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USHNITSKY Innokentiy Dmitrievich – Head of the Department of Therapeutic, Surgical, Orthopedic Dentistry and Childhood Dentistry of the Medical Institute of the Federal State Educational Institution "M.K. Ammosov North-Eastern Federal University", Doctor of Medical Sciences, Professor. E.mail: incadim@mail.ru; Tel: 89241708940; orcid.org/0000-0002-4044-3004; **CHAKHOV Alexander Alexandrovich** – associate professor of the Department of Therapeutic, Surgical, Orthopedic Dentistry and Childhood Dentistry of the Medical Institute of the Federal State Educational Institution "M.K. Ammosov North-Eastern Federal University", Ph.D.; E.mail: alex-alex41169@mail.ru; Tel: 89142272730; orcid.org/0000-0002-6371-0734; **PINELIS Iosif Semenovich** – Head of the Department of Surgical Dentistry, "Chita State Medical Academy," Chita, Doctor of Medical Sciences, Professor. E-mail: pinelisml@mail.ru, +79145200178; **PINELIS Yury Iosifovich** – Doctor of Medical Sciences, Associate Professor of Surgical Dentistry, "Chita State Medical Academy," Chita. E-mail: pinelisml@mail.ru, +79144615908; **YURKEVICH Alexander Vladimirovich** – Dean of the Dental Faculty, Department Head of Dentistry of the Orthopedic Federal State Medical University of the Far Eastern State Medical University of the Ministry of Health of the Russian Federation, Doctor of Health, E-mail: dokdent@mail.ru; ph. +7-962-502-58-88; **VINOKUROV Mikhail Mikhailovich** – Head of the Department of Faculty Surgery, Urology, Oncology and Otolaryngology of the Medical Institute of the Federal State Educational Institution "M.K. Ammosov North-Eastern Federal University", Doctor of Medical Sciences, Professor, E-mail: mmv_mi@rambler.ru; Tel: 89248699457, **KOLOSOVA Olga Nikolaevna** – chief researcher at the Institute of Biological Problems of Cryolithozone of the Siberian Branch of the Russian Academy of Sciences, Ph.D., professor. E-mail: kololgonik@gmail.com; ph. +7-924-177-29-12; **SAVVINA Irina Lvovna** – Associate Professor, Department of Foreign Languages in Technical and Natural Specialties, Institute of Foreign Philology and Regional Studies, "M.K. Ammosov North-Eastern Federal University", PhD. E-mail: sil26@list.ru; тел. +7-924-861-41-85.

I.D. Ushnitsky , A.A. Chakhov, I.S. Pinelis, Yu.I. Pinelis, A.V. Yurkevich, M.M. Vinokurov, O.N. Kolosova, I.L. Savvina

MANDIBULAR ANESTHESIA BY THE GOW-GATES METHOD

Despite the extensive study of local anesthesia in dentistry, problems of safe and anaesthesia quality improving remain unsolved. At the same time, one of the important aspects of adequate local anesthesia is knowledge of the anatomical-topographic features of the maxillofacial area, which have their own age and gender differences. In this regard, researches improving local anesthesia with anatomical features is of important theoretical, scientific and practical importance. **The research aim** is to increase the accuracy of determining the topography of the target point in condylar process neck by Gow-Gates mandibular anesthesia method. **Materials and methods.** A total of 91 lower jaws (49 males, 42 females) were studied, and 108 CT scans were analyzed. Statistical processing was carried out with the SPSS software package, version 22. Correlation and factor (by Varimax method) analyses were performed with Pearson coefficient (r). **Results.** Individual anatomical and topographic features of the mandibular ramus were obtained, which influence on the exact determination of the target point and needle immersion depth during Gow-Gates mandibular anesthesia. Thus, we have developed Ushnitsky-Chakhov's device for mandibular anesthesia using the Gow-Gates method. Discussion. The advantages of this device are the precise determination of the injection needle direction in the area of the mandibular condylar process outer surface, which eliminates the use of complex and difficult-to-remember anatomo-topographic points for the dentist, which are used in the standard mandibular anesthesia by Gow-Gates method. **Conclusion.** Determination of target point topography by Gow-Gates mandibular anesthesia method is carried out by the device that promotes more accurate delivery of the injection needle tip to the inner surface of the condylar process neck of mandibular ramus, which increases the safety and effectiveness of anesthesia. Traumatic injuries of maxillary artery, tissues of temporomandibular joint, mandibular neuro-vascular bundle and lateral pterygoid muscle are excluded or minimized as much as possible.

Keywords: anatomy and topography, mandible, local anesthesia, safety, effectiveness.

