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THE MARTIN-GRUBER ANASTOMOSIS IN BRAZILIANS: AN ANATOMICAL STUDY

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ABSTRACT

Communications between nerves are relatively common, and individual variations in their anatomical organization have been described. Knowledge of the prevalence of such variations is necessary when establishing the diagnosis of neuropathies and surgical landmarks. In this study, 64 anterior forearm regions of cadavers of blacks and whites of both sexes, were dissected to examine the communication between the median and ulnar nerves (Martin-Gruber anastomosis). This anastomosis was found in five cases (7.8%), one of which was bilateral. There were no significant gender or racial differences in the incidence of this connection. The anastomosis showed secondary branches in two cases, and ran posteriorly to the ulnar artery in three cases, and advanced anteriorly to the *flexor digitorum profundus* muscles in all cases. Despite the low incidence of Martin-Gruber anastomosis in Brazilians observed here, the importance of an adequate investigation of these connections needs to be underscored. Understanding the existence of this variation, its location and its possible presentation is important for correct patient assistance.

Key words: Anastomosis, Martin-Gruber, median, nerve, ulnar

INTRODUCTION

Martin-Gruber anastomoses (MGAs) are crossovers of nerve fibers in the forearm between the median and the ulnar nerves [19]. The incidence of MGAs ranges from 5% to 40%, with an average of 17% [14,19]. Most of these connections cross from the median nerve to the ulnar nerve, and are bilateral in 10-40% of the cases [22]. When present, unilateral MGAs occur more frequently in the right arm. MGAs apparently carry only motor fibers [8,14].

MGAs may lead to the misdiagnosis of conditions affecting the nerve supply to the upper limb muscles, particularly the intrinsic muscles of the hand. The crossing axons can innervate intrinsic muscles supplied by the ulnar nerve, the median nerve or both. The motor deficit of the muscles varies according to the level of nerve injury [18]. In this context, an anatomical investigation of the topography of MGAs is very important for reinforcing clinical electrophysiological findings and in helping to understand motor, sensory and autonomic dysfunctions. In this study, we used embalmed cadavers to investigate the frequency and the topographic distribution of MGAs in the anterior forearm of Brazilians.

MATERIAL AND METHODS

The anterior forearm regions of 17 male and 15 female embalmed adult cadavers from individuals, 20 to 74 years old, were dissected. The cadavers, which included 20 blacks and 12 whites, were obtained from the Department of Anatomy of the Federal University of São Paulo and were prepared within the last years. The ulnar and median nerves and their branches were carefully dissected with the aid of a magnifying glass. The MGAs were photographed with a Minolta SR-T 101-b camera to document the anatomical arrangement and the relationship with adjacent structures.

RESULTS

Communication between the median and ulnar nerves was observed in five of 64 upper limbs (7.8%) (Figs. 1 and 2). The incidence in the forearms of males (three cases) was greater than in females. A bilateral MGA was found in one female cadaver (cases III and IV) and represented 40% of the cases. No ulnar-to-median connections were found. Among the median-to-ulnar connections, three were present on the right side and two on the left. There were no significant racial or gender differences in the incidence of these communications (Table 1).

