УДК 617.52+616.314.2)-053.2-007.2-053.1:614.2(477.83)/.
DOI 10.11603/2311-9624.2018.4.9751

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Clinical evaluation of the developed method effectiveness of anesthesia of the zygomaticofacial nerve

Summary. The branching of the trigeminal nerve on the face has an individual anatomical variability. The individual variability of innervation of soft tissues of the maxillofacial area should be taken into account during their local anesthesia. During the blockade of the zygomaticofacial nerve in accordance with the well-known technique, only 74 % of the cases of anesthesia in the buccal and zygomatic areas were completely anesthetized.
The aim of the study – to give a clinical evaluation of the effectiveness of the developed method of anesthesia of the zygomaticofacial nerve.
Materials and Methods. In the clinical observation 41 stationary stomatological patients with planned surgical interventions on the lateral facial area took part (in the buccal area – 16 patients, in the zygomatic area – 25 patients). In order to detect the individual anatomical features of the facial part of the head in patients, the facial index was determined by the Garson's formula as the relation between the morphological height of the face and its width multiplied by 100. These patients were applied a developed method of conductive anesthesia of the zygomaticofacial nerve and compared its effectiveness with a known method. Pain sensitivity and perception in patients were studied using subjective and objective methods. Pain sensitivity was determined by injection of a needle (pinprick) into the epidermis. Pain perception during local anesthesia administration was evaluated by the Sounds, Eyes and Motor (SEM) scale.
Results and Discussion. Taking into account the results of craniometric studies as well as the individual topographic and anatomical features of zygomaticofacial nerve branching in people with different types of skull structure, the technique of conduction anesthesia of the branches of the zygomaticofacial nerve was developed. During surgical treatment the effectiveness of the local anesthetic developed method was evaluated as good – it was observed in patients a stable anesthesia, without psychosomatic peculiarities as well as local and general complications.
Conclusions. Application in clinical conditions of the technique of conductive anesthesia of the zygomaticofacial nerve, developed by us, in combination with the classical method of local anesthesia of the buccal nerve provides painless surgical interventions on the lateral area of the face. For the successful local anesthesia of the zygomatic and buccal regions, it is necessary to take into account the anatomical variability of the branch on the face of the zygomaticofacial nerve in patients with different types of skull structure and face shape.

Key words: zygomaticofacial nerve; buccal nerve; zygomatic and buccal regions; anatomical variability on the face; local conduction anesthesia.

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Клінічна оцінка ефективності розробленої методики анестезії вилично-лицевого нерва

Резюме. Розгалуження трійчастого нерва на обличчі має індивідуальну анатомічну мінливість. Варіабельність іннервації м'яких тканин щелепно-лицевої ділянки необхідно враховувати під час їх місцевого знеболювання. Під час проведення блокади вилично-лицевого нерва за відомою методикою лише у 74 % випадків щічна й вилична ділянки були повністю знеболені.
Мета дослідження – клінічно оцінити ефективність розробленого методу анестезії вилично-лицевого нерва.
Матеріали і методи. У клінічному спостереженні взяли участь 41 стаціонарний стоматологічний хворий, яким було заплановано хірургічне втручання на боковій ділянці обличчя (на щічній ділянці – 16 пацієнтів, на виличній ділянці – 25 хворих). Для виявлення індивідуальних анатомічних особливостей форм обличчя у пацієнтів визначали лицевий індекс за формулою Гарсона як співвідношення

між морфологічною висотою обличчя та його шириною, помножене на 100. Цим хворим застосували розроблений метод провідникової анестезії вилично-лицевого нерва і порівнювали його ефективність із відомим методом. Больову чутливість і сприйняття болю у пацієнтів вивчали за допомогою суб'єктивних та об'єктивних методів. Чутливість до болю визначали шляхом введення голки (уколу) в епідерміс. Сприйняття болю під час проведення місцевої анестезії оцінювали за шкалою "Звуки", "Очі" та "Рухи" (ЗОР).

Результати досліджень та їх обговорення. З урахуванням краніометричних досліджень, а також індивідуальних топографо-анатомічних особливостей розгалуження вилично-лицевого нерва у людей із різними типами будови черепа, розроблено методику провідникової анестезії гілок вилично-лицевого нерва. Під час хірургічного втручання ефективність розробленого методу місцевої анестезії оцінювали як добру, в пацієнтів спостерігали стійке місцеве знеболювання, без психосоматичних особливостей, а також місцевих та загальних ускладнень.

