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Results of the study of electroexcitability of the skin in the area of innervation of the lower alveolar nerve

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***Abstract*---**In patients with mandibular fractures, 87.6% of cases showed varying severity damage to the lower alveolar nerve (LAN). So, in most cases, when the displacement of fragments is less than 0.5 cm, a mild degree was noted, when the displacement is from 0.5-1.0 cm - an average degree, and more than 1.0 cm-a severe degree of damage to the LAN. In 3.7% of cases, violations of deep sensitivity were detected. It was revealed that the highest rates of electrical excitability of the skin were noted in 2-the 2nd and 3-3rd zones. So, at admission, the average values in patients with mild severity of damage were noted at the level of 56.5±1.5 mkA, with an average degree - of 115.8±3.1 mkA, with severe-163.8±4.5 mkA. It is noted that the higher the indicators, the more pronounced the violation of sensitivity. The values of indicators in the main group by day 32-40 were 1.6 times less than in the control group. After 6 months of treatment, only 2.3% of patients in the main group had clinical disorders in the innervation zone of the LAN and increased indicators of electrical excitability in 2-the 2nd and 3-3rd zones, when as in the control group, high indica-tors were observed 2.5 times more often.

***Keywords*---**lower alveolar nerve, electroexcitability, excitability, mandibular, fracture.

Introduction

The field of dental implantology has gained widespread acceptance as a method of therapy. As a result of its capacity to restore both aesthetics and functionality, it has become the option of choice for replacing natural teeth that are hopeless or that have been lost. In spite of the high success rate that it has, however, its use has been associated with a great deal of difficulty (Dmitrieva L.A. et al. 2001). The modification of sensation after implant implantation in the posterior jaw is one of the problems that might have the most severe consequences. There have been reports that indicate the occurrence of such a consequence is as high as 13%. When administering severe local anaesthetic injections or, more importantly, when performing dental implant osteotomy or installation, this might happen as a consequence of damage to the inferior alveolar nerve (IAN) or the lingual nerve. Both nerves provide sensation to the tongue (Wolf G.F et al. 2014; Modina T.N et al. 2005). Because this complication may result in one of the most uncomfortable experiences for the patient as well as the dentist, it is imperative that every precaution be made to prevent it. Once it has occurred, the dentist is responsible for providing the patient with the right treatment and should be aware of when it is necessary to send the patient to a micro neurosurgeon (Kopeikin V.N. et al. 2004).

The degree of change in feeling may range from a little paresthesia all the way up to total anaesthesia, depending on the severity of the nerve lesion. Additionally, it could just be temporary, it can be managed, or it might even be permanent in certain instances. Many studies aimed to give guidance for the prevention and treatment of IAN injuries that may occur during the insertion of dental implants in the posterior region of the mandible (Cohen E. et al. 2003, Tsepov L.M. et al. 2002).

To investigate the progression of lower alveolar neuritis by employing a scale for measuring the degree of discomfort in the parameters of electroexcitability of the facial skin on the affected side, as well as their changes in response to treatment in patients who have suffered lower alveolar nerve damage (Zikriyaevna et al. 2020; Tashkenbaeva et al. 2020). To study the course of lower alveolar neuritis using a scale for measuring the intensity of pain in the parameters of electroexcitability of the facial skin on the side of the damage, and their dynamics during treatment in patients with lower alveolar nerve injury.

Materials and Methods

Using the PARKELL Digitest 2 obtained data on the state of the skin excitability threshold in the studied areas, that innervate the lower alveolar nerve on the chin and lower lip. The study was performed at the time of admission to the hospital, on the 10th day, on the 32nd-40th day, and after 6 months after the injury. On channels 3-7, the threshold was changed using long-lasting subthreshold DC current pulses in order to ascertain the threshold dependency of refractoriness, supernormality, and SD. This was done in order to discover the relationship between the threshold and these three properties. The intensity of the DC current was represented as a percentage of the threshold current measured on channel 2 using the 1.0 ms stimulus, and it was varied every minute in increments of 10%

from +50% (depolarizing) to -50% (hyperpolarizing) or vice versa. The polarizing current lasted either 30 or 120 milliseconds, and the test stimuli were timed to take place either 10 or 100 milliseconds following the beginning of the current. The changes in threshold that were generated by polarization were then adjusted in such a way that the unpolarized value before ischaemia was set to unity.

