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The results of the development of a personalized method of mandibular foramen searching in the aspect of mproving the efficiency and safety of inferior alveolar nerve block

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Abstract

The position of mandibular foramen and its correspondence with the mandibular nerve are the key positions of the personified research. The ideas of different anatomic schools about the positions of mandibular foramen are based on their own research of native, clinical, radiological materials and on the averaged common tendencies.

Aim. *It was the development, anatomical and clinical evaluation of the effectiveness of the individual method of finding the projection of the mandibular foramen on the ramus of mandible.*

Materials and methods. *The study was conducted on 200 adult (from 20 to 45 years) cadaveric mandibles with the preserved (saved) height of the alveolar process in the distal part from December 2018 to April 2019. Linear measurements based on points C1-C2; M(c1-c2); C1-A; R-A; R- M were carried out with the help of caliper in cm. To assess the effectiveness of the proposed method, a numerical rating scale for pain estimation in combination with the Wong-Baker facial scale in adaptation for single use was used.*

Results. *Thus we received an anatomical and mathematical model of projection point of mandibular foramen (F) on the upper surface of the ramus of mandible according to the results of measurement. On the basis of anthropometric studies a predictive calculation of the depot area for local anesthetic while using the proposed method of anesthesia was done. An approximate position of the needle tip when immersed in 2/3 of the length is projected on mandibular foramen slightly behind and upwards of the lingula of the mandible. The effectiveness of mandibular anesthesia is estimated within the limits from 77,6% to 89,4 %. Recently, there has been an increased interest in personalization in dentistry, both globally and in individual methods and means. Special significance of the personification evident in the value of an anatomo-topographical and constitutional peculiarities of patients. The study of pain sensation in the process of the treatment of mandible dental diseases with the use of classical and modified methods showed a high level of efficiency, as well as the absence of a statistically significant difference between the results. The absence of significant difference proves the clinical efficiency of the proposed model of finding the injection area mark points.*

Key words: *local anesthesia, personalized medicine, IAN block, mandible.*

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Highlights:

1. Ramus of mandible and its inner surface represent a field of interest for researches whose aim is to increase the effectiveness of local anesthesia in dentistry.

2. On the basis of anthropometric studies a predictive calculation of the depot area for local anesthetic while using the proposed method of anesthesia was done.

RELAVANCE

Ramus of mandible and its inner surface represent a field of interest for researches whose aim is to increase the effectiveness of local anesthesia in dentistry. The position of mandibular foramen and its correspondence with the mandibular nerve are the key positions of the personified research. The ideas of different anatomic schools about the positions of mandibular foramen are based on their own research of native, clinical, radiological materials and on the averaged common tendencies [1]. Descriptions of clinical cases [2, 3], native materials researches [4], radiological data [5] researches showing additional or abnormally positioned mandibular foramen can be found. Iwanaga J. (2016) describes a patient with two minor round radiolucent formations on the inner surface of the ramus of mandible, 3D reconstruction visualized an additional mandibular foramen. Sunohara M. (2017) on the basis of the data of Cone beam computed tomography (CBCT)

research presents an analyses of relative positions of inferior alveolar nerve and mandibular foramen from the position of branched microchannels connected in mandibular. This type of variant microanatomy is the extreme form manifestation which corresponds with first postulate of the theory developed by Shevkunenko V.N. [6] Along with non-classified micro structures, including vessels and nerves, a retromolar canal [7, 8, 9, 10, 11] which includes a neurovascular bundle was determined. It causes additional innervations [12] and can play the role of transfer system for additional anesthesia while treating mandible dental diseases according to Truong M.K. [13] Numerous researchers underline the low percentage of visualization of additional holes on the inner surface of the ramus of mandible according to conventional x-ray studies. Thus Pancer B. [14] stresses the necessity of carrying out cone beam computed tomography (CBCT) researches planning surgery and conducting of anesthesia in order to calculate the distance to, so called, additional mandibular foramen.

Intraoral blockade methods of inferior alveolar nerve alone, as well as in complex with lingual and buccal nerves are widely described. Among these methods are palpation method, G. Gow-Gates technique. A separate niche is occupied by methods used in case of limited mouth opening due to various etiologies, among them methods by Akinosi [15], Vazirani [16], Lagardy and methods aimed at minimizing the patient's comfort at injections, for example, Jorgensen&Hayden technique [17].

A disadvantage of the classical, individually oriented, and modern methods is the lack of control of needle immersion in tissue, non-clear points for orientation, the need for wide opening of the mouth, the lack of consideration of physiological attrition of the teeth, hyper or hypotonia pterygoid muscles.

