

# Anastomosis between median nerve and ulnar nerve in the forearm

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## Abstract

**Introduction:** Anastomosis between the median nerve and ulnar nerve can occur in the forearm region. It consists in crosses of axons which may produce changes in innervation of the upper limb muscles, mainly motor part of intrinsic muscles in the hand. Anastomosis in the forearm can be classified in two types: Martin Gruber anastomosis and Marinacci anastomosis. This study has as purpose to report the incidence, type, topography of anastomosis found and assess the length of this anastomosis. **Material and Methods:** For this study, 30 forearms were dissected in the Anatomy Institute of Severino Sombra University. In order to check the incidence of anastomosis and its topography, the length of the anastomotic branch was measured with a measuring tape (3M). In addition schematic drawings were executed. **Results:** Three (3) anatomical pieces that contained the Martin-Gruber anastomosis with an average length of 6.6 cm were found. One (1) anatomical piece with a 7.4 cm long Marinacci anastomosis was found, even though such type of anastomosis shows low incidence, and was found only in electroneuromyography studies. **Conclusion:** The study of anomalous communications between median and ulnar nerves in the forearm deserves great attention for its incidence and its clinical importance, mainly in the correct diagnosis of peripheral neuropathies, for example in the Carpal Tunnel Syndrome, which produces changes in the upper limb innervation. The importance of its verification and delimitation is also crucial to avoid lesions in surgical procedures.

**Keywords:** Martin-Gruber anastomosis, Marinacci anastomosis, median nerve, ulnar nerve, dissection.

## 1 Introduction

Anastomosis between ulnar nerve and median nerve can occur in the forearm region. It is composed in crosses of axons which may produce changes in the innervations of the upper limb muscles, mainly motor part of intrinsic muscles in the hand (MANNERFELT, 1966; KIMURA, MURPHY and VARDA, 1976). Anastomosis in which the branch anastomotic originates proximally in the median nerve and unites distally in the ulnar nerve is known as Median-Ulnar anastomosis type or Martin-Gruber anastomosis. Martin, a Swedish anatomist, in 1763 was the first one to consider the possibility of connection between the fascicles of the median and ulnar nerves in the forearm (MARTIN, 1763). In the following century, in 1870, Gruber dissected 250 forearms and found 38 connections (GRUBER, 1870) (15.2%), thenceforth, anastomosis of the Median-Ulnar type have been known as Martin-Gruber anastomosis. It can arise between the branches destined to the deep flexor muscle of the fingers, or directly in the median to the ulnar nerve, or between the anterior interosseous and ulnar nerves or in combinations between these types of anastomoses (NAKASHIMA, 1993).

However, another type of anastomosis can happen in the forearm. When the anastomotic branch originates proximally in ulnar nerve and unites distally to median nerve is simply called anastomosis of Median-Ulnar type, or Martin-Gruber reverse anastomosis or Marinacci anastomosis. Marinacci in

1964 made a case report of a patient who traumatized the median nerve in forearm, but still had preservation of the median nerve innervations in the hand muscles, although had denervation of the flexor muscles in forearm (MARINACCI, 1964). The Marinacci anastomosis is infrequently notified. In some studies this type of anastomosis had not been found, being considered for many authors as anatomical anomaly.

The occurrence of the Martin-Gruber or Marinacci anastomoses can be understood by the fact that the median and ulnar nerves were developed from a similar embryonic region (ALMEIDA, VITTI and GARBINO, 1999). In addition, there are studies with high incidence of connections of peripheral nerves in monkeys which indicates a phylogenetic basis (MANNERFELT, 1966; SPERINO, 1888).

