



## ORIGINAL ARTICLE

CLINICAL AND ANATOMICAL APPROBATION OF THE EFFECTIVENESS OF THE  
TECHNIQUE OF SEARCHING FOR THE PROJECTION OF THE SUBCHONDRAL  
NEUROVASCULAR BUNDLE IN THE CLINIC OF MAXILLOFACIAL

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## Abstract

The anatomy and morphology of the location of the mental neurovascular bundle varies significantly among populations and is largely dependent on many factors, such as the developmental process as well as comorbidities and diseases. Due to the need of practical health care in express methods of finding the main projections of the neurovascular bundles and associated foramen, morpho-analytical modeling of the method of finding the projection of the mandibular foramen on the skin of the mandible was performed. At the request of ultrasound diagnosticians and maxillofacial surgeons, an attempt was made to calculate a unified point of projection of the subchondral neurovascular bundle as a reference point for research and evaluation of the effectiveness of the therapeutic process of mandibular fracture.

We have obtained a coordinate system that can be projected both on the patient's facial skin and on the CT data. Clear positioning of the chin neurovascular bundle will allow to perform both diagnostic, for example, the study of blood flow velocity of vessels during ultrasound examination in acute trauma, in persons with increased body mass index, and treatment, for example, nerve blockade, manipulations with greater accuracy and safety for the patient.

**Keywords:** morphometric study; morphologic study; chin neurovascular bundle.

## Introduction

Today facial traumas continue to be an urgent problem in dentistry and maxillofacial surgery. Epidemiologic studies of Russian and foreign sources show a twofold increase in cases of bone injuries of the maxillofacial region (MFR) over the last thirty years,<sup>1,2</sup> and the share of mandibular injuries in relation to the total number of injuries varies between 3.2 and 8%.<sup>3-5</sup> It should be noted that the frequency of mandibular traumatism in the Russian Federation over the last twenty years continues to remain at a high level without a downward trend.<sup>6</sup> Injuries to the bones of the facial skeleton belong to socially significant problems because they often lead not only to functional impairment, but also to aesthetic impairment. Such disorders can lead to disfigurement, which brings a person not only physical but also psycho-emotional suffering.<sup>7</sup>

Most often the working-age population (18-44 years old) is exposed to mandibular trauma, which makes the problem socially significant. Treatment of such fractures usually consists in immobilization of the fragments by applying bicuspid splints. This method of treatment is orthopedic and accounts for up to 87% of cases.<sup>8,9</sup> The fundamental criterion for a positive treatment outcome is the presence of consolidation, which is determined by radiographs or computed tomography. However, this method of diagnostic examination does not fully assess the restoration of mandibular integrity in mandibular fractures, as well as the normalization of blood flow.<sup>10</sup>

One of the objective criteria for the restoration of bone integrity is the normalization of blood flow, especially if the fracture line includes the outlet orifice.

The use of Doppler sonography is a clear tool for assessing the healing process. In the study by Mancini JC et al. (2016), it was shown that bone atrophy on the background of jaw fracture slows down the blood flow velocity in the facial and, predominantly, mental arteries compared to healthy ones.<sup>11</sup>

The aim of this study is to develop a protocol for finding a unified point of projection of the mental neurovascular bundle as a reference point for research and evaluation of the effectiveness of the treatment process in mandibular fractures.

## Materials and Methods

The study was carried out on the passported anatomical material of the Department of Operative Surgery and Topographic Anatomy of the N. V. Sklifosovsky Institute of Clinical Medicine of the I. M. Sechenov First Moscow State Medical University (Sechenov University). 100 adult cadavers heads with preserved bite height were included in the study. Arterial staining was performed using liquid, colored, solidifying, natural silicone injected into the common carotid artery on both sides (Kleiwer, RF) to enhance clarity. Previously frozen objects were slowly thawed naturally, and 24 hours later, immediately before infusion, the vessels without pronounced pressure were washed with a mixture of warm physiological solution and heparin to remove potential thrombizing elements and prevent intravascular damage. After obtaining fluid flow through the opposite artery, the vascular bed was considered ready for injection. Injection of scleral vessels as well as alveolar branches was considered as a staining criterion. At the end of staining, the object was left at room temperature for 3 hours, then the necessary examinations were performed, followed by dissection and visualization of the result. Measurements were performed on the skin of the lower third of the face using a ruler and caliper. To find the projection of the jawline and, consequently, the jawline neurovascular bundle on the skin of the lower third of the face, we measured the main bony landmarks of the mandible on the proposed points: A-C; R-Pm; I-Mm.