Introduction. Today the priority tasks of health care development are the quality improvement of medical and preventive care with the introduction and application of innovative technologies, which will directly have a positive impact on the preservation and improvement of public health [18, 32]. In practical dentistry, one of the important factors is qualitative anesthesia in the medical care provision, which is accompanied by effective methods search [1, 4, 12, 17, 19, 20]. It should be noted that the effectiveness and safety of anesthesia conductor methods and quality of medical interventions depend on anatomy and topography knowledge of the maxillofacial region, which have age and gender features [2, 3, 5-17, 21-27, 29, 30]. In Researches improving the quality of local anesthesia, taking into account the anatomical and topographic features of the maxillofacial area, have important scientific, theoretical and practical significance [17, 28, 31, 33].

The research aim is to increase the accuracy of determining the target point topography in condylar process neck by Gow-Gates mandibular anesthesia method.

Materials and methods. A craniometric study by V.P. Alekseev, G.F. Debets methods was conducted to identify the anatomical and topographic variability of the lower jaw data (1964). Determina-

tion by the examined anatomical material gender for the female and male types was carried out according to V.I. Pashkova's method (1958). There were no destruction and deformations of anatomical material. Some of them had single minor destruction of teeth, crowned processes, which did not have a negative effect in obtaining reliable results during craniometric measurements. The research was carried out at the departments of therapeutic, orthopedic, surgical dentistry and pediatric dentistry, normal and pathological anatomy, operative surgery with topographic anatomy and forensic medicine of the Medical Institute of the Federal State Educational Institution " M.K. Ammosov North-Eastern Federal University". Our craniometric research included 91 lower jaws, 42 females and 49 males, 108 CT images of "KaVo OP300 Maxio" tomograph for 3D diagnostics (Germany) with the OnDemand 3D™ program.

The following craniometric points of the mandible were measured:

March. 71a. Biom. rb', ramus smallest width; distance starting from the mandibular canal opening to the front edge of the lower jaw ramus; distance from the front edge of the lower jaw ramus to the target point; the distance between the temporal crest to the anterior edge of the mandible ramus; the distance between the target point of temporal crest of the mandible ramus; thickness of the lower jaw ramus in the region of the front edge at the level of the target point. A caliper was used to measure condylar and angular width, smallest ramus width, symphysis and body height, anterior width, mandibular opening, width and height of the tongue of the lower jaw ramus. At the same time, we additionally proposed a L point located at the level of the condylar crest above the inner surface lingula of the lower jaw ramus to determine the dimensions: 1) from the front edge of the ramus to the point L; 2) from the trailing edge of the ramus to the point L; 3) from the lower jaw notch to point L; 4) from the base of the lower jaw to the point L and dimensions: the angle in the lingula projection located on the inner surface of the jaw ramus; distance from the anterior edge of the ramus and temporal crest of the lower jaw; bone thickness of the jaw ramus within the target point; distance from the temporal crest to the target point of the mandible branch. The obtained results from the study of craniometric points and additional dimensions of the mandible gave us the basis for the device development for performing mandibular anesthesia by Gow Gates method [14], consisting of 4 main components, which include a guiding cylinder (oral part), fixing ring for thumb of left hand, arched forming parts of structure, point of needle direction (inside part) with opening for fixation by means of middle finger of left hand.

Statistical processing of clinical material was carried out by standard methods with "SPSS" programs, version 22. At the same time, factor (according to the Varimax method) and correlation analyses were carried out with the Pearson coefficient determination (r).

Results and discussion. There are confirmed individual features of the index of mandible ramus width, which influence the needle immersion depth during mandibular anesthesia. In general, there are absolute dimensions of the smallest ramus width of the lower jaw (March. 71a. Biom. rb'). So, according to V.P. Alekseev, G.F. Debets (1964), after the final process of growth of the facial skeleton bones, the lower jaw ramus width in men with its very small and very large size is 24.8-29.5 and 37.9-42.6 mm, and 23.2-27.6 and 35.4-39.8 mm in women, respectively,.

The craniometric results show the variability presence of ramus width and mandibular opening, as well as target point. At the same time, the difference between the minimum and maximum ramus width indicators in men was at the level of 17.89 + 0.56 mm, and in women - 18.99 + 0.68 mm ($p > 0.05$), where the overall average difference between the minimum and maximum data in men and women was 18.44 + 0.39 mm. A comparative analysis of the obtained average values of the smallest ramus width in men (31.65 + 0.32 mm) and women (29.32 + 0.33 mm) revealed significant differences ($p < 0.05$), where the total average indicator of women and men was 30.83 + 0.23 mm, which indicates significant differences compared to the average indicators of women and men ($p < 0.05$).