Висновки. Застосування в клінічних умовах методики провідникової анестезії вилично-лицевого нерва у поєднанні з класичним методом місцевої анестезії щічного нерва, яку ми розробили, забезпечує безболісні хірургічні втручання на боковій поверхні обличчя. Для успішного місцевого знеболювання виличної та щічної ділянок необхідно враховувати анатомічну мінливість розгалужень на обличчі вилично-лицевого нерва у пацієнтів із різними формами обличчя.

Ключові слова: вилично-лицевий нерв; щічний нерв; вилична та щічна ділянки; анатомічна мінливість форми обличчя; місцева провідникова анестезія.

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Клиническая оценка эффективности разработанного метода обезболивания скуло-лицевого нерва

Резюме. Ветвление тройничного нерва на лице имеет индивидуальную анатомическую изменчивость. Вариабельность иннервации мягких тканей челюстно-лицевой области должна учитываться при их местном обезболивании. Во время проведения блокады скуло-лицевого нерва по известной методике только в 74 % случаев щечная и скуловая области были полностью анестезированы.

Цель исследования – клинически оценить эффективность разработанного метода обезболивания скуло-лицевого нерва.

Материалы и методы. В клиническом наблюдении приняли участие 41 стационарный стоматологический больной, которым были запланированы хирургические вмешательства в боковой области лица (в щечной области – 16 пациентов, в скуловой области – 25 больных). Для определения индивидуальных анатомических особенностей строения лица у пациентов определяли лицевой индекс по формуле Гарсона как отношение между морфологической высотой лица и его шириной, умноженное на 100. Этим больным применили разработанный метод проводниковой анестезии скуло-лицевого нерва и сравнивали его эффективность с известным методом. Болевую чувствительность и восприятие боли у пациентов изучались с использованием субъективных и объективных методов. Болевая чувствительность определялась путем покалывания иглой в эпидермис. Восприятие боли во время местной анестезии оценивали по шкале "Звуки", "Глаза" и "Движение" (ЗГД).

Результаты исследований и их обсуждение. С учетом краниометрических исследований, а также индивидуальных топографо-анатомических особенностей ветвления скуло-лицевого нерва у людей с различными типами строения черепа, была разработана методика проводникового обезболивания ветвей скуло-лицевого нерва. Во время хирургического вмешательства эффективность разработанного метода местной анестезии оценивалась как хорошая, у пациентов наблюдалось стабильное местное обезболивание без психосоматических особенностей, а также местных и общих осложнений.

Выводы. Применение в клинических условиях методики проводниковой анестезии скуло-лицевого нерва вместе с классическим методом местной анестезии щечного нерва, которую мы разработали, обеспечивает безболезненное хирургическое вмешательство на боковой области лица. Для успешной местной анестезии скуловой и щечной областей необходимо учитывать анатомическую изменчивость разветвления на лице скуло-лицевого нерва у пациентов с различными формами лица.

Ключевые слова: скуло-лицевой нерв; щечный нерв; скуловая и щечная области; анатомическая изменчивость формы лица; местная проводниковая анестезия.

Introduction It is well known that the sensory innervation of the maxillofacial area (MFA) is quite complicated. In the soft tissues of the face the sensory branches of the trigeminal nerve, as well as the cervical superficial nerve plexus are branching [1, 2]. In adjacent anatomical sites these nerves are anastomosed with each other. The branching of the trigeminal nerve on the face has an individual anatomical variability dividing into two types [3]. In the first type the innervation of the face is dominated by the superficial branches of the maxillary nerve, its branches (zygomaticofacial and infraorbital nerves) are involved in sensitive innervation of the cheek area. The second type on the face is dominated by superficial sensory branches of the mandibular nerve, its branches (buccal and mental nerves) are involved in sensitive innervation of the cheek area [3, 4]. Here, buccal nerve forms a plexus with the facial nerve, infraorbital nerve and mental nerve [4–7]. The main sensory nerve of the buccal region is the (long) buccal nerve [8, 9]. The skin of the upper anterior part of the cheek is supplied by lateral rami of the large superior labial branch from the infraorbital nerve [10]. The lower part of the cheek is innervated by terminal branches from the superficial cervical plexus. The transverse cervical nerve (forming part of the superficial cervical plexus) may contribute cutaneous sensory innervation to the skin of the inferior border of the lateral and anterior mandible [11, 12].