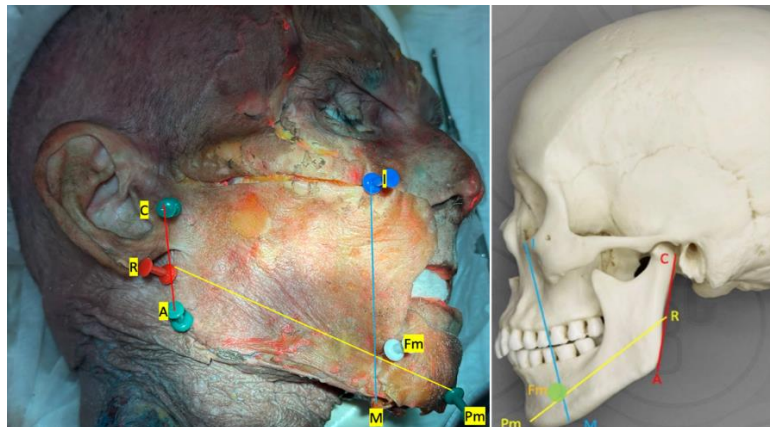
These landmarks were the following points:

- I - point projecting to the suture between the oculomandibular process of the zygomatic bone and the body of the maxilla;
- M - edge of the mandible;
- I-M - perpendicular drawn between these points;
- C - head (condyle) of the mandible;
- A - angle of the mandible;
- C-A - length of the mandibular branch;
- R - projection on the middle of mandibular branch length along the longitudinal line A-C;
- Pm - point corresponding to the mental protuberance (protuberantio mentalis);
- R-Pm - line drawn from the middle of mandibular branch to the mental eminence;
- Fm - point of intersection of lines R-Pm and I-M, corresponding to the front from the crossing of the mental aperture area.

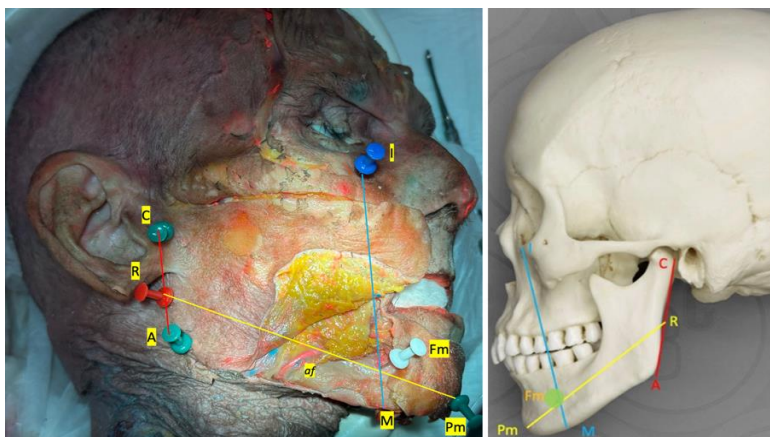
To verify the conception, the smallest and largest limits of values, the error of the mean M and the standard deviation were determined. At the preparatory stage, marks were made in the projection of the points

we proposed for landmarks (Figures 1a, b).

Next, a layer-by-layer dissection was performed in the Fm point (foramen mentalis) to determine the projection zone (Figures 2a, b).



**Figure 1a, b.** Dermal construction of projection lines between the landmark points



**Figure 2a, b.** Dissection of the area of the mental aperture and the artery of the same name (the af - facial artery, a. facialis, was exposed for verification).