In conditions affecting the nerves that supplies intrinsic muscles of the hand, this anastomosis can cause confusion in the diagnosis since the crosses of axons can innervate the intrinsic muscles supplied by the ulnar nerve, median nerve or both (KAZAKOS, SMYDIS, XARCHAS et al., 2005). A typical example is Carpal Tunnel Syndrome which symptoms may be incomplete or exacerbate due the existence of these anastomoses, because a modification happens in the upper limb innervation. Moreover, a traumatic injury in forearm nerves might amiss be interpreted as a partial injury of the median nerve or ulnar nerve (BOLUKBASI, TURGUT

and AKYOL, 1999). Besides, significance also must be given to its topography, in order to prevent injuries in the anastomotic branch during surgical procedures of the upper limb.

The purpose of this study is to determine the incidence, type, topography of these anastomoses in corpses in the Anatomy Institute of Severino Sombra University and compare the results with other studies. Therefore, the objective is to notify the variation of anastomosis between median and ulnar nerves, identifying its relation with abnormal standards of innervations in the hand muscles, and thus, assist the diagnosis of peripheral neuropathies and the prognostic of injuries in forearm nerves.

## 2 Materials and methods

The material used in the execution of this work consists in 30 upper limbs, of adult corpses settled in glycerin solution, in the Anatomy Institute of Severino Sombra University (IAUSS). It did not have previous election of the material and was used all the available parts.

The members had been placed in the supine position for exposition of the anterior forearm region, and proceed with the careful dissection of the median and ulnar nerves and its branches. The possible occurrence of connection between the nerves was verified and the size of the anastomosis was measured by a measuring tape.

All the anatomical parts were numbered and photographed in order to register the anatomical arrangement and the relation with adjacent structures. Finally, schematic drawings had were made of all parts evidencing the conformation and path of the anastomotic fibres.

## 3 Results

The presence of Martin-Gruber anastomosis was verified in three of the thirty studied parts (10.0%), being two of the left side (66.6%) and one of the right side (33.3%). The average size of the anastomotic branch since its origin until junction with ulnar nerve was 6.6 cm (Table 1). On the topographical disposal of the communicating branches, two had presented its origin in the anterior interosseous nerve (Figure 1 and 2). In one case the branch originated directly from median nerve (Figure 3). In two cases the branches had followed an oblique path since its origin, after the division of the brachial artery. In the other case, it followed an arched path, originated before the division of the brachial artery. All the branches were located between the superficial flexor muscle of the fingers and deep flexor muscle of the fingers. In the three cases the communicating fibres had joined to the ulnar nerve in an only branch.

Anastomosis between proximally in the ulnar nerve and distally in the median nerve (Marinacci Anastomosis) was evidenced in one case (Figure 4), in the right side. The communicating fibres had originated after the division of the

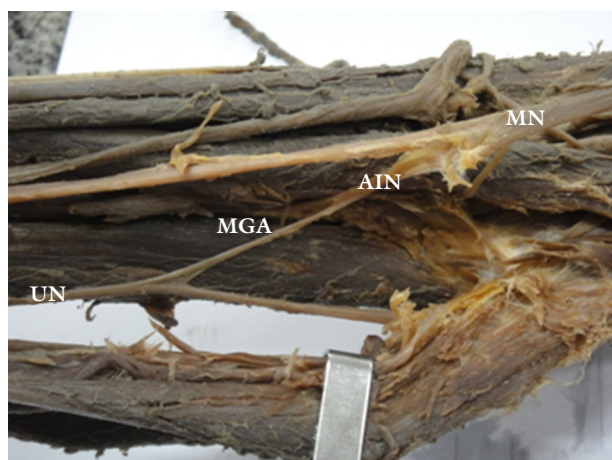
brachial artery, following an oblique path of 7.4 cm until its connection with the median nerve in an only branch (Figure 5).

