

The Martin-Gruber Anastomosis in Bosnian population: an anatomical study

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Abstract

The Martin-Gruber anastomosis (MGA) is the anastomosis in which the anastomotic branch originates proximally from the median nerve (MN) and unites distally with the ulnar nerve (UN). This is the most common form of “anomalous” innervation that have been reported in the upper part of the forearm. This study has a purpose to report the incidence, type, topography of MGA found and access the length and diameter of these anastomosis. For this study, 60 anterior forearms (30 right and 30 left) from adult adavers were dissected. The presence of MGA was verified in 18,33% forearms. Single MGA anastomosis was found in 90,9%, corresponding to type A in 10%, type B in 10% and type C in 80%, while double MGA was found in 9,1%, both been duplication of type C. Anastomoses were found mainly on the right side in anatomical examination (seven against four). No statistically significant difference was found between men and women regarding the frequency of the MGA. In pattern I, the course of of MGA was transversal in 90% of cases, and arched in 10%, while in pattern II, the superior connection was transversal and the inferior was oblique. The MGA passed in front of the ulnar artery in 3 cases and behind in 9 cases. The average length of the anastomosis was 6.2 cm, while the average diameter was 1.14 mm. The anastomoses between MN and UN are clinically relevant so therefore the knowledge of the existance of the MGA in the forearm, types of presentation and topography is extremely important for the correct diagnosis of neuropathies as well as essential to diferrentiate a complete damage from a partial injuries of peripheral nerves.

Keywords

Nervus medianus, nervus ulnaris, Martin-Gruber anastomosis.

Introduction

The Martin-Gruber anastomosis (MGA) is the anastomosis in which the anastomotic branch originates proximally from the median nerve (MN) and unites distally with the ulnar nerve (UN). This is the most common form of “anomalous” innervation that have been reported in the upper part of the forearm. The MGA was first described by Martin in 1763 (8). First, he described a branch between the MN and UN that sometimes runs under the pronator teres muscle, and also a connection between MN and UN in the palm which he called the “arcus volaris nervorum”. In 1870, Gruber dissected 212 forearms and found in 38 forearms that nerve branches coursed from the MN proximally to the to the UN distally (2). MGA has been reported to occur in 15-31% of subjects (7,18). Most often the anomalous axons innervate

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the first dorsal interosseous muscle and less often the hypothenar and thenar muscles (3).

The purpose of our research was to determine the incidence and also the characteristics of MGA anastomosis in the Bosnian population. We also compared our results to those of similar previous studies.

Material and Methods

Sixty anterior forearms of fresh frozen adult cadavers were dissected in the Department for pathology of University Clinical Centre Tuzla and the morgue of Tuzla during a time period of two years. The forearms with traumatic lesion that unables dissection are not included in the study. The forearm is placed in the position of supine. An 'S' shaped incision from the lower limit of cubital fossa to the radiocarpal joint was carried out. This type of incision covered the whole anterior surface of the forearm. The superficial fascia was opened and the flexor carpi ulnaris muscle and tendon mobilised to give full exposure of the ulnar artery and UN. The branches of the UN in the forearm were dissected and all possible anastomoses between MN and UN were documented. The level at which the connections joined the MN and UN was measured using the medial epicondyle of the humerus as reference (point 0). The NM, NU and their branches were carefully dissected with the aid of magnifying glasses. The length and diameter of anastomosis were measured with a caliper. All anatomical parts were photographed in order to register the anatomical arrangement and the relation with adjacent structures. Statistical comparisons were performed using the chi-squared test. $P < 0.05$ was regarded as statistically significant.