In order to anesthetize the upper part of the cheek and soft tissues of the zygomatic area, besides the conductive anesthesia of the buccal nerve, we performed a blockade of the zygomaticofacial nerve in accordance with a well-known technique (Fig.1), when the anesthetic is injected at the lower outer edge of the orbit [13–15], where the zygomaticofacial foramina are located, through which the branches of the zygomaticofacial nerve go outside from the zygomatic bone [16–18]. However, the buccal and zygomatic areas were completely anesthetized in 74 % of cases. In 26 % of cases with uncomplete anesthesia of buccal and zygomatic areas revealed clinically we noticed that only the central part of the zygomatic region as well as the small area adjoining to the lower outer edge of the orbit were anesthetized. The upper part of the zygomatic region adjoining to the zygomaticofrontal suture as well as the lateral part adjoining to the zygomaticotemporal suture remained sensitive. The absence of the necessary anesthetic effect in these cases was associated, in our opinion, with the individual anatomical variability of the branching of the zygomaticofacial nerve on the face. These patients were broad-faced or long-faced. Accordingly the individual variability of innervation of soft tissues of the maxillofacial area should be taken into account during their local anesthesia.

Fig. 1. Blockade of the zygomaticofacial nerve in accordance with a well-known technique

As a result of craniometric studies, we detected anatomical variability of the structure of the skull. There is a certain feature of the localization of the zygomaticofacial foramen on the lateral (facial) surface of the zygomatic bone, depending on the type of structure of the skull. In people tha have mesaticephalic zygomaticofacial foramen in most cases are located «chain», congruent to the lower – outer edge of the eye orbit, away from this anatomical formation at (8.2±2.3) mm. In the brachycephalic skulls – most of the zygomaticofacial foramen are centered near the lower – outer edge of the eye orbit, and were at a distance of (9.3±2.7) mm. However, in 33.3 % of cases, they were shifted from the eye orbit to the zygomaticotemporal suture and were located at a distance – (14.2±2.3) mm to it.

The aim of the study – to give a clinical evaluation of the effectiveness of the developed method of anesthesia of the zygomaticofacial nerve.

Materials and Methods. Taking into account the results of craniometric studies as well as the individual topographic and anatomical features of zygomaticofacial nerve branching in people with different types of skull structure, we have developed the technique of conduction anesthesia of the branches of the zygomaticofacial nerve. The facial surface of the zygomatic bone resembles a scalene quadrangle, which differs in the form in each person, depending on the type of structure of the skull. Therefore, anatomical landmark for anesthetic injection is determined individually in each patient. It is located at the intersection of two imaginary lines, which connect the opposite corners of the quadrangle: a vertical, drawn from the zygomaticofrontal suture to the lower corner of the zygomatic bone and the horizontal, drawn from the zygomaticotemporal suture to the zygomaticomaxillary suture (Fig. 2). Zygomaticofacial foramina are located within the imaginary ellipse, the center of which is the place of the needle injection. The average distance to these openings along the large semiaxis is (10.4±4.8) mm, and (5.7±1.5) mm along small one.

Fig. 2. Blockade of the zygomaticofacial nerve (results of our research)

In people with mesoprosopnic face shape (mesocephalic skulls), a local anesthetic (1.0 ml) is injected after the needle insertion into a definite anatomical landmark. In patients with leptoprosopnic face shape (dolichocephalic skulls) in order to exhaust all branches of the facial nerve needle after inclination should be pushed forward by 1.0–1.5 cm vertically towards the frontal joint. In patients with euriprosopnic face shape (brachycephalic skulls), to block the branches of the zygomaticofacial nerve in the place where they reach the surface of the zygomatic bone, the needle should be directed horizontally 1.0–1.5 cm towards the zygomaticotemporal suture.

In the clinical observation 41 stationary stomatological patients with planned surgical interventions on the lateral facial area took part (in the buccal area – 16 patients, in the zygomatic area – 25 patients). In case of pathological processes (benign tumors, keloid scars, fistulas of migrating granulomas) located in the buccal region, surgical interventions were conducted under local conduction anesthesia of buccal and zygomaticofacial nerves. The conduction anesthesia of the buccal nerve was carried out through the skin at the anterior edge of the base of the coronary process of the mandible, where the buccal nerve passes [4, 6, 7].

