

*Paşa Diana Nicolae, Catereniuc Iliia Matei*  
**INCIDENCE OF CARPAL TUNNEL SYNDROME AND THE  
MORPHOLOGICAL PRESENTATION OF ANATOMICAL VARIANTS  
OF THE MEDIAN NERVE**

*State University of Medicine and Pharmacy Nicolae Testemitanu,  
Chisinau, Republic of Moldova*

*Investigation of variants of median nerve in the carpal tunnel and the clinical  
significance of these variants.*

**Key words:** median nerve, carpal tunnel syndrome

*Паша Д.Н., Катеренюк И.М.*  
**РАСПРОСТРАНЕННОСТЬ КАРПАЛЬНОГО ТУННЕЛЬНОГО  
СИНДРОМА И ПРЕДСТАВЛЕНИЕ АНАТОМИЧЕСКИХ  
ВАРИАНТОВ СРЕДИННОГО НЕРВА**

*Государственный Медицинский и Фармацевтический Университет  
им. Николае Тестемицану, г. Кишинёв, Молдова*

*Исследование вариантов разветвления срединного нерва в запястном канале и  
клиническое значение этих вариантов.*

**Ключевые слова:** срединный нерв, синдром запястного канала

Median nerve compression in the carpal tunnel is one of the most common syndromes in clinical practice. Anatomical variations of the median nerve are significant for wrist joint surgery, especially in the treatment of carpal tunnel syndrome.

**Purpose:** In this study, we describe the incidence of carpal tunnel syndrome and anatomical variants of the median nerve on cadaveric dissection.

**Methods:** The data regarding the incidence of carpal tunnel syndrome compared to other compressive neuropathies of the upper limb and an analysis of median nerve variability in the carpal tunnel on cadaveric dissection.

**Results:** Among the 722 patients the carpal tunnel syndrome was identified in 101 cases that constituted 13.9%, includes 28 men and 73 women. The average age of patients with this syndrome was 56,7 years of age. The observed the presence of carpal tunnel syndrome on the right side in 61 patients, on the left side 35 and bilateral in 5 patients. Out of a total of 118 patients with nerve compressions, 85.5% have carpal tunnel syndrome and 14.5% other compressive syndromes. It is observed that carpal tunnel syndrome has a higher rate in urban areas with 59 cases (58.4%) and 42 cases (41.6%) for rural areas. Twenty hands were dissected it was found origin of the thenar branch of median nerve, 15 cases extraligamentous type, 4 cases subligamentous type and 1 cases transligamentous and in 1 case presence of median artery

**Conclusions:** The anatomy of the upper limb involved in the occurrence of carpal tunnel syndrome demonstrates the source of nerve compression and a

relevant prognostic. Knowledge of anatomical variants of specialists can minimize iatrogenic lesions.

Compressive neuropathies in the upper limb are among the most common conditions specific to plastic surgery, especially in patients with work-related symptoms. In recent times, there has been a continuous growth in the incidence of this pathology due to the increased prevalence of obesity. [1]

The precocity of establishing the diagnosis and initiating the treatment are fundamental for the decrease of the morbidity associated with the nervous compression, the increase of the patient's quality of life and for the best possible socio-professional reintegration. [2]

Interdisciplinary collaboration is another key point in nerve compression syndromes, various medical conditions and personal factors, including diabetes, hypothyroidism, alcoholism, obesity, smoking, being associated with nerve damage.

Also, the differential diagnosis with other neurological disorders, with similar symptoms, is essential in interdisciplinary collaboration between the plastic surgeon - neurologist / neurosurgeon - diabetologist - rheumatologist.

The major objective for the patient is to benefit from a complete social and professional reintegration, with a minimum of morbidity and low costs for the patient and society.

The most common nerve compression syndrome is carpal tunnel syndrome, with a prevalence of about 3% in the general population and 5-15% in the industrial environment.

**Materials and methods.** This study presents two areas of research. A retrospective descriptive study looks at the data of 101 patients with carpal tunnel syndrome, admitted to the Microsurgery department of the IMSP "Institute of Emergency Medicine". This includes 28 men and 73 women the range of ages was 22–76 years old. These cases were recorded between 2016 and 2020.

The second study is an analysis of median nerve variability in the carpal tunnel on cadaveric dissection. 20 upper limbs were dissected at the Department of anatomy and clinical anatomy of State University of Medicine and Pharmacy Nicolae Testemitanu.