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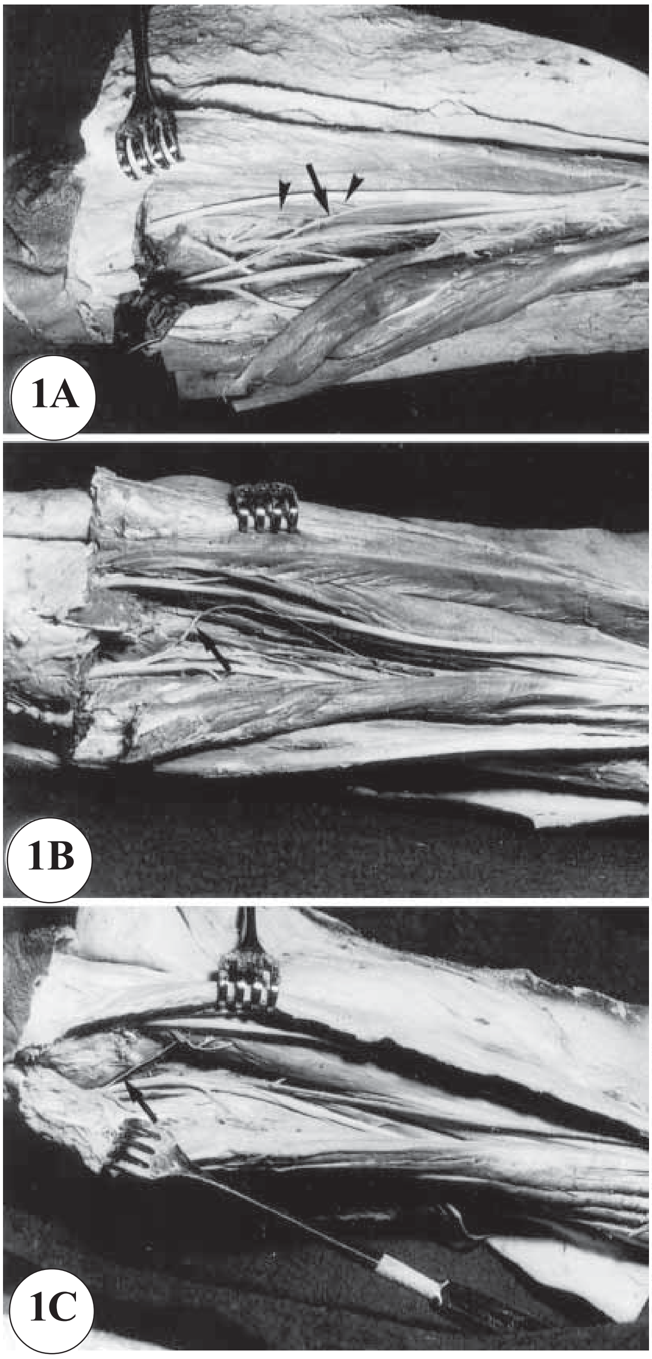
Topographically, the communication branches originated from the anterior interosseous nerve in four cases and directly from the median nerve in one case. Three branches were located posterior to the ulnar artery and two anteriorly. All of the branches, were located between the *flexor digitorum superficialis* and the *flexor digitorum profundus* (Table 1).



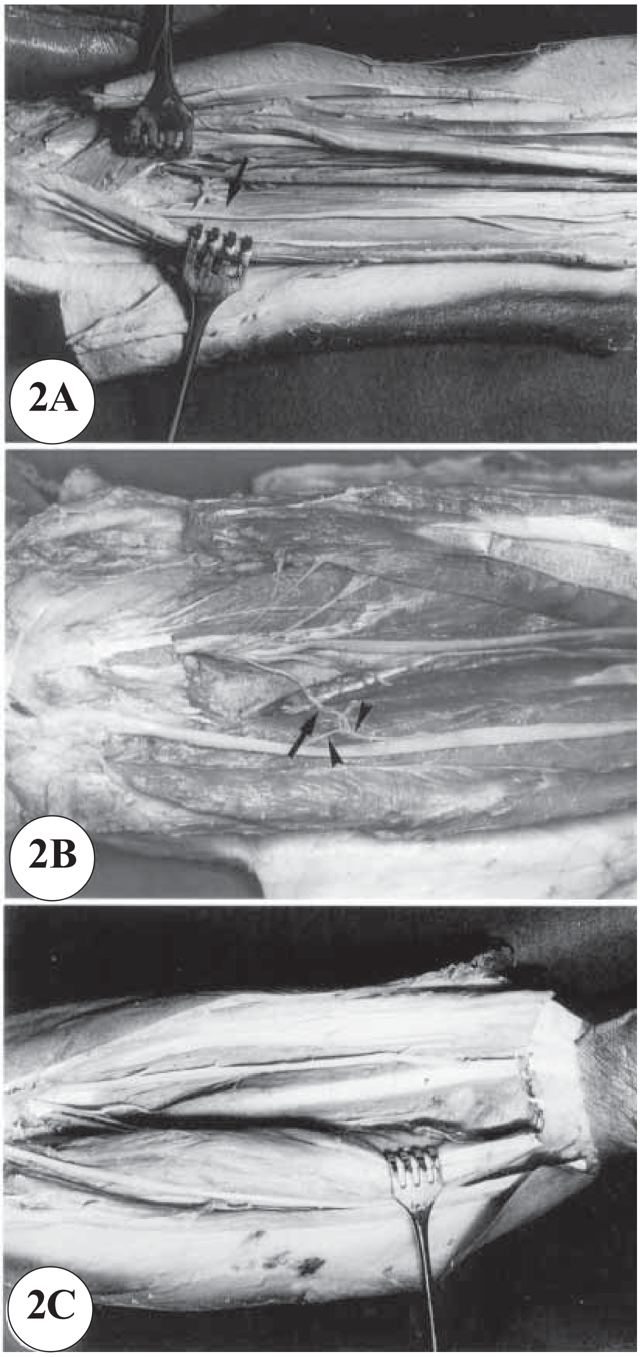


Figure 1. Martin-Gruber anastomosis in three cases. **A**) Case I: male, white and right forearm (**arrow** – main MGA; **arrowheads** – secondary branches of MGA), **B**) Case II: male, black and right forearm (**arrow** – MGA) **C**) Case III: female, white and right forearm (**arrow** – MGA). (Original magnification x4).