Results

Out of sixty forearms (30 left and 30 right), 46 belonged to males and 14 to females. The age of cadavers ranged from 22 to 73 years (fig. 1). The length of cadavers ranged from 162 to 185 centimeters while the length of dissected forearms measured from cubital fossa to radiocarpal joint ranged from 24,5 to 27 centimeters. The presence of MGA was verified in 11 (18,33%) forearms which were studied. Single anastomosis was found in 10 (90,9%) forearms-pattern 1, while in one forearm we found 2 (1,67%) anastomosis in the left forearm-pattern 2 (fig. 2). It occurred in 6 of the 46 male cadavers (1 bilateral, 3 only in the right and 1 only in the left forearm) and in 5 of the 14 female cadavers (1 bilateral, 2 only in the right forearm and 1 only in the left forearm). Therefore, the MGA was found in 11 of the 60 forearms, which were dissected. These anastomoses were classified into three types depending on the level of origin of the anastomosis from the MN. Type A originates from the branch of the MN to the superficial forearm flexor muscles, type B from the MN itself and type C from the anterior interosseous nerve. Out of 10 single MGA, type A occurred in 1 case (10%), type B in 1 (10%) and type C in 8 cases (80%) while double MGA was found in 1 (9,1%) case, both being a duplication of type C. MGA was registered in 75% in one hand, and in 25% in both hands. Out of 6 unilateral MGA, 83,33% was registered in right and 16,67% in left hand what is statistically significant ($p=0,01$). No

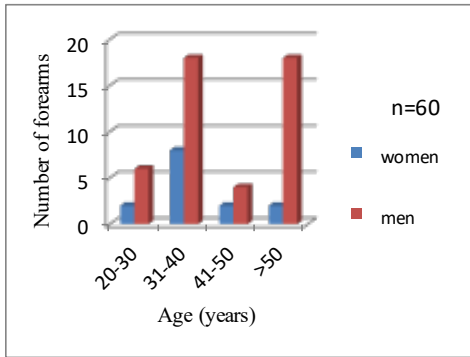


Figure 1. Dissected forearms according to age and sex.

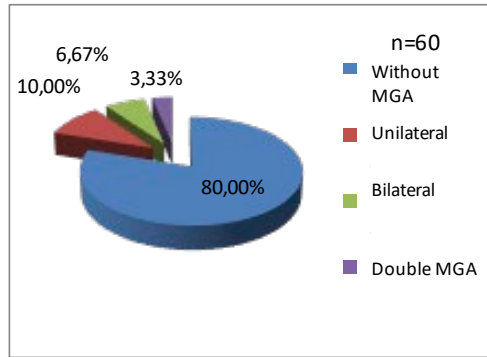
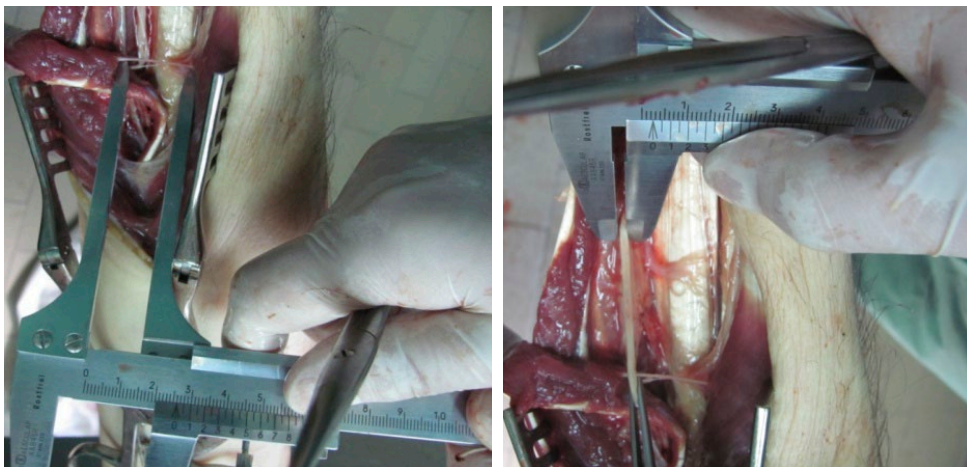


Figure 2. The incidence of Martin-Gruber anastomosis.

statistically difference was found between men and women regarding the frequency of MGA ($p=0,53$). In pattern I, the course of of MGA was transversal in 9 (90%) cases, and arched in 1 (10%) while in pattern II, the superior connection was transversal and the inferior was oblique. The MGA passed in front of the ulnar artery in 3 cases and behind in 9 cases. The average length of the anastomosis was 6.2 cm while the average diameter was 1.14 mm (fig. 3). Its origin was on average 6.6 cm distal to the medial epicondyle, and its connection to the UN was on average 11.2 cm distal to the medial epicondyle.