**Results.** Among the 722 patients the carpal tunnel syndrome was identified in 101 cases, that constituted 13.9%. The overall ratio of all median nerve lesions and carpal tunnel syndrome is 34.9% to 65.1% (Table 1). Only 28 males (30.3%) had carpal tunnel syndrome, whereas it was identified in 34 women (69.7%). The average age of patients with this syndrome was 56,7 years of age.

Table 1

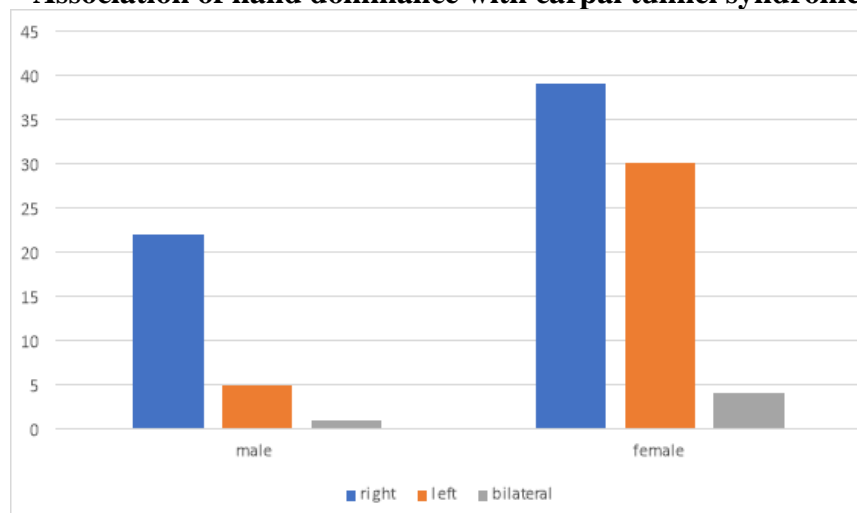
**A comparison of carpal tunnel syndrome and median nerve damage**

Years	Median nerve damage	Carpal tunnel syndrome
2016	30	23
2017	21	19
2018	48	23
2019	41	23
2020	15	13
Total	155	101

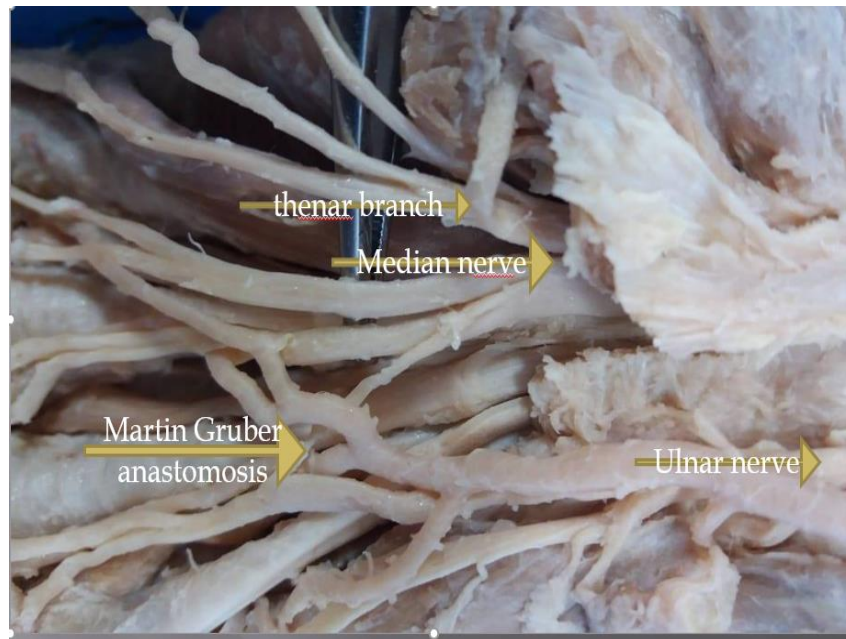
The observed the presence of carpal tunnel syndrome on the right side in 61 patients, on the left side 35 and bilateral in 5 patients (Table 2). Out of a total of 118 patients with nerve compressions, 85.5% have carpal tunnel syndrome and 14.5% other compressive syndromes, respectively, including guyon's canal syndrome and cubital tunnel syndrome.