The aim of the research was the development, anatomical and clinical evaluation of the effectiveness of the individual method of finding the projection of the mandibular foramen on the ramus of mandible.

Materials and methods. The study was conducted on 200 adult (from 20 to 45 years) cadaveric mandibles with the preserved (saved) height of the alveolar process in the distal part from December 2018 to April 2019. Linear measurements based on points C1-C2; M(c1-c2); C1-A; R-A; R- M were carried out with the help of caliper in cm. The names of points are based on Latin terms denoting anatomical formations according to International anatomical terminology [18].

The minimum and maximum values, M average error and standard deviation were determined. We carried out anatomical and mathematical modeling (fig. 1) of the process of individualization of the method of finding the projection of the mandibular foramen on the ramus of mandible.

In order to fulfill the anatomical and mathematical modeling the following dimensions were determined:

1) Anatomical width, distance C1-C2 : distance between condylar process and coronoid process;

2) Point M(c1-c2) was determined as the projection point on the area of the middle of the edge of the zygomatic arch, which clinically corresponds to the cavity in the area between front-upper part of condylar process and lower part of zygomatic arch;

3) Working anatomical height C1-A: distance between the condylar process and and mandibular angle;

The projection point (R) on the front surface of ramus of mandible was determined. It is higher than retromolar area of mandible.

4) Oblique bottom distance between mandibular angle (A) and projection point of retromolar area of mandible (R);

5) Oblique top distance between R and M(c1-c2).

To assess the effectiveness of the proposed method, a numerical rating scale for pain estimation in combination with the Wong-Baker facial scale in adaptation for single use was used. Numeric rating Scale for pain (NRS) (fig. 2) is a digital version of Visual Analog Scale for pain (VAS). It is a horizontal line, 10 cm long, with numbers from 0 to 10 on it, where 0 is "no pain", 5 is "moderate pain" and 10 is "the strongest pain you can imagine". After the end of the treatment, the patient was asked to choose a number from 0 to 10, which corresponds to his pain during the treatment of the tooth taking into consideration the method of anesthesia. In our study we compared classic inferior alveolar nerve block (IANB) with our method.

RESULTS

The working anatomical width, distance C1-C2: distance between condylar process and coronoid process is 3,93±0,1.

Thus, point M(c1-c2) is located at a distance 1,98±0,046cm to the front from the condylar process(C1). Absolute anatomical height (C1-A) of the mandible according to the measurement of distance between the condylar process (C1) and mandibular angle (A) is 6,1±0,22 cm. The absence of a statistical difference between the distances makes the projection of the line A – M (C1-C2) identical.

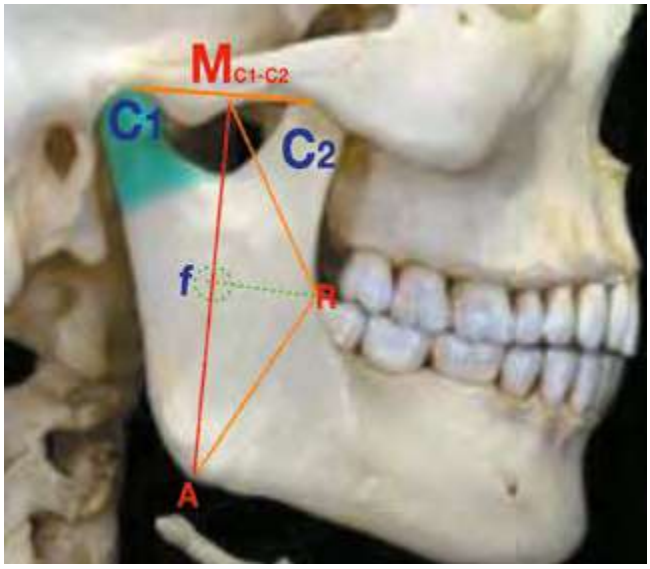

Fig. 1. **The anatomical model for measurement of local anesthesia target point**

Fig. 2. **The numerical rating scale for pain estimation in combination with the Wong Baker facial scale**

Oblique bottom distance between the most prominent point of mandibular angle (A) and projection point of the rear upper edge of retromolar area of mandible (R) was determined. This distance is 3,596±0,15cm.

Oblique top distance between M(c1-c2) and the projection point of the rear upper edge of retromolar area of mandible (R) was measured.

The distance between the projection point of the rear upper edge of retromolar area of mandible (R) and point M(c1-c2), projected on the submandibular fossa (F) was measured.

Thus we received an anatomical and mathematical model of projection point of

mandibular foramen (F) on the upper surface of the ramus of mandible according to the results of measurement.