In 20 patients applied developed method of conductive anesthesia of the zygomaticofacial nerve and compared its effectiveness with a known method [13–15] that was applied in 21 patients exposed to surgical interventions in the cheek area (7 cases) and zygomatic area (14 cases). In order to detect the individual anatomical features of the facial part of the head in patients, the facial index was determined by the Garson’s formula as the relation between the morphological height of the face and its width multiplied by 100. Numeric value of facial index 79.0–83.9 defines the broad face (euriprosopne); 84.0–87.9 – middling face (mesoprosopne); 88.0–92.9 and more – oblong face (leptoprosopne) [19, 20]. In the majority, euriprosopnic face shape responds to the brachycephalic skull, mesoprosopnic face shape – to mesocephalic skull and leptoprosopnic face shape – to dolichocephalic skull [3]. The zygomatic area was divided into four quadrants: the upper-front, upper-back, lower-front and lower-back by imaginary, mutually perpendicular lines, carried through its center. The buccal area was also divided into quadrants in a similar manner. Pain sensitivity and perception in patients were studied using subjective and objective methods. Pain sensitivity was determined by injection of a needle (pinprick) into the epidermis. The assessment of pain sensitivity was performed on a four-point scale in each quadrant: 0 points – no sensitivity, 1 point – sensitivity is sharply reduced, 2 points – sensitivity is moderately reduced, 3 points – tactile and pain sensitivity is completely preserved [21]. Pain perception during local anesthesia administration was evaluated by the Sounds, Eyes and Motor (SEM) scale [22]. Sounds, Eyes, and Motor (SEM) scale was used to assess the observed pain. It is divided into two categories of comfort and discomfort. The discomfort response is further divided into three subscales: mild pain, moderate pain and severe pain (Table 1).

Observing patients behavior during surgical manipulations is essential in pain evaluation, as their facial expressions, complaining, and body movements are important diagnostic criteria.

The protocol used in this study conformed to the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Danylo Halytskyi Lviv National Medical University.

The bivariate correlations procedure with Pearson’s correlation coefficient was used to

Table 1. The Sounds, Eyes, and Motor (SEM) scale for measuring the comfort or discomfort.

Observations	Comfort	Discomfort		
		Mild pain	Moderate pain	Severe pain
Sounds	No sounds indicating pain	Nonspecific sounds; possible pain indication	Specific verbal complaints, e.g., "Ouch", raises Voice	Verbal complaint indicates intense pain, e.g., scream, sobbing
Eyes	No eye signs indicating discomfort	Eyes wide, show of concern, no tears	Watery eyes, eyes flinching	Crying, tears running down face
Motor	Hands relaxed; no apparent body tension	Hands show some distress or tension, grasps chair due to discomfort, muscular tension	Random movement of arms or body without aggressive intention of physical contact, grimace, twitch	Movement of hands to make aggressive physical contact, pulling head away

measure linear association between variables. The Pearson chi-square test was used to compare percentages and frequencies.The probability of the obtained results was evaluated according to the Student probability criterion by statistically computing the data using common methods of statistics from the package "Statistica-7". A 'P' value of 0.05 was considered for statistical significance.

Results and Discussion. The effectiveness of the developed method of conduction anesthesia of zygomaticofacial nerve was studied in clinical conditions. After the blockade of the buccal nerve in 16 patients with various face shape before surgical interventions it was found that in the cheek area was anesthetized only partially: pain sensitivity remained in the upper part of the cheek area – (1.5±0.5) points ($p > 0.05$). When evaluating pain perception behind a Sounds, Eyes and Motor (SEM) scale, patients had discomfort (moderate pain). After an additional blockade of the branches of the zygomaticofacial nerve, according to the developed technique, a complete anesthesia of the above-mentioned topographic anatomical site occurred in all patients independently from the face shape: pain sensitivity – 0 points ($p<0.05$). When evaluating pain perception behind a SEM scale, patients had comfort. After the blockade of the zygomaticofacial nerve in 11 patients with various face shape before surgical interventions in the zygomatic region it was found that in 100 % of cases complete anesthesia in the zygomatic area occurred: pain sensitivity – 0 points (p < 0–01) (Table 2). Patients in experimental group exhibited the greatest percentage (100 %) of comfort score. The loss of pain sensitivity on the skin of the buccal and zygomatic regions absolutely confirmed the effectiveness of the developed method of local conduction anesthesia. During surgical treatment the effectiveness of the local anesthetic methods was evaluated as good – it was observed in patients a stable anesthesia, without psychosomatic peculiarities as well as local and general complications.