A.

B.

Figure 3. The lenght and diameter of Martin-Gruber anastomosis.

Discussion

Anastomoses between MN and UN occur frequently in humans so therefore they are considered as a variation rather than an anomaly. In the forearms of 15% to 31% of individuals, motor axons descend from the MN, crossing to the UN, and ultimately innervating intrinsic hand muscles which are normally supplied by the UN (7,18). There is no consensus in the literature about the classification of anastomosis between the two nerves (5). Classifications based on anatomical dissections have been proposed by Nakashima (9), Hirasawa (4), Thomson (16), Shu et al. (13), Srinivasan and Rhodes (14) and Rodriguez-Niedenfuhr et al. (11). Uchida and Sugioka (17), Oh et al. (10) and Kimura et al. (6) proposed classifications based on electrophysiological examinations while Shu (13) proposed classification based on histological examinations (5). The incidence of anastomosis between the two nerves in earlier reports was 15.2% according to Gruber (2), 15.5% according to Thomson (16), 10.5% according to Hirasawa (4), 15.5% according to Mannerfelt (7), 23% according to Taams (24), 21.3% according to Nakashima (9), 13.1% according to Rodriguez-Niedenfuhr et al. (11). Mannerfelt (7) was the first to use electrodiagnostic techniques to detect anastomosis between the two nerves and reported a 15% incidence, while other authors, using the same technique have reported incidences of anastomosis ranging from 15% to 39% in normal or unselected subjects. The highest incidence of the anastomosis was found for the first dorsal interosseous muscle (FDI). Willbourn and Lambert (18) reported that anomalous axons innervate the FDI muscle much more commonly (95%) than the hypothenar (41%) and thenar muscles (14%). We compared our results to those of previous reports. Pattern I comprises cases with one anastomotic branch, and Pattern II those with two anastomotic branches. Types A, B, and C are subdivisions depending on the level of origin of the anastomosis from the MN. Type A originates from the branch of the MN to the superficial forearm flexor muscles; type B from the MN itself and type C from the anterior interosseous nerve. In our study, the incidence of the MGA was 18,33%. Single MGA anastomosis was found in 90,9%, corresponding to type A in 10%, type B in 10% and type C in 80%, while double MGA was found in 9,1%, both been duplication of type C. Our results confirm that the anastomosis appears as single or double branch with various origins from the MN or its branches, as already described by Thomson (16), Srinivasan and Rhodes (14) and Taams(15). The unilateral MGA occurs more often on the right side than on the left (15). In our study anastomoses were also found mainly on the right side in anatomical examination (seven against four). No statistically significant difference was found between men and women regarding the frequency of these anastomoses. The course of the anastomosis has been more frequently described as transverse or oblique than arched (2,4). We found that in pattern I, the course of MGA was transversal in 9 cases and arched in 1 case, while in pattern II, the superior connection was transversal and the inferior was oblique. MGA passed in front of the ulnar artery in 3 cases and behind in 9 cases.

The anastomoses between MN and UN are clinically relevant. These connections are often suggested as causes for unusual motor losses of the muscles in the hand after peripheral nerve lesions (1,12). The knowledge of the existence of the MGA in the forearm, its types of presentation and topography is extremely important for the correct diagnosis of neuropathies, essential to differentiate a complete damage from a partial injuries and to prevent complications during surgical procedures.

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