On the basis of anthropometric studies a predictive calculation of the depot area for local anesthetic while using the proposed method of anesthesia was done. Thus, an approximate position of the needle tip when immersed in 2/3 of the length is projected on mandibular foramen slightly behind and upwards of the lingula of the mandible (Fig. 3).

For the verification of the intraoral search we offer the following scheme. Due to the absence of a definition of the space behind the last molar on the maxilla having no constant bone restrictions in international anatomical terminology, we offer to introduce the working term "maxillary retromolar space" or Rmax. Clinically, this space is located behind the last present (significant for 2 and 3 molars) molar on the maxilla and represents the deepening of the oral mucosa having a projection of condylar process, which is determined by palpation.

The following scheme is proposed for intraoral orientation: the injection area is located at the intersection of the perpendicular drawn through the Rmax and Rman

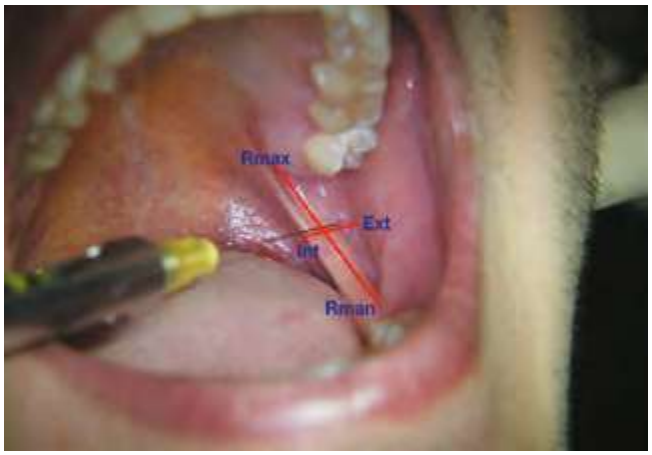

Fig. 3. **The scheme of location of the projection points on the inner edge of the ramus of mandible**

*Fig. 4.***Direction of the needle to the injection point by UltraSafetyPlus (Septodont)**

Table 1. **Method of performing modified mandibular anesthesia on the right (right handed dentist)**

Method variants	Out of the oral cavity	In the oral cavity
0 stage	The patient is asked to open his mouth to the limit of freedom (comfort).	
I stage	By palpation, the anterior edge of the masseter and the last molar of the mandible are determined, behind which the thumb is installed.	The thumb is located at the posterior upper edge of the mandibular retromolar space.
II stage	The ring finger of the left hand is located in the area of mandibular angle.	
III stage	The middle finger palpates the condylar process of the mandibular ramus and the lower edge of the zygomatic arch a bit forward from the condylar process.	
IV stage	The index finger is placed anteriorly from the position of the middle finger (the deepening formed by the cavity under the zygomatic arch and the mandibular notch is found by palpation).	
V stage	The index finger goes down onto the middle of the mandibular ramus (the direction corresponds to the centre of the base of the triangle formed by the mark points). This location should be considered as an external mark point for the intraoral injection.	

Table 2. **Method of performing modified mandibular anesthesia on the left (right handed dentist)**

Method variants	Out of the oral cavity
I stage	The thumb of the left hand is located in the area of mandibular angle.
II stage	The ring finger of the left hand is placed at the anterior edge of the mandibular ramus (tactilely behind the last molar on the mandible).
III stage	The index finger palpates the condylar process and the lower edge of the zygomatic arch anteriorly from the condylar process.
IV stage	The middle finger is placed anteriorly from the position of the index finger (the deepening formed by the cavity under the zygomatic arch and the mandibular notch is found by palpation).
V stage	The index finger goes down onto the middle of the mandibular ramus (the direction corresponds to the centre of the base of the triangle formed by the mark points). This location should be considered as an external mark point for the intraoral injection.

retromolar area and the line passing through the middle of the perpendicular between the edges of the muscles. To search for the projection of the mandibular foramen we offer the following schemes which can be performed both with or without immersing the thumb into the oral cavity. The algorithm of performing modified mandibular anesthesia on the right is given in the Table 1 and at figure 4.

The algorithm of performing modified mandibular anesthesia on the left is given in the Table 2. In this case, the dentist is behind.

To compare the offered method with the basic one already used, 50 patients were treated using the offered method. They complained of short-term pain when food got into the area of chewing teeth of the mandible. The distribution of patients by age and sex did not show any statistical difference, therefore, a classification according to the diagnosis was carried out. It is presented in Table 3. The patients were further divided into 2 groups. The patients of the first group were treated with the classically used mandibular anesthesia method, the patients of the second group were treated with a modified method of mandibular anesthesia. The aim of the research was to study the effectiveness of anesthesia performed with both methods.

