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Original Article

Anatomy Section

Martin–Gruber Anastomosis- A Cadaveric Study in North Indian Population

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ABSTRACT

Introduction: Communications between peripheral nerves are important in the light of the fact that these are responsible for a myriad of clinical symptoms. Communication between the median nerve and ulnar nerve (Martin-Gruber anastomosis) is a frequent finding observed anatomically in 10%-30.6% subjects and physiologically in 5-40%. It may lead to exacerbated or attenuated clinical symptoms.

Aims & Objectives: To find out the incidence of Martin-Gruber anastomosis in North Indian population by cadaveric dissection.

Materials and Methods: The material comprised of 60 upper limbs belonging to 30 cadavers (M:F::28:2) which were dissected to find out incidence of Martin-Gruber anastomosis.

Results: Martin-Gruber anastomosis was encountered in 7(11.6%) limbs of the present study. It was seen more frequently unilaterally (16.6%) than bilaterally (3.3%) and only in males. Classification of limbs into various patterns and types was done. Further its ontogeny, phylogeny, genetic inheritance and clinical implications are discussed in detail.

Conclusion: To conclude, in North Indian population, the Martin-Gruber anastomosis is encountered in 11.6% limbs.

Keywords: Median nerve, Nerve communications, Ulnar nerve

INTRODUCTION

Brachial plexus and its branches depict numerous variant which have been reported by different workers [1,2]. One such variant is crossing over of nerve fibres between different branches of brachial plexus like between median nerve and musculocutaneous nerve and between median nerve and ulnar nerve. The communicating ramus in the later group i.e. between median nerve & ulnar nerve may be of following types-:

(a)A communicating ramus from median nerve to ulnar nerve in the forearm, the so called Martin-Gruber anastomosis.

(b)Ulnar to median nerve communication in the forearm, so called reversed Martin-Gruber Anastomosis or Marinacci communication.

(c)The Riche-Cannieu anastomosis occurs in the palm between recurrent branch of median nerve & deep branch of ulnar nerve.

(d) The communicating ramus between the common digital nerves that arise from ulnar & median nerve in the palmar surface of hand is known as Berretini anastomosis [3].

Out of these four types, the first i.e. Martin-Gruber anastomosis is commonest and most important too. It was first described by the Swedish anatomist Martin [4] and later by Gruber [5] and thus named as Martin-Gruber Anastomosis. It consists of a communicating ramus which leaves either the main trunk of median nerve or its anterior interosseous branch and join the main trunk of ulnar nerve to ultimately innervate the intrinsic hand muscles [6]. Its incidence varies between the anatomical & physiological studies. In anatomical studies it is found in 10%-30.6% [7-11] while in physiological studies the range becomes wider to 5%-40% [12-14]. It has been also noted that the unilateral Martin-Gruber anastomosis is more often seen on right side as compared with left side [8,12,10]. However, no sexual dimorphism is seen [6], though an autosomal dominant inheritance is observed [13].

Clinically the Martin-Gruber anastomosis may lead to misdiagnosis of conditions affecting the nerve supply of upper limb muscles like carpal tunnel syndrome, cubital tunnel syndrome and leprosy neuropathy. Understanding the existence of this variation, its location and its possible presentation is important for correct patient assistance [15]. Similarly, in lesions proximal to the communication, the motor and sensory innervation remains normal and also in complete lesion of median nerve some muscles innervated by median nerve may not be paralysed leading to erroneous conclusion [16]. Martin-Gruber anastomosis has also been implicated clinically in anomalous innervations of muscle or skin and in anomalous nerve conduction observed during electrophysiological studies. If the anaesthetized nerve has intramuscular course then it is a potential compression site and thus carries additional clinical implication [17,18].