Spearman's correlation coefficient and Mann-Whitney U-criterion were used in statistical data processing. Differences at  $p < 0.05$  were considered statistically significant. The values of the correlation coefficient that are at least average in strength and  $> 0.500$  were considered.

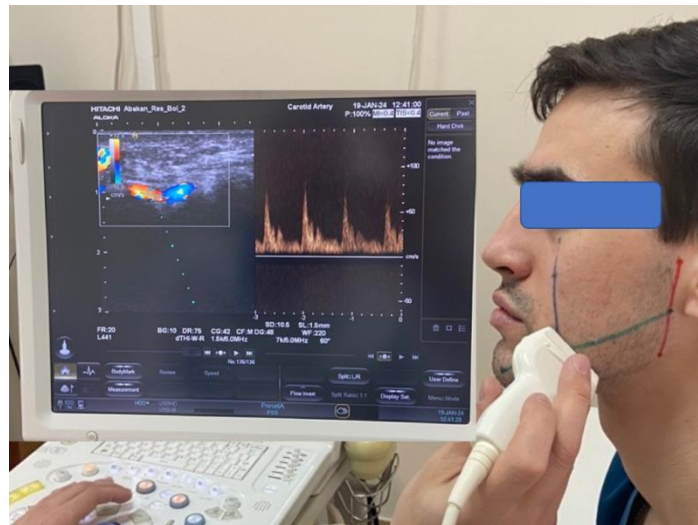
Clinically, the technique was tested by superimposing a projection through ultrasound of the jawline region. Patients of both sexes were marked on the facial skin in the form of 3 intersecting lines using the above-described technique (Figures 3a, b).



**Figures 3a, b.** Schematic of determining the projection of the mental aperture by anatomical points on the skin

In the area of intersection of two lines: blue (I-M) and green (R-Pm), we determine the exit point of the jawline (Fm). To confirm the theory, an ultrasound examination was performed on a Hitachi Aloka Noblus (Hitachi, Japan), using a linear high-density transducer

with a frequency of 5-18 MHz. The study was performed in B-mode (black and white), color Doppler, energy Doppler, spectral Doppler (spectrum of arterial and venous blood flow) (Figure 4).



**Figure 4.** Determination of the location of the mental artery relative to the preformed markings using Doppler flowmetry

## Statistical analysis

Metric data were presented as mean  $\pm$  standard deviation. Multiple comparisons were performed using non-parametric test Mann–Whitney. The p-value less than 0.05 was considered significant.

## Results

The height (working length) of the mandibular branch from the condyle "C" (mandibular head), clinically determined subcutaneously by palpation anteriorly from the external auditory canal through the mandibular excursion to the protruding point of the angle "A", was analyzed to calculate the given parameters. The following limits were obtained according to skull type: Dolichocrania, n=31, Brachyocrania, n=34, Mesocrania, n=35. On average, the height of the mandibular branch was  $5.87 \pm 0.3$  cm. To test the hypothesis about the significance of the limits of branch length between cranial index types, i.e. whether the zone of crossed values between two series is small enough, the Mann-Whitney U-criterion between groups was calculated.

Thus, when comparing mesocrania and dolichocrania the obtained empirical value of  $U_{amp}$  (0)

was in the zone of significance at  $p \leq 0.05$ . However, when comparing mesocrania and brachyocrania the obtained empirical value of  $U_{amp}$  (2) was in the zone of insignificance at  $p \leq 0.05$ . Comparing dolichocrania and brachyocrania the obtained empirical value of  $U_{amp}$  (0) was in the zone of significance at  $p \leq 0.05$ .

The next landmark was chosen as the distance between points I, which corresponds to the lower edge of the orbit, and more precisely to the suture between the maxillary oculomandibular process and the zygomatic bone. Clinically, it can be additionally determined by the fossa located below the canine fossa with the suborbital neurovascular bundle, the compression of which causes hyposthesia and paresthesia in patients.

On average, the distance from the suture between the oculomandibular process of the zygomatic bone and the body of the maxilla to the lower edge of the mandible was  $77.87 \pm 9.93$  cm. To test the hypothesis about the significance of length limits between cranial index types, that is, whether the zone of crossed values between two rows is small enough, the Mann-Whitney U-criterion between groups was calculated.