The obtained craniometric indicators of the difference between the minimum and maximum values of the distance between the opening and front edge of the lower jaw ramus in women are at the level of 12.41 + 0.45 mm, and 13.02 + 0.41 mm in men ($p > 0.05$), where the overall average indicator between the minimum and maximum values in men and women was at the level of 12.71 + 0.28 mm. A comparative analysis of mean values of the distance between the opening and anterior edge of the mandibular ramus in men (18.21 + 0.19 mm) and women (17.20 + 0.20 mm) revealed significant differences ($p < 0.05$). Meanwhile, the overall average between the minimum and maximum values for men and women was within the numerical values of 17.71 + 0, 37mm. At the same time, a comparative analysis of the total average indicator (17.66 + 0.15) and the average indicators of men and women characterizes the presence of significant differences ($p < 0.05$).

It should be emphasized that the mandible craniometric data related to the study of the distance between the ramus anterior edge and the target point characterize certain differences between the minimum and maximum values in men and women, which are respectively 11.89 + 0.40 mm and 12.19 + 0.43 mm ($p > 0.05$). At the same time, the overall average difference between the minimum and maximum values for men and women is 12.04 + 0.25 mm. Meanwhile, the obtained average values in men (16.86 + 0.18 mm) and women (15.67 + 0.21 mm) characterize the presence of significant differences ($p < 0.05$). The data analysis of the average values of men, women and the total average (men, women) is 16.44 + 0.14 mm, which determines the presence of significant differences ($p < 0.05$).

It should be noted that for the device development and mandibular anesthesia method, when conducting craniometric studies, we took into account the indicators of the lower jaw ramus, which are associated with the distance from the temporal crest to the target point, from the ramus front edge to the temporal crest, as well as with the indicator of the ramus thickness in the area of the anterior edge of the lower jaw at the level of the target point. At the same time, the minimum and maximum values of the distance between the ramus anterior edge and the temporal crest in women and men ranged from 1.60 + 0.10 to 12.0 + 0.22 mm. At the same time, a comparative assessment of the average data of men and women did not reveal significant differences ($p > 0.05$), where their average value was 6.40 + 0.19 mm. Meanwhile, the average distance between the temporal crest and the target point for men and women is 10.5 + 0.07. Meanwhile, a similar situation is determined in values of the lower jaw ramus thickness in the anterior edge region at the level of the target point, where the data were respectively from 3.80 ± 0.07 to 11.40 ± 0.16, as well as 7.38 ± 0.08 mm.

Pearson's correlation analysis revealed a marked association of the smallest ramus width of the mandible with the distances between the ramus anterior edge and the target point ($r = 0.69$), the ramus anterior edge and the temporal crest ($r = 0.51$), the temporal crest and the

Anatomical and topographic characteristics of the lower jaw for conducting mandibular anesthesia (mm)

Name of indicators	Men (l/j, n=49); (CT, n=57)			Women (l/j, n=42); (CT, n=51)			Men and women (l/j, n=91); (CT, n=108)		
	min	max	average	min	max	average	min	max	average
March. 71a. Biome. rb′, smallest branch width	21.5 ±0.57	39.0 ±0.25	31.65 ±0.32	20.0 ±0.67[1]	39.4 ±0.34	29.32 ±0.33[2]	20.0 ±0.41	39.4 ±0.18	30.83 ±0.23[3]
Distance from the front edge of the branch to the opening of the lower jaw	12.0 ±0.41	25.0 ±0.22	18.21 ±0.19	10.5 ±0.44[1]	23.0 ±0.24[1]	17.20 ±0.20[2]	10.5 ±0.31	25.0 ±0.16	17.66 ±0.15[3]
Distance from the front edge of the branch to the target point	11.0 ±0.34	23.0 ±0.25	16.86 ±0.18	9.7 ±0.43[1]	21.9 ±0.22[1]	15.67 ±0.21[2]	9.7 ±0.28	23.0 ±0.14	16.44 ±0.14[3]
Distance between the front edge of the branch and the temporal ridge	1.60 ±0.16	11.0 ±0.30	6.58 ±0.14	3.0 ±0.11[1]	12.0 ±0.32	6.23 ±0.20	1.60 ±0.10	12.0 ±0.22	6.40 ±0.19
Distance between the temporal ridge and the target point	6.5 ±0.09	16.0 ±0.19	11.01 ±0.10	6.3 ±0.08	14.5 ±0.18	9.99 ±0.10	6.3 ±0.07	16.0 ±0.13	10.5 ±0.07
Thickness of the lower jaw branch in the region of the anterior edge at the level of the target point	3.8 ±0.11	10.0 ±0.20	7.36 ±0.08	4.4 ±0.11[1]	11.4 ±0.25[1]	7.41 ±0.14	3.8 ±0.07	11.4 ±0.16	7.38 ±0.08

Note. 1 - statistically significant differences between the minimum and maximum indicators of men and women; 2 - statistically significant differences in the average statistical indicators of men and women; 3 - statistically significant differences between the average indicators of men, women and general average indicators (men and women).