## 4 Discussion

The incidence informed on the literature of the Martin-Gruber anastomosis was 15.2% according to Gruber (1870), 15.5% according to Thomson and Hollinshead (1958) and Mannerfelt (1966), 10.5% according to Hirasawa (1931), 23% according to Taams (1997) and 21.3% according to Nakashima (1993), while in this work the incidence of



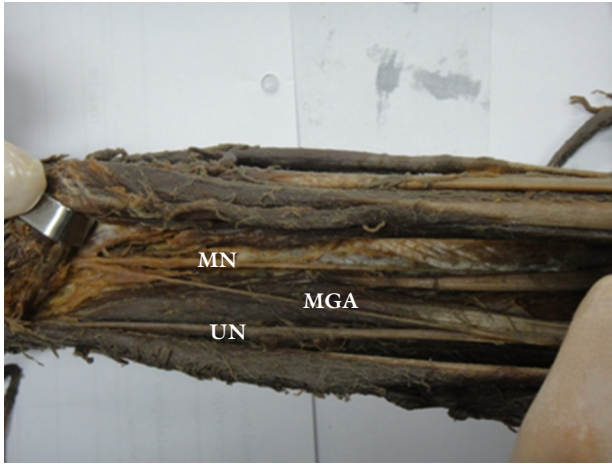
**Figure 1.** Dissection of the forearm showing the anastomosis of Martin-Gruber (median-to-ulnar), the origin of the anastomotic branch it's the anterior interosseous nerve. MN: median nerve. MGA: Martin-Gruber Anastomosis. UN: ulnar nerve.



**Figure 2.** Dissection of the forearm showing the anastomosis of Martin-Gruber (median-to-ulnar), the origin of the anastomotic branch it's the anterior interosseous nerve. UN: ulnar nerve. MGA: Martin-Gruber Anastomosis. AIN: anterior interosseous nerve. MN: median nerve.

**Table 1.** Characteristics of the Martin-Gruber anastomosis in the three cases found.

Piece number	Origin of the branch	Path	Measure of the branch (cm)	Side
1	Anterior interosseous nerve	Oblique	5.2	Left
2	Anterior interosseous nerve	Arched	10.6	Left
3	Median nerve trunk	Oblique	4.2	Right



**Figure 3.** Dissection of the forearm showing the anastomosis of Martin-Gruber (median-to-ulnar), the origin of the anastomotic branch it's the trunk of median nerve. MN: median nerve. MGA: Martin-Gruber Anastomosis. UN: ulnar nerve.



**Figure 4.** Dissection of the forearm showing the anastomosis of Marinacci (ulnar-to-median), the origin of the anastomotic branch it's the trunk of ulnar nerve. UN: ulnar nerve. MA: Marinacci Anastomosis. MN: median nerve.

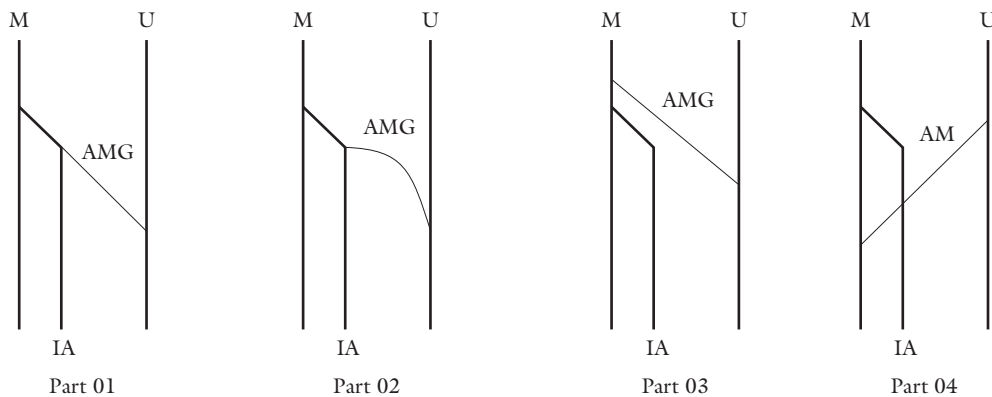
the Martin-Gruber anastomosis was 10%. In the studies of Nakashima (1993), in 56.5% of the Martin-Gruber anastomoses, the anastomotic branch originated proximally in the anterior interosseous nerve and in this pursuit the incidence was 66.6%. Besides, in that study, only 4.3% of the anastomoses originated directly in the median nerve, whereas in this study the incidence for this type of anastomosis was 33.3%.