Thus, comparing mesocrania and brachyocrania, the obtained empirical value of  $U_{Emp}$  (0) was within the zone of significance at  $p \leq 0.05$ . Comparing

dolichocrania and brachyocrania, the obtained empirical value of UEmp (0) was within the zone of significance at  $p \leq 0.05$ . Evaluating mesocrania and brachyocrania the obtained empirical value of Uemp (0) was in the zone of significance at  $p \leq 0.05$ . Thus, a persistent statistical difference between the distance from the suture between the ocular process of the zygomatic bone and the body of the upper jaw to the lower edge of the lower jaw is determined. This index plays an important clinical role in calculating the danger and safety zones for injection and in performing operations in the maxillofacial region.

To create a target, point coinciding with the projection of the mandibular foramen and the neurovascular bundle of the same name, a line was drawn through the mid-length of the mandibular branch along the A-C length from point R to the Pm (protuberantio mentalis). Clinically, this line is projected onto the skin and runs obliquely along the body of the mandible. Averaged, the distance from the mid-length of the mandibular branch to the chin eminence was  $106.21 \pm 10.26$  cm. To test the hypothesis about the significance of length limits between cranial index types, that is, whether the zone of crossing values between two rows is small enough, the Mann-Whitney U-criterion was calculated between the groups.

When comparing the length at all skull shapes, the obtained empirical value of Uamp (3) was in the zone of insignificance at  $p \leq 0.05$ .

From the measurement results, it can be concluded that there is a statistical difference between the extreme forms, dolichocrania and brachyocrania, and between mesocrania and dolichocrania. Clinically, this has significance in the search for permanent landmarks. According to the results obtained, the mental artery was located immediately anteriorly at the intersection of the perpendicular I-M and the horizontal R-Pm (Fig.2) As seen in the dissection, the volume of subcutaneous fat in the study area can significantly complicate the palpatory method of determining the artery, especially in conditions of maxillofacial trauma.

Nevertheless, there is still an obvious relevance of a quick and accurate search for the projection of the main neurovascular bundles in the clinic of

maxillofacial trauma. Thus, edema, muscle traction, features of posttraumatic deformity - all this can slow down the necessary search and reduce the quality of pre- and clinical stages of treatment and rehabilitation measures. Studies show the importance of proper positioning in facial interventions.<sup>12</sup>

Manson's point is known, which can be determined quite easily when it is necessary to search for the projection of the facial artery,<sup>13</sup> but no such tactics have been developed before for the mental neurovascular bundle.

### Conclusion

We have obtained a coordinate system that can be projected both on the patient's facial skin and on the CT data. Clear positioning of the chin neurovascular bundle will allow to perform both diagnostic, for example, the study of blood flow velocity of vessels during ultrasound examination in acute trauma, in persons with increased body mass index, and treatment, for example, nerve blockade, manipulations with greater accuracy and safety for the patient.

### Declarations

#### *Conflicts of interest and financial disclosures*

The author declares that he has no conflict percent and there was no external source of funding for the research in question.

#### *Ethical approval*

The study was approved by the University ethics committee and was conducted in accordance with the Declaration of the World Medical Association.

#### *Informed consent*

Informed consent was obtained from all individual participants included in the study.

#### *Source of funding*

The work was not funded.