In 7 patients of control group before surgical interventions in the cheek area after buccal nerve anesthesia by the standard method in all patients pain sensitivity remained in the upper part of this topographic anatomical region – (1.5±0.5) points ($p > 0.05$). After the additional zygomaticofacial nerve anesthesia by the known method complete anesthesia of the cheek area occurred in 4 patients, they had mesoprosopnic and leptoprosopnic face shapes. In 3 patients with euriprosopnic face shape pain perception remained in the upper part of the cheek. In 14 patients of control group before surgical interventions in the zygomatic region after the anesthesia of zygomaticofacial nerve by known method complete anesthesia occurred in 7 patients with mesoprosopnic face shape and in 2 patients with leptoprosopnic face shape ($p < 0.01$). In 5 patients complete anesthesia was not achieved: pain sensitivity remained in the zygomatic region – (2.0±0.5) points ($p > 0.05$). Among them there were 3 patients with leptoprosopnic face shape and 2 – with euriprosopnic face shape (Table 2). When evaluating pain perception behind a SEM scale, patients had discomfort (severe pain). This affirms that the introduction of local anesthetic to block the zygomaticofacial nerve by the known method near lower-outer edge of the orbit allows achieving the needed effect only in patients with mesoprosopnic face shape. In order to anesthetize this nerve in people with broad and oblong face shape, anatomical variability of its branching should be considered.

We conducted the $\chi 2$ test to investigate a potential statistically significant association between applied methods of anesthesia of zygomaticofacial nerve and the received efficiency depending on the shape of the face (Table 3). Indicators – P in comparison groups are statistically significant in all cases.

Table 2. The effectiveness of applied methods of anesthesia of zygomaticofacial nerve

Groups of patients depending on applied method of anesthesia of zygomaticofacial nerve		The appearance of anesthesia of the soft tissues after the blockade of zygomaticofacial nerve (number of cases)	
		Zygomatic area	Upper part of the buccal area
Experimental group (anesthesia of zygomaticofacial nerve by the developed method) (n=20)	Patients with euriprosopnic face shape (n=5)	Anesthesia occured – 3 cases	Anesthesia occured – 2 cases
	Patients with mesoprosopnic face shape (n=8)	Anesthesia occured – 4 cases	Anesthesia occured – 4 cases
	Patients with leptoprosopnic face shape (n=7)	Anesthesia occured – 4 cases	Anesthesia occured – 3 cases
Control group (anesthesia of zygomaticofacial nerve by the known method) (n=21)	Patients with euriprosopnic face shape (n=5)	Anesthesia did not occur – 2 cases	Anesthesia did not occur – 3 cases
	Patients with mesoprosopnic face shape (n=10)	Anesthesia occured – 7 cases	Anesthesia occured – 3 cases
	Patients with leptoprosopnic face shape (n=6)	Anesthesia occured – 2 cases Anesthesia did not occur – 3 cases	Anesthesia occured – 1 case

Table 3. Statistical estimation of the effectiveness of anesthesia in patients of comparable groups

Groups of patients depending on applied method of anesthesia of zygomaticofacial nerve (n1 – Experimental group; n2 – Control group)	Experimental group n1 = 20	Control group n2 =21	Chi-square test	P
Patients with euriprosopnic face shape (n1 = 5; n2 =5)	100 %	0%	10.0	0.002
Patients with leptoprosopnic face shape (n1 = 7; n2 = 6)	100 %	50 %	4.55	0.03
Comparative assessment in general by groups (n1 = 20; n2 =21)	100 %	62 %	9.44	0.002

Conclusions. Application in clinical conditions of the technique of conductive anesthesia of the zygomaticofacial nerve, developed by us, in combination with the classical method of local anesthesia of the buccal nerve provides painless surgical interventions on the lateral area of the face.

For the successful local anesthesia of the zygomatic and buccal regions, it is necessary to take into account the anatomical variability of the branch on the face of the zygomaticofacial nerve in patients with different types of skull structure and face shape.

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Received 04.09.18