As the number of patients was relatively small, we united all the patients with inflammatory diseases of the pulp into one group. Thus, it was shown that in the process of dental caries treatment (K021) in the first group only two patients had mild pain estimated at 1 and 2 points, which corresponds to the mark "hurts little bit", in the second group 3 patients indicated minor pain, with one patient noted 2 points, and the other two – 1 point.

The Spearman correlation coefficient (ρ) for this group is equal to 0.384, considering the fact that a direct correlation between the characteristics studied and correlation density according to the Chaddock scale is moderate. The critical value of Spearman's criterion is 0.786. The interdependence of the features is statistically not significant ($p>0.05$). This result proves that both methods have shown the same effectiveness in the process of caries treatment.

In the process treatment of teeth with irreversible pulpitis and pulp necrosis, out of 19 patients of the first group who were anesthetized using the classical method 5 patients had weak pain, which corresponded to an assessment of 3 points, and 2 patients had 4 points. In the second group of patients (18 people), who underwent anesthesia using a modified method of mandibular anesthesia, there was one patient with little noticeable pain (1 point) and three patients with mild pain (3 points). The Spearman correlation coefficient (ρ) for this group is equal to 0.413, considering the fact that a direct correlation between the characteristics studied and correlation density according to the Chaddock scale is moderate. The critical value of Spearman's criterion is 0.472. Dependence of the features is statistically not significant ($p>0.05$). This result proves that both methods have shown the same effective result for the treatment of pulpitis.

DISCUSSION

The effectiveness of mandibular conductive anesthesia is estimated within the limits from 77,6% [19] to 89,4 % [20]. Recently, there has been an increased interest in personalization in dentistry, both globally and in individual methods and means [21; 22]. Special significance of the personification evident in the value of an anatomo-topographical and constitutional peculiarities of patients [23].

In total we see the results which are proved by Spearman correlation coefficient (ρ) for tooth decay and irreversible pulpitis and pulp necrosis treatment. In the study, we compared the effectiveness of the methods used by the criterion of uniformity, the lack of statistical difference in the results confirms the effectiveness of the proposed method of mandibular anesthesia.

CONCLUSION

Thus, the study of pain sensation in the process of the treatment of mandible dental diseases with the use of classical and modified methods showed a high level of efficiency, as well as the absence of a statistically significant difference between the results. The absence of significant difference proves the clinical efficiency of the proposed model of finding the injection area mark points.

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III Стоматологическая олимпиада МГМСУ «Эндодонтическое мастерство» и «Реставрация зубов» – 2019

Ежегодное проведение олимпиады МГМСУ по направлениям «Эндодонтическое мастерство» и «Реставрация зубов» в рамках III Стоматологического форума молодежной науки «Современные технологии в стоматологии» приобрело новые усовершенствование. В этом году среди студентов и ординаторов проходили сразу четыре олимпиады: на базе Учебного центра STI-dent и Учебного Центра DENTSPLY SIRONA (Sirona Training Center). Организатор форума – кафедра кариесологии и эндодонтии МГМСУ им. А.И. Евдокимова (заведующий кафедрой кариесологии и эндодонтии – заслуженный врач РФ, декан стоматологического факультета МГМСУ им. А.И. Евдокимова, д.м.н., профессор Митронин А. В.). Совместное проведение олимпиад и форума делает мероприятие уникальным клиническим событием, которое позволяет студентам и ординаторам повысить свои теоретические и практические знания для дальнейшего их использования в повседневной практике.

После предварительного отбора конкурсантов традиционно допущены к каждой олимпиаде 12 учащихся.

6 марта 2019 года были проведены олимпиады по эндодонтии и реставрации, на базе Учебного центра STI-dent.

Участниками стали ординаторы и студенты стоматологического факультета МГМСУ, среди них четыре врача-стоматолога – клинических ординатора:

1. Алексикова О. В.
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3. Куценко А. Д.
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7. Сухих М. О.
8. Тараткина Д. С.

Предварительно до олимпиады Митронин А. В., Шорина Т. В., Галиева Д. Т. провели мастер- классы:

- 27.02.2019 мастер-класс с исполнением участниками: «Обработка корневых каналов NiTi-инструментами с поперечным осевым сечением» проводился на кафедре кариесологии и эндодонтии.
- 28.02.2019 Митронин А. В., Истомина М., Галиева Д. Т. – мастер-класс «Реставрация жевательной группы зубов, современные композитные материалы».
- 05.03.2019 Митронин А. В., Галиева Д. Т., Останина Д. А. – мастер-класс с исполнением