Taams (1997) suggested that the Martin-Gruber anastomosis, when unilateral, occurs more often in the right forearm than left and in 10-40% of the cases is bilateral. In this study was not found bilateral anastomosis, however unilaterally incidence was bigger in the left forearm. Gruber (1870) suggested that it would be more common to find only one anastomotic branch than two; in this search was found only one branch making the connection between median and ulnar nerves in all the cases.

Villar (1905) and Goss (1988) affirm that the Martin-Gruber anastomosis mainly find in the upper forearm portion, in the plan between the epitrochlear muscles and the deep flexor of the fingers. In this study the anastomosis was located mainly between the muscles deep flexor of the fingers and superficial flexor of the fingers, below of the round pronator muscle; which is in agreement with the study of Villar (1905) and Goss (1988).

Srinivasan and Rhodes (1981) examined congenital abnormal embryos and found in all of them (embryos with trisomy 21) the Martin-Gruber anastomosis in both forearm. Crutchfield and Gutmann, (1980) and Piza-Katzer (1976) had found communication of the median nerve and ulnar nerve in members of families of patients who had shown this anomalous connection, and suggested that it is hereditary, probably dominant autosomal.

Brandsma (1993) described the case of five patients with complete injury of the ulnar nerve in the elbow and in the medium nerve in the wrist, that although had neuropathy due to leprosy, the patient had kept good function of the first dorsal interosseous muscle and short flexor of the thumb. Those finds were attributed to the presence of the Martin-Gruber anastomosis, which was confirmed later with studies of nervous conduction, enhancing its clinical importance.



**Figure 5.** Schematic drawings of the types of anastomosis found and its branch origin, and path of the branch. M: median nerve. U: nerve to ulnar. AM: anastomosis of Marinacci. AMG: Anastomosis of Martin-Gruber.

Regarding to the Marinacci anastomosis, there is not studies of its incidence in corpses, but its incidence in electroneuromyography studies would be 5% according to Rosen (1973) and 16.7% according to Golovchinsky (1990). A single piece that contains the Marinacci anastomosis was found in the Anatomic Institute of Severino Sombra University. The anastomotic branch originates proximally in the ulnar nerve and inserts distally in the anterior interosseous nerve. Moreover it was on the right forearm and the anastomotic branch was unique, measuring 7.4 cm long.

Shafic, Moussallen and Stafford (2009) published a case report of a patient who despite had presented typical clinical symptoms of the Carpal Tunnel Syndrome, did not reveal none of the clinical signals of compression of the median nerve, such as the Tinel signal and the Phalen signal. The patient presented evident ulnar nerve compression in the elbow, and when the ulnar nerve was test in the groove for ulnar nerve, the patient presented the symptomatology of carpal tunnel syndrome.

## 5 Conclusion

It is clear from the presented study that the anastomosis between the median nerve and ulnar nerve are relevant. This anastomosis explains some cases where injuries in the forearm nerves are not reflected in the hand muscles. The knowledge of the existence of the anastomosis between the median and ulnar nerves in forearm, its types of presentation and its topography is extremely important for the correct diagnosis of neuropathies. In addition, it is essential to differentiate a complete damage from a partial injury of a peripheral branch and to prevent complications in surgical procedures. In this way we can give better patient care.

Furthermore, the connection between median and ulnar nerves can cause an alteration in the clinical symptomatology, mainly in patient who has the Carpal Tunnel Syndrome. Therefore, the patient with an anastomosis between the median and ulnar nerves that has Carpal Tunnel Syndrome may present changes in the pattern of muscles innervation and in the sensitive part of the hand, in this way, generating exacerbated or attenuated clinical symptoms, different of the usual clinic. The knowledge of this anastomosis for the correct diagnosis of peripheral neuropathies is also important in the differentiation of partial traumatic injuries and total. Besides, it is significantly to prevent lesions of the anastomotic branches in surgical procedures of the upper limb.

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