Figure 2. Variations in the Martin-Gruber anastomosis in two cases compared to the usual distribution of the median and ulnar nerves. **A**) Case IV: female, white and left forearm (**arrow** – MGA), **B**) Case V: male, black and left forearm (**arrow** – main MGA; **arrowheads** – secondary branches of MGA), **C**) Median and ulnar nerves without communication. (Original magnification x4).

Table 1. Characteristics of the five Martin-Gruber anastomoses branches (MGAB) found in 64 forearms dissected. (*) Same cadaver. FDPM - *Flexor digitorum profundus* muscle; UA - ulnar artery.

Cases	Gender	Race	Forearm	Situation of the MGAB relative to the FDPM	Situation of the MGAB relative to the UA
I	Male	White	Right	Anterior	Posterior
II	Male	Black	Right	Anterior	Anterior
III (*)	Female	White	Right	Anterior	Anterior
IV (*)	Female	White	Left	Anterior	Posterior
V	Male	Black	Left	Anterior	Posterior

DISCUSSION

MGAs may be a remnant of the common ventral nerve trunk that innervates flexor muscles in the extremity, and this may be of phylogenetic significance [4]. In many mammals, including primates, there are similar connections between the median and ulnar nerves at or below the elbow. Since MGAs are frequent in humans, they are considered a variation rather than an anomaly [14].

In contrast to the frequent occurrence of median-to-ulnar connections in the forearm, those from the ulnar to the median nerve are extremely rare [2].

Kimura *et al*. [13] stated that no ulnar-to-median anastomoses were observed electrophysiologically in any of the 656 hands which they examined. Similarly, Wilbourn and Lambert [26] found no such connections in 200 forearms. Nakashima [16] dissected 108 forearms and found only median-to-ulnar connections, which were present in 21% of the cases. Leibovic and Hastings [14] have proposed a comprehensive classification for MGAs that includes ulnar-to-median connections. The rarity of these anastomoses indicates that they are anomalies. In relations to the type of nerve fibers involved, Hasegawa *et al*. [8] described MGAs as a motor anastomosis that spread from the median to the ulnar nerves in the forearm, whereas Simonetti [20] stated that the anastomosis also involved sensory fibers moving in the opposite direction (ulnar-to-median nerves).

Other communications between forearm nerves can also result in sensory cutaneous territories similar to those produced by MGAs. Thus, a recent anatomical study in Brazilians showed that the sensory territory of the dorsal cutaneous branch of the ulnar nerve was supplied by the superficial branch of the radial nerve in 6.7% of 194 hands that were analyzed [18]. This percentage is similar to that reported here for MGAs. These observations demonstrate the importance of understanding MGAs and other communications in the forearm when assessing nerve injuries.

The incidence of MGAs in the present study was 7.8%, compared to previously reported frequencies of 10.5% to 23% [1,7,9,15,17,22,23]. Despite the lower frequency of MGAs in Brazilians, these anastomoses are still important when diagnosing nerve injuries. There were no important gender and racial differences in the incidence of MGAs in this study. In an electrodiagnostic study of 1200 forearms in Japanese volunteers, Kayamori [12] found an MGA incidence of 9.7% and no significant difference between males and females. However, some reports have suggested a relationship between genetic factors and the presence of MGA. Crutchfield and Gutmann [5] reported a study of MGA in five subjects from the same family. Srinivasan and Rhodes [21] examined congenitally abnormal fetuses and found that all fetuses with trisomy 21 had an MGA in both forearms. These findings suggested an autossomal dominant inheritance.

The anatomical arrangement of MGAs found here was similar to that described by others [1,10,11, 16,19], with thin anastomoses originating from median nerve branches that are normally pure motor nerves. MGAs most commonly innervate the first dorsal interosseous and the hypotenar muscles [3,24,26]. The anatomical study of muscles supplied by the ulnar and median nerves is clinically important for understanding the mechanism of lesions. MGAs have resulted in misdiagnosis during the assessment of nerve injuries [25], carpal tunnel syndrome [6], cubital tunnel syndrome [24] and leprosy neuropathy [4]. Despite the low incidence of MGAs in Brazilians observed here, the importance of an adequate investigation of these connections needs to be underscored. Understanding the existence of this variation, its location and its possible presentation is important for correct patient assistance.

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