REFERENCES

1. Ghezta NK, Bhardwaj Y, Ram R, et al. Incidence Pattern of Bear-Inflicted Injuries to the Maxillofacial Region-Soft and Hard Tissue Injuries, Their Management, and Sequelae. *J Oral Maxillofac Surg.* 2019;77(5):1043.e1-1043. e15. doi:10.1016/j.joms.2018.12.029
2. Tuckett JW, Lynham A, Lee GA, Perry M, Harrington U. Maxillofacial trauma in the emergency department: areview. *Surgeon.* 2014;12(2):106-114. doi:10.1016/j.surge.2013.07.001
3. Afanasyev VV. Traumatology of maxillofacial region - Moscow: *GEOTAR-Media*, 2010;256 c
4. Karpov SM, Christoforando DY, Shevchenko PP, Sharipov EM, Abidokova FA. Epidemiologic aspects of maxillofacial trauma on the example of Stavropol. *Russian stomatologic journal.* 2012;1:50-51. eLibrary ID:18112397
5. Malykh MS, Mellin RV, Sivolapov KA, Vasiliev YL. Posttraumatic deformation of the mandible caused by untimely application for medical help. *Clinical Dentistry.* 2022;25(1). doi:10.37988/1811-153X\_2022\_1\_70
6. Socially significant diseases population of Russia in 2018 (Statistical Materials). M., 2019. 73 p. Russian
7. Yakovenko LL, Yakovenko OO, Gonchar DG. The forensic medical evaluation of injuries to the maxillofacial region. *Sud Med Ekspert.* 2016;59(2):10-13. doi:10.17116/sudmed201659210-13
8. Movshovich I.A. Operative orthopedics. *Moscow: Medical information agency.* 2006.
9. Kyung HM, Park HS, Bae SM, Sung JH, Kim IB. Development of orthodontic microimplants for intraoral fixation. *Journal of Clinical Orthodontics.* 2003;37(6):321-328.
10. Darawsheh HM, Makarova NI, Dydykina IS, et al. Study of variability of pterygomandibular space in terms of target point of inferior alveolar nerve blockade. *Ann Anat.* 2024;252:152197. doi:10.1016/j.aanat.2023.152197
11. Mancini JC, Garcia MR, de Oliveira IR, de Freitas RR, Luz JG. Analysis of the blood supply of the edentulous mandible after fracture: a color Doppler sonography study. *Oral Maxillofac Surg.* 2016;20(4):417-424. doi:10.1007/s10006-016-0583-0.
12. Darawsheh HM, Entel T, Omarova ZK, et al. Vascular Complication After Lateral Temporal Lifting Technique: A Case report. *Bulletin of Dentistry and Oral and Maxillofacial Surgery.* 2023;19(4):128-135. doi:10.58240/1829006X-2023.19.4-5.
13. Calva D, Chopra KK, Sosin M, et al. Manson's point: A facial landmark for identification of the facial artery. *J Plast Reconstr Aesthet Surg.* 2015;68(9):1221-7. doi:10.1016/j.bjps.2015.05.007

**ՎԼԻՆԻԿԱԿԱՆ ԵՎ ԱՆԱՏՈՄԻԱԿԱՆ ԹԵՍԱՎՈՐՈՒՄ ԴԻՄԱԾՆՈՏԱՅԻՆ ՎՆԱՍՎԱԾՔԻ  
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ՄԵԹՈԴԻ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ՎԵՐԱԲԵՐՅԱԼ**

Ռուսլան Մելին,<sup>1</sup> Ելենա Կարպովա,<sup>2</sup> Օլեսյա Կիտկո,<sup>3</sup> Լյուդմիլա Վրովինա,<sup>4</sup> Իրինա Չուվարկովա,<sup>4</sup>  
Յուրի Վասիլև<sup>5</sup>

1. Իսակասիայի Հանրապետության գլխավոր դիմաձևնոտային վիրաբույժ, Ն.Վ. Սկլիֆոսովսկու անվան կլինիկական բժշկության ինստիտուտ, Մոսկվայի առաջին պետական բժշկական համալսարանի

- օպերատիվ վիրաբուժության և տեղագրական անատոմիայի ամբիոն՝ Ի.Մ. Մեչենով (Մեչենովի համալսարան), Մոսկվա, Ռուսաստան
2. Բժշկական գիտությունների դոկտոր, պրոֆեսոր, մաշկային հիվանդությունների և կոսմետոլոգիայի ամբիոն, բարձրագույն կրթության դաշնային պետական ինքնավար ուսումնական հաստատություն, Ռուսաստանի Ն. Ի. Պիրոգովի անվան ազգային հետազոտական բժշկական համալսարան, Մոսկվա, Ռուսաստան
  3. Բժշկական գիտությունների թեկնածու, դոցենտ. Ն.Վ. Սկիֆոսովսկու անվան կլինիկական բժշկության ինստիտուտ, Մոսկվայի առաջին պետական բժշկական համալսարանի օպերատիվ վիրաբուժության և տեղագրական անատոմիայի ամբիոն՝ Ի.Մ. Մեչենով (Մեչենովի համալսարան), Մոսկվա, Ռուսաստան
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### Ամփոփում