Table 2

**Association of hand dominance with carpal tunnel syndrome**

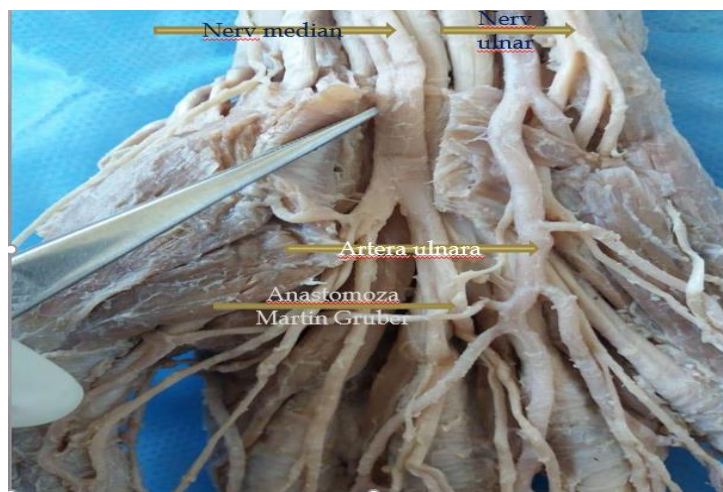


After geographical distribution of patients it is observed that carpal tunnel syndrome has a higher rate in urban areas with 59 cases (58.4%) and 42 cases (41.6%) for rural areas, respectively. Twenty hands were dissected it was found origin of the tenor branch of median nerve, 15 cases extraligamentous type, 4 cases subligamentous type and 1 cases transligamentous (Figure 1,2)



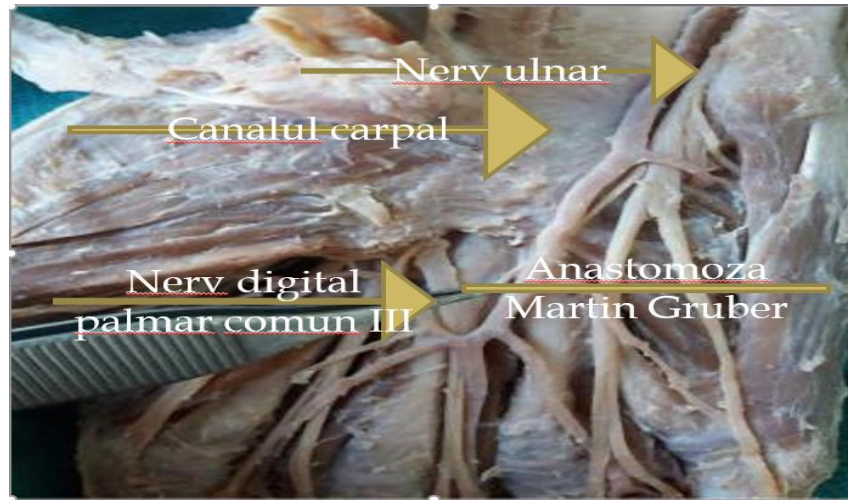
*Fig.1.* Extraligamentous origin of the thenar branch of median nerve

Origin of the thenar branch is extraligamentous and was identified in 15 cases. Martin Gruber anastomosis originating from the anterior part of the common digital neves III, IV.



*Fig.2.* Reverse Martin Gruber anastomosis and subligamentous origin of the thenar branch

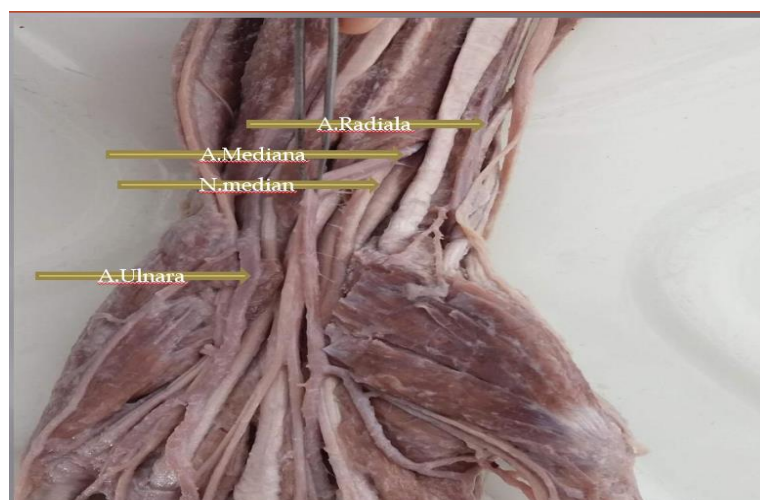
Open carpal tunnel and visualization the median nerve and subligamentous thenar branch. Reverse Martin Gruber anastomosis of the ulnar nerve.



