  | 0.61   | 1.15  |
| VQ              | 50%    | 88%    | 48%   |
| Q1              | 1.7    | 0.3    | 1.7   |
| Q3              | 4.1    | 0.8    | 3.3   |
| Min             | 0.9    | 0      | 0.3   |
| Max             | 6.3    | 2.2    | 4.1   |
| N               | 13     | 13     | 13    |
| CI              | 0.83   | 0.33   | 0.62  |

(VQ: variation coefficient; Q1: quartile 1; Q3: quartile 3; Min: minimum value; Max: maximum value; N: number of parts; CI: confidence interval.)

Table 2. Distribution of the types of anastomoses according to the classification of Meals and Shaner18 modified by Bas & Kleinert10.

| Type  | N  | %   | P value |
|-------|----|-----|---------|
| Type 1| 10 | 76.9 | Ref.    |
| Type 3| 1  | 7.7% | <0.001  |
| Type 4| 2  | 15.4 | 0.002   |

DISCUSSION

The sensitivity of the palmar surface of the hand is supplied by the median and ulnar nerves, with its classic early divisions in the midline of the ring finger. Two nerve communications between the median and ulnar nerves in the palm are known: one is deep, has a motor nature, known as Riche-Cannieu anastomosis, whereas the second, superficial and sensitive, is described as Berretini anastomosis.

Several published studies have evaluated the prevalence of different types of anastomoses between the median and ulnar.

In the last column of Table 2 we show p values for comparisons of each type when compared to the most prevalent as a reference (Ref.). This study demonstrated that Berretini anastomosis type I was the most prevalent and considered statistically different from the other types.

In Table 3 we compared the values in length, origin and end of anastomosis between types I and 3/4. We noted that there is statistically significant difference between the types only for origin values. Parts classified as type I had an average of 0.85cm from the origin compared to an average of 0.20cm of parts types III and IV.
nerves in the palmar region of the hand. However, the prevalence of these anastomoses is variable, with studies reporting between 6 and 94%.\textsuperscript{5,11} Authors like Bas and Kleinert,\textsuperscript{10} Stancic et al.,\textsuperscript{12} and Don Griot et al.,\textsuperscript{13} reported the presence of Berretini anastomosis in 67, 81, and 94%, respectively. The present study identified 43.3% of this anatomical variation. Even considering the large variability between studies, we can state categorically that this is not an occasional finding as the first reports supposed.

The classification proposed by Meals and Shaner\textsuperscript{6} is most used for topographic characterization of these superficial sensitive anastomoses between the median and ulnar nerves, due to the fact that the authors explained the variability due to the sensory innervation of the fingers. In 1999, Bas and Kleinert\textsuperscript{10} added type IV classification, featuring a plexiform distribution of anastomosis, found in 17% of the parts. Subsequently, Tagil et al.,\textsuperscript{14} found a prevalence of type IV in 10% of hands. There is also a complete agreement between the frequencies of different types of anatomical anatomical studies. The results of Meals and Shaner,\textsuperscript{6} Bas and Kleinert,\textsuperscript{10} Stancic et al.,\textsuperscript{12} Don Griot et al.,\textsuperscript{13} and Tagil et al.,\textsuperscript{14} are shown in Table 4, in comparison to the current study.

Type I anastomosis was the most prevalent, corroborating other studies in the literature.\textsuperscript{14} As in studies by Stancic et al.,\textsuperscript{12} we did not find in any sample type II anastomosis (origin on the median nerve distally with the ulnar nerve).

According to Agge et al.,\textsuperscript{15} and Jimenez et al.,\textsuperscript{16} these lesions are more frequent after endoscopic carpal tunnel release, although this technique has lower risk of complications in general, and provides quicker return to functional activities.

### Table 4. Prevalence of sensory type Berretini anastomosis on different studies.

| Type     | Present study | Stancic et al. (1999) | Don Griot et al. (2000) | Tagil et al. (2007) | Meals & Shaner (1983) | Bas & Kleinert (1999) |
|----------|---------------|-----------------------|------------------------|---------------------|-----------------------|-----------------------|
| Type I   | 33.34%        | 40%                   | 43%                    | 65%                 | 37%                   | 6%                    |
| Type II  | 0%            | 0%                    | 3.30%                  | 3.50%               | 13%                   | 16%                   |
| Type III | 3.40%         | 6.70%                 | 7.50%                  | 16%                 | 0%                    | 0%                    |
| Type IV  | 6.70%         | 10%                   | 17%                    | 16%                 | 0%                    | 0%                    |

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