

Z. Aslı AKTAN  
Lokman ÖZTÜRK  
Okan BİLGE  
Mehmet Asım ÖZER  
Yelda Atamaz PINAR

## A Cadaveric Study of the Anatomic Variations of the Brachial Plexus Nerves in the Axillar Region and Arm

Received: April 07, 2000

Department of Anatomy Faculty of Medicine,  
Ege University, Bornova, 35100 İzmir -  
TURKEY

**Abstract :** Forty-eight upper limbs were dissected in order to study the courses and relations of the brachial plexus nerves in the axilla. Connections between the musculocutaneous and median nerves were found in five arms. There was a suprascapular nerve arising from the union of C4 and C5 directly in one cadaver. A branch from the median nerve extending to the brachial artery

was determined. In one of the cadavers the radial nerve arose only from the union of posterior divisions of the inferior and middle trunks.

**Key Words:** median nerve, ulnar nerve, radial nerve, musculocutaneous nerve, suprascapular nerve, brachial plexus, shoulder surgery

### Introduction

The brachial plexus is formed by the ventral rami of spinal nerves C5-C8 and Th1. The brachial plexus extends downward and laterally, and then passes over the first rib behind the clavicle and enters the axilla. The brachial plexus gives rise to a number of nerves to the upper limb (1).

The ventral rami of C5 and C6 unite to form the superior trunk, C7 becomes the middle trunk, and C8 and Th1 form the inferior trunk. These three trunks just above or behind the clavicle bifurcate into anterior and posterior divisions. All of the posterior divisions form the posterior cord. The lateral cord is formed by the union of the anterior divisions of the superior and middle trunk. The medial cord is formed as a continuation of the anterior division of the inferior trunk (1,2).

The peripheral nerves arise from the cords.

### Materials and Methods

The materials used for this study consisted of 48 upper limbs of 24 cadavers from the dissection laboratory with an age range of 50-80 years at Ege University Medical Faculty, Department of Anatomy. All the cadavers were male. The dissections were made by an incision in a distal to proximal direction from elbow to axilla. The peripheral nerves and the trunks were dissected separately.

### Results

To determine the anatomic relationships of the peripheral nerves of the brachial plexus in the arm and axillar region, 24 arms and axillar regions were dissected bilaterally.

Connections between the musculocutaneous nerve and median nerve were found in five arms. Three of them were in the left arm (Figure 1). The connections were not bilateral in any cadaver. They left the musculocutaneous nerve  $0.95 \pm 0.42$  cm from the formation of this nerve. The point of entering the median nerve was  $10.25 \pm 2.32$  cm from the formation of the median nerve. The mean length of these interconnections was  $5.50 \pm 2.50$  cm.

The suprascapular nerve is a large branch of the superior trunk normally (1). In cadaver it arose from the union of C4 and C5 directly (Figure 2). This anomaly was seen on the right side. The suprascapular nerve on the left side was the branch of the superior trunk as usually seen.

In one cadaver there was a branch from the median nerve extending to the brachial artery (Figure 3).

The radial nerve arises from the posterior cord (C5, C6, C7, C8, Th1). The radial nerve in our cadaver arose from the union of the posterior divisions of the inferior trunk and the middle trunk in the left upper extremity. No division from the superior trunk joined the radial nerve (Figure 4).



Figure 1. The interconnection between the median and musculocutaneous nerves (mcn: musculocutaneous nerve, mn: median nerve).



Figure 2. Suprascapular nerve arising from the brachial plexus (sn: suprascapular nerve).

The left phrenic nerve in a 60-year-old male cadaver was connected with the brachial plexus by a branch to the superior trunk.

### Discussion

Martin-Gruber connections are crossovers of nerve fibres in the forearm between the median nerve and the ulnar nerve. These connections have a high incidence in the forearm. They have been shown to cause confusion in the assessment of nerve injuries, carpal tunnel syndrome, cubital tunnel syndrome and leprosy neuropathy. However,

these connections in the arm have not been discussed as Martin-Gruber anastomosis in the literature (2-6).