Ենթակցակային նյարդանոթային խրճի տեղակայման անատոմիան և մորֆոլոգիան զգալիորեն տարբերվում է բնակչության շրջանում և մեծապես կախված է բազմաթիվ գործոններից, ինչպիսիք են զարգացման գործընթացը, ինչպես նաև ուղեկցող և անցյալում տարած հիվանդությունները: Նյարդանոթային խրճերի և հարակից անցքերի հիմնական պրոյեկցիաների որոնման էքսպրես մեթոդների գործնական բժշկական օգնության անհրաժեշտության հետ կապված, իրականացվել է ստորին ծնոտի մաշկի վրա ենթակցակային անցքի պրոյեկցիայի որոնման մեթոդի մորֆո-վերլուծական մոդելավորում: Ուլտրաձայնային ախտորոշիչ բժիշկների և դիմաձնոտային վիրաբույժների խնդրանքով փորձ է արվել հաշվարկել ենթակցակային նյարդանոթային խրճի միասնական պրոյեկցիոն կետը՝ որպես ստորին ծնոտի կոտրվածքի բուժման գործընթացի արդյունավետության հետազոտման և գնահատման ուղեցույց:

Մենք ստացել ենք կոորդինատային համակարգ, որը կարող է նախագծվել ինչպես հիվանդի դեմքի մաշկի վրա, այնպես էլ CT տվյալների վրա: Կզակի ներդրանքային խրճի հստակ դիրքավորումը թույլ կտա կատարել և՛ ախտորոշիչ, օրինակ՝ ուլտրաձայնային հետազոտության ընթացքում անոթների արյան հոսքի արագության ուսումնասիրությունը սուր տրավմայի ժամանակ, մարմնի զանգվածի ինդեքսով մարդկանց մոտ, և՛ բուժում, օրինակ՝ նյարդային շրջափակում, մանիպուլյացիաներ հիվանդի համար ավելի մեծ ճշգրտությամբ և անվտանգությամբ:

### КЛИНИКО-АНАТОМИЧЕСКАЯ АПРОБАЦИЯ ЭФФЕКТИВНОСТИ МЕТОДИКИ ПОИСКА ПРОЕКЦИИ ПОДБОРОДОЧНОГО СОСУДИСТО-НЕРВНОГО ПУЧКА В КЛИНИКЕ ЧЕЛЮСТНО-ЛИЦЕВОЙ ТРАВМЫ

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### Резюме

Анатомия и морфология расположения подбородочного сосудисто-нервного пучка значительно варьирует среди популяций и во многом зависит от многих факторов, таких как процесс развития, а также от сопутствующих и перенесённых заболеваний. В связи с потребностью практического здравоохранения в экспресс методах поиска основных проекций сосудисто-нервных пучков и ассоциированных отверстий было проведено морфо-аналитическое моделирование способа поиска проекции подбородочного отверстия на кожу нижней челюсти. По запросу врачей УЗИ-диагностики и челюстно-лицевых хирургов была предпринята попытка расчета унифицированной точки проекции подбородочного сосудисто-нервного пучка, как ориентира для исследований и оценки эффективности лечебного процессе перелома нижней челюсти.

Мы получили систему координат, которую можно проецировать как на кожу лица пациента, так и на данные КТ. Четкое расположение сосудисто-нервного пучка подбородка позволит проводить как диагностику, например, исследование скорости кровотока сосудов при ультразвуковом исследовании при острой травме, у лиц с повышенным индексом массы тела, так и лечение, например, блокаду нервов, манипуляции с большей точностью и безопасностью для пациента.