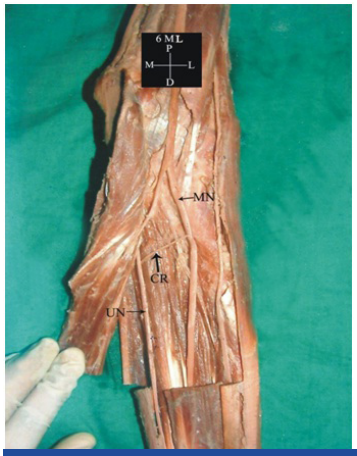
Thus an anatomical investigation of topography of Martin-Gruber anastomosis is very important for understanding motor, sensory and autonomic dysfunctions. So this study was designed on embalmed cadavers to find out the incidence and topography of this variant in North Indian population.

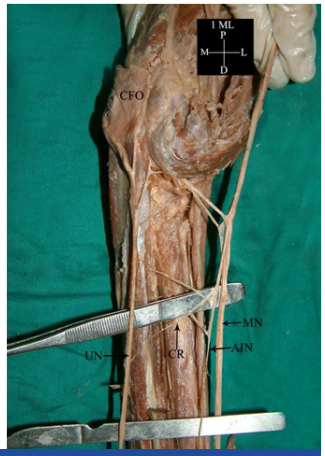
MATERIALS AND METHODS

The material of the present study comprised of 60 upper extremities of 30 well embalmed adult human cadavers (M:F::28:2) obtained from Department of Anatomy, Government Medical College, Amritsar during the period from 2007-2009. These were serialized from 1-30 with suffix 'R' for right and 'L' for left extremity and M or F for male and female sex respectively. The median nerve was exposed from formation till termination as per the dissection steps given in Cunningham's Manual of Practical Anatomy [19]. Similiarly ulnar nerve was traced till its termination. The Martin-Gruber anastomosis was identified, cleared and photographed where ever possible.

RESULTS

Out of the 30 cadavers, in one cadaver (17M), Martin-Gruber anastomosis was found in both the upper limbs (3.33%). Apart from this in five more limbs it was found unilaterally. Out of these five limbs three belonged to the right side and two belonged to the left side. Thus in toto out of 60 limbs of the present study it was seen in seven limbs (11.6%).





[Table/Fig-1]: Communicating ramus (CR) (Martin-Gruber Anastomosis) from main trunk of median nerve (MN) to main trunk of ulnar nerve (UN).
[Table/Fig-2]: Communicating ramus (CR) (Martin-Gruber Anastomosis) from anterior interroseous nerve (AIN) to main trunk of ulnar nerve (UN). {Branches from anterior interroseous nerve (AIN) to Flexor digitorum profundus (FDP) are also seen}.

Out of the seven limbs with Martin-Gruber anastomosis, in two limbs (6ML&17MR) it was located in the forearm between main trunk of median nerve and main trunk of ulnar nerve [Table/Fig-1] while in the rest, it was from anterior interosseous nerve to ulnar nerve [Table/Fig-2]. The course of communicating ramus was oblique starting from median nerve or anterior interosseous nerve proximally and going to ulnar nerve distally in all the variant limbs [Table/Fig-1,2].

DISCUSSION

As observed earlier, Martin-Gruber anastomosis was seen more frequently unilaterally (16.6%) as compared with bilaterally (3.3%). In unilateral limbs, it was found more on right side as compared with left side. This was in consonance with the earlier studies that unilateral Martin-Gruber anastomosis is more common on right side [8,10,12]. All the limbs in which Martin-Gruber anastomosis was seen belonged to male sex but it could be attributed to the fact that out of 30 cadavers of the present study, 28 belonged to the male sex. It was seen in seven (11.6%) limbs of the present study. [Table/Fig-3] compares its incidence with the earlier studies.

S.No	Authors	Year	Number Of Limbs Studied	Incidence (%)
1.	Gruber [5]	1870	250	15.2%
2.	Kayamori [20]	1987	1200	9.7%
3.	Nakashima [7]	1993	108	21%
4.	Prates et al., [21]	2003	64	7.8%
5.	Felippe et al., [22]	2012	30	10%
6.	Present study	2015	60	11.6%

[Table/Fig-3]: Incidence of martin-gruber anastomosis.