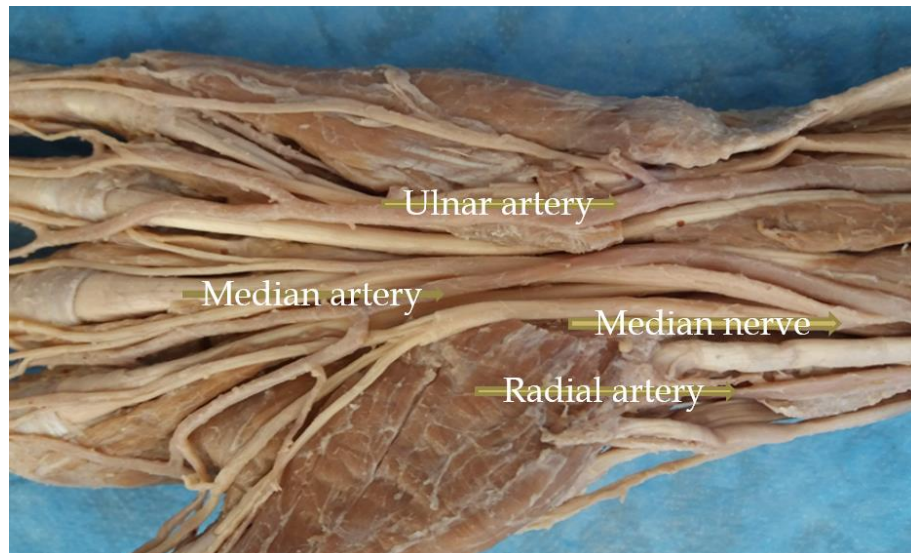
*Fig. 3. Reverse Martin Gruber anastomosis and transligamentous origin of the tenar branch*



*Fig.4. Hight bifurcation of the median nerve*



*Fig.5. Presence of the median artery*



*Fig.5.* Presence of the median artery

Another Mayo Clinic research reported in the literature highlights the predominance of females for carpal tunnel syndrome in a 3:1 ratio over males and the peak of this pathology is reached at the age of 45-54 for women and the elderly for men.

The variations of the Martin - Gruber anastomosis can be classified by types: model I includes cases with an anastomotic branch, and model II with two anastomotic branches. Types a, b and c are subdivisions depending on the level of origin of the anastomotic branch of the median nerve. Type a comes from the branch of the median nerve to the superficial muscles of the forearm. Type b comes from the median nerve itself and type c from the anterior interosseous nerve. [3]. These variants of anastomosis should be known from short transverse incisions in surgery for carpal tunnel syndrome. [4]

Lanz reported 12% (29 hands) changes of median nerve pathway in 246 hands. The motor branch of the median nerve with distal origin of the retinaculum flexorum (extraligamentous), doubled innervating the tenor eminence in 46% of cases and branches below the flexor retinaculum (subligamentous) in 31% of cases, in 23% of cases the motor branch perforates the retinaculum passing through its own tunnel (transligamentous) to the thenar muscles. Accessory branches of the median nerve in the distal portion of the carpal tunnel (group II) were found in 18 hands (7%), the high division of the median nerve (group III) in 7 cases (3%).

Stancic et al. reported that there were no variants in 48 of the 100 hands. In Group 1A 16 hands, 16 hands were in Group 1B, 5 hands were in Group 1C, 2 hands were in Group 1D, 7 hands were in Group 2, one hand was in Group 3B, and 4 hands were in Group 4A.

Kozin in the dissection of 101 cadavers, in 7% of cases the recurrent branch of the median nerve passed through the transverse ligament of the carpus, in 74% of cases the recurrent nerve passed distally through a separate obliquely oriented fascia and in 19% of cases it passed distally of the transverse ligament of the carpus, but did not pass through the obliquely oriented fascia. He

concluded that the transligamentous branch is unusual and the reported high incidence of branches passing through the transverse ligament of the carpus can be explained by the wrong combination of the recurrent nerve passing through the obliquely oriented fascia with the recurrent nerves passing through the transverse ligament of the carpus [5]

On 60 cadaveric hands, Alizadeh et al. reported 78% variations in the median nerve. In 28 (47%) hands, the recurrent nerve went through an extraligamentous course (Lanz group 0), subligamentous in 17 (28.3%) (Lanz group 1A), transligamentous in 7 (11.7%) (Lanz group 1B). The recurrent branch comes from the ulnar part in 7 (11.7%) cases (Lanz group 1C) (1). Steinberg et al. dissected both hands at 23 corpses; it was found that the nerve had a normal trajectory at 33 of 46 (71.7%) upper extremities. The most common variant observed was the motor branch that crosses the carpal transverse ligament from 2 to 4 mm proximal to the distal end of the tunnel at 13 hands (28.3%). An additional branch in the proximal part of the tunnel was found in 10 cases (21.7%). [6]

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