Fig. 1. Anatomical and topographic features of the variability of the width of the lower jaw ramus

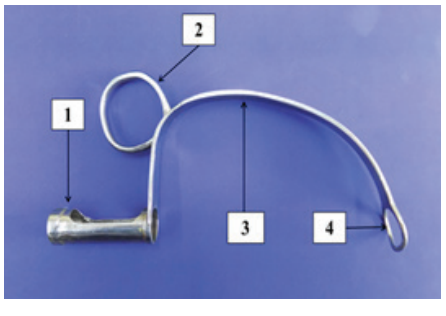

Fig. 2. Ushnitsky-Chakhov device for mandibular anesthesia according to the Go-Gates method (metal structure for reusable use)

Fig. 3. Technological integration of the device with a fixed standard cartridge syringe located in the channel of the guide cylinder

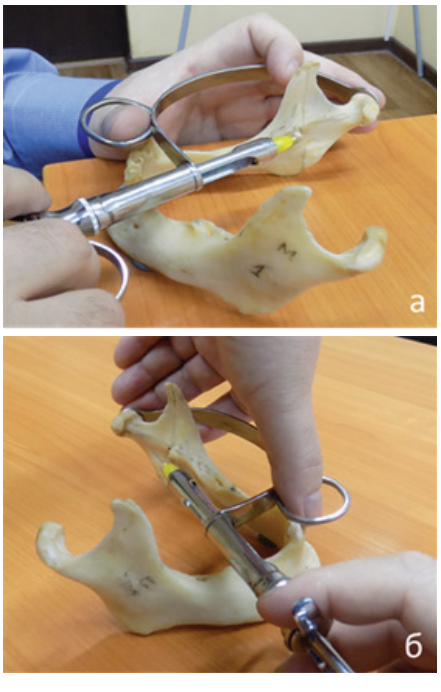

Fig. 4. Application of the device for conducting mandibular anesthesia according to the Go-Gates method: a - on the right; b - left

target point (r = 0.54) and characterizes that the needle immersion depth during mandibular anesthesia depends on individual width sizes. This trend is also confirmed by the results of a factor analysis of effect of the mandibular ramus width on craniometric indicators taken into account when performing mandibular anesthesia by the Varimax method with Kaiser normalization.

Taking into account the craniometric research results, we have developed a device characterized by design simplicity and technological implementation. This device used for Gow Gates mandibular anesthesia consists of all-metal body with 4 main components, including a fixing ring, a cylinder guiding a carpool syringe, end part with a fixing hole for guiding a needle with an arch (Figures 2, 3). The device guide cylinder has a diameter corresponding to the diameter of the carpel syringe (12 mm). At the same time, the cylinder length is 45 mm, which provides optimal limitation of excessive movement of the injection needle outside the target point and into soft tissues. Also, the cylinder allows to shift the mouth angle when choosing the device arrangement in the oral cavity in the region of premolars and molars of the mandible from the opposite injection side and promotes smooth needle insertion in the tissue, which is important for high-quality anesthesia due to unimpeded sliding of the syringe inside the cylinder. In addition, it has a wide window located centrally to control the aspiration sample, volume and rate of anesthetic administration. The left hand thumb fixing ring 2 is a metal ring with a 15 mm diam-

eter, which is located on the arch outside and allows the device to be securely fixed during anesthesia. The arcuate forming part of the construction 3 takes into account the face average dimensions, connects the guiding cylinder 1 and direction point of the needle 4, which allows using the device for patients with different facial types and directing the needle to the target point. The direction point of the needle 4 with the opening for fixing the middle finger of the left hand is located in the end part of the forming arch and serves for fixation in the area of the outer surface of the condylar process of the mandible, which is the direction point of the injection needle to the target point (the condylar process inner surface). To improve the device fixation, the metal rim of the fixing hole has a concavity that takes into account the shape of the condylar process from the outside, which makes it possible to use the device from both the left and right sides of the lower jaw (Figure 4 - a, b). The device parts are made of carbon steel - hardened stainless steel and are sterilized by standard methods.

Thus, the advantage of anesthesia device use is the precise determination of the direction of the injection needle, which is carried out by the guiding cylinder and needle direction point (fixing hole), which is installed in the area of the external surface of the condylar process of the lower jaw using the middle finger of the left hand, which eliminates the use of complex and difficult-to-remember anato-topographic points for the dentist, which are used by Gow-Gates standard method of mandibular anesthesia.

Conclusion. Determination of target point topography during mandibular anesthesia by Gow-Gates method will be carried out by the device that promotes more accurate delivery of the injection needle tip to the inner surface of the condylar process mandibular ramus neck. Such approach creates prerequisites for improving the safety and effectiveness of anesthesia associated with the elimination of maxillary artery injury, temporomandibular joint tissues, mandibular nervous-vascular bundle and lateral pterygoid muscle. In addition, the device is used for mandibular anesthesia on both sides and is easy to use, which is very important for young doctors.

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