Median-ulnar anastomoses in the forearm were first described by the Swedish anatomist Martin in 1763. Gruber demonstrated its presence in 15.2% of the arms he dissected (4). Chiarapattanakom et al. determined communications in the arm between the musculocutaneous and median nerves in 9 arms (8%).

Venirratos et al. found 22 communications between the musculocutaneous and median nerves in 16 out of 79 cadavers. In six subjects they were present bilaterally.



Figure 3. A branch from the median nerve to the brachial artery (mn: median nerve, ba: brachial artery).



Figure 4. Radial nerve from the inferior and middle trunks (ti: truncus inferior, tm: truncus medius, nr: radial nerve).

Nine of these 22 communications were proximal to the entrance of the musculocutaneous nerve into the coracobrachialis (7,8). The connections determined in our study were unilateral and seen in five arms (10.43%). It is said that if the lateral root of the median nerve is small, the musculocutaneous nerve connects with the median (1), nerve but in our study in one cadaver arm out of 48, the lateral root was not small. The connections were near but before the origin of the coracobrachial muscle. These connections between the nerves may provide another motor and sensitive innervation during a defect in these nerves after a trauma.

Eglseder and Goldman dissected 54 cadaver arms to determine the course and anatomic relationships of the musculocutaneous nerve in the arm. They noticed interconnections between the musculocutaneous nerve and median nerve in 36% of dissections. The mean length of these interconnections was 1.77cm (9). This is a much higher percentage of interconnections than those determined in previous studies and our study.

In the literature there is no mention of any variation in the arising of the radial nerve from the brachial plexus. It arises from the posterior cords of three of the trunks

but in our study the posterior cord of the superior trunk did not join the radial nerve (1). To our knowledge this variation is mentioned here for the first time.

It was found that a suprascapular nerve arose from the union of C4 and C5 directly, not from the superior trunk as expected. This variation was also not mentioned in the literature before.

An extending branch to the brachial artery from the median nerve was seen in the right arm of a cadaver. It was thought that it could be a thick sympathetic branch.

During axillary and shoulder surgery this should be kept in mind by the surgeon as well. In brachial plexus

injuries, extraplexal nerves such as the spinal accessory nerve, rami of the cervical plexus or intercostal nerves are transferred onto trunks, cords, or individual nerves or else segments of the brachial plexus. Because of this kind of surgery the anatomy of the plexus is very important for the surgeon (10).

*Correspondence author:*

*Z. Aslı Aktan*

*Ege University of Medicine Faculty*

*Department of Anatomy, Bornova*

*35100, İzmir-TURKEY*

**References**

1. Peter L. Williams. Gray's Anatomy, Churchill Livingstone, Great Britain, 38th Edition, 1266-1274, 1995.
2. KO Taams. Martin-Gruber connections in South Africa, J-Hand-Surgery-British, 22 (3): 328-330, 1997.
3. Shu HS, Chantelot C. Martin-Gruber communicating branch: anatomical and histological study, Surg Radiol Anat, 21: 115-118, 1999.
4. Nakashima T. An anatomic study on Martin-Gruber anastomosis. Surg Radiol Anat, 15: 193-195, 1993.
5. Leibovic SJ, Hastings H. Martin-Gruber revisited. Journal of Hand Surgery, 17A: 47-53, 1992.
6. Buschbacher RM: Mixed nerve conduction studies of the median and ulnar nerves. Am J Phys Med Rehabil, 78 (6): 69-74, 1999.
7. Venieratos D, Anagnostopoulou S. Classification of communications between the musculocutaneous and median nerves. Clin Anat. 11 (5): 327-31, 1998.
8. Kingery WS, Wu PBJ. An usual presentation of a traumatic ulnar mononeuropathy with a Martin-Gruber anastomosis. Muscle & Nerve, 19: 920-922, 1996.
9. Eglseder WA Jr, Goldman M. Anatomic variations of the musculocutaneous nerve in the arm. Am-J-Orthop. 26 (11): 777-80, 1997.
10. Narakas AO, Heintz VR. Neurotization in brachial plexus injuries. Clin Ortop and Related Res, 237: 43-56, 1988.