Nidenfuhr et al., (based on a study of 70 human cadavers) have classified Martin-Gruber anastomosis in 2 patterns with each pattern further subdivided into 3 types as follows [23]:

Pattern I-Anastomosis made by only one branch.

Pattern II- Anastomosis made by two branches.

Both these patterns are further classified into 3 types, each depending upon origin of communicating ramus from median nerve or its branch as follows:

Type a-Communicating ramus originates from branch to superficial forearm flexors-47.3%.

Type b-Communicatng ramus originates from main trunk of median nerve-10.6%.

Type c- Communicatng ramus originates from anterior interosseous nerve-31.6%.

Author	Year	Pattern I (%)	Type Ia (%)	Type Ib (%)	Type Ic (%)	Pattern II (%)
Gruber [5]	1870	95	13	8	74	5
Thomson [24]	1893	100	3	19	78	0
Hirsawa [25]	1931	50	15.40	0	34	50
Srinivasan & Rhodes [26]	1981	100	6	3	91	0
Nakashima [7]	1993	95.95	0	4.35	91.30	4.35
Taams [8]	1997	100	7	0	93	0
Shu et al., [10]	1999	64	0	17.60	47.10	35.30
Niendefuhr et al., [23]	2002	89.50	47.3	10.60	31.60	10.50
Prates et al., [21]	2003	100	0	20	80	0
Present Study	2015	100	0	28.50	71.40	0

[Table/Fig-4]: Incidence of martin-gruber anastomosis.

Accordingly in the present study, only Pattern I was seen and within this pattern two limbs (28.5%) fall into Pattern I type b & five limbs (71.4%) in pattern Ic, with no limb in Pattern Ia. [Table/Fig-4] compares the incidence of different patterns and types as reported by earlier workers.

ONTOGENY- The variations in the nerve patterns may be a result of the altered signalling between the mesenchymal cells and neuronal growth cones and once formed antenatally persist postnatally [27,28] or these may be due to circulatory factors at the time of fusion of brachial plexus cords [29]. Random factors influencing the mechanism of formation of limb muscles and the peripheral nerves during the embryonic life may be accredited to the occurrence of communication. The human brachial plexus is known to appear as a single radicular cone in the upper limb bud which divides longitudinally into ventral and the dorsal segments. The ventral segments gives roots to the median and the ulnar nerves with musculocutaneous nerve arising from the median nerve. The possibility of failure of differentiation may be a cause for some of the fibres taking an aberrant course as communicating branch [30].

PHYLOGENY- Martin-Gruber anastomosis may be of phylogenetic importance as it is seen in many mammals including primates which show similar connections between median nerve and ulnar nerve [31]. Studies have shown a high incidence of Martin-Gruber anastomosis in apes [32] & monkeys [33,34].

GENETIC INHERITANCE- Srinivasan & Rhodes examined congenitally abnormal embryos with trisomy 21 and found Martin-Gruber anastomosis in all of them in both the forearms [26]. So they linked it with trisomy 21. Also Crutchfield & Gutmann found Martin-Gruber anastomosis in 62% of family members of five propositi of the patients who had shown this anomalous connections & suggested that it is hereditory, probably autosomal dominant [13,35].

CLINICAL IMPLICATIONS- A positive aspect of Martin-Gruber anastomosis is that it can provide another motor and sensory innervation during a defect in these nerves after a trauma [36]. On the other hand these may also result in misdiagnosis during the assessment of nerve injuries [37], carpal tunnel syndrome [38], cubital tunnel syndrome [39] and leprosy neuropathy [40]. In such cases, identification of Martin-Gruber anastomosis becomes very crucial because it not only generates exacerbated or attenuated clinical symptoms, different from the usual ones [22] but also mode of treatment differs accordingly. However, nerve conduction study remains a reliable tool for its diagnosis [41].

CONCLUSION

To conclude, in North Indian population, the Martin-Gruber anastomosis is encountered in 11.6% limbs with no statistically significant difference between right and left sides. This variation is equated phylogenetically with apes and monkeys. A genetic inheritance with autosomal dominance is also suggested.

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