Results and Discussions

Based on these data, it can be concluded that at the time of admission in both groups, the values of skin electrical excitability in the studied zones did not have statistical differences, the highest values of indicators were determined in 2-the 2nd and 3-3rd zones. In patients of the main group, the average values were determined at the level of 55.0±1.5 UA and 58.0±1.5 UA, respectively, with mild damage. In mild cases, clinical manifestations were accompanied by a feeling of "crawling goosebumps" in the lower lip area on the side of the injury, and a decrease in skin sensitivity on the side of the injury. In moderate severity, the values of electrical excitability in 2-the 2nd and 3-3rd zones varied from 109.6±3.1 μA to 121.9±3.5 μA, in severe cases-from, 159.5±4.5 μA to 168.1±4.8 μA, which indicates a greater violation of sensitivity with an increase in the severity of damage byN.

Table 1 - Indicators of electrical excitability of the skin of the chin area and lower lip in patients of the main and control groups at the time of admission

Degree of severity of LAN damage	*1st zone*		*2nd zone*		*3rd zone*		*4th zone*	
	Osn. (μA)	Counter. (μA)	Osn. (μA)	Counter. (μA)	Osn. (μA)	Counter. (μA)	Osn. (μA)	Counter. (μA)
Easy	36,5±1,0	37,4±1,0	55,1±1,5	54,1±1,5	58,7±1,5	57,1±1,5	42,8±1,2	41,9±1,2
Average	73,2±2,0	74,3±2,0	109,6±3,1	110,2±3,1	121,9±3,5	122,1±3,5	84,8±2,4	85,2±2,4
Heavy	132,3±3,7	131,3±3,7	159,5±4,5	157,4±4,5	168,1±4,8	167,5±4,8	142,3±4,0	141,3±4,0

Clinical manifestations of moderate to severe lower alveolar nerve damage were complete loss of skin sensitivity in these areas (14% of patients), severe pain syndrome (88%), impaired functioning of facial muscles (2.6%), impaired sensitivity of the mucous membrane and teeth on the side of the injury (96%). In 12.6% of patients, minor areas of paraesthesia of the lower lip and chin on the other side were noted. Dynamics of indicators of electrical excitability of the skin of the chin area and lower lip in patients of the main and control groups on 10-the 10th day of treatment is presented.

Table 2 - Indicators of electrical excitability of the skin of the chin area and lower lip on 10-the 10th day of treatment

Degree of severity of LAN damage	*1st zone*		*2nd zone*		*3rd zone*		*4th zone*	
	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)
Easy	29,4±1,4	35,1±1,4	40,1±4,2*	49,6±4,6	42,3±4,0	50,8±4,6	27,4±1,5	36,2±1,6
Average	51,8±2,9*	68,4±3,4	80,3±5,1*	95,8±5,6	90,4±4,6*	115,8±5,3	63,7±1,5*	74,8±1,6*
Heavy	105,7±4,5*	117,8±5,0	120,3±5,1*	135,7±5,5	145,8±5,8*	155,3±6,0	105,4±4,5*	127,3±5,2

Note: M - sample mean, t-sample standard deviation, * - statistically significant differences; $p < 0.05$.

In patients with mild LAN damage, the values of electrical excitability in 1-the 1st and 4-4th zones of the main group of patients on 10-the 10th day of treatment significantly decreased and amounted to 29.4±1.4 UA and 27.4±1.5 UA, which corresponds to the indicators of electrical excitability on the healthy side ($p<0.001$). In 2-the 2nd and 3-3rd zones, there was a pronounced tendency to decrease the indicators of electrical excitability, which amounted to 40.1±4.2 μA and 42.3±4.0 μA in the main group ($p<0.005$). Whereas in the control group, the indicators of electrexcitability decreased but did not reach the degree of statistical confidence and made in 1-the area of 35.1±1,4 μa, in the 2-nd zone - 49,6±4,6 μa, in the 3-second zone - 50,8± 4,6 μa, in the 4-th area and 36.2±1,6 μa.

In 15% of patients in the control group, the feeling of "crawling goosebumps" remained, while in all patients in the main group, the clinical symptoms of damage to the lower alveolar nerve were stopped. In the main group of patients with moderate and severe LAN damage, there was also a significant decrease in skin electrical excitability on the side of the lesion on 10-the 10th day of treatment (The indicators were 1-4-zones: 51.8±2.9 μA and 63.7±1.5 μA in zones 1, and 4±1,5 μA, in zones 2, 3 and 80.3±5.1 μA and 90.4±4.6 μA and 3±4,6, respectively. In the control group, a statistically significant decrease in electrical excitability after ten days was noted only in 4-the 4th zone ($p< 0,005$).

On 32-40-day treatment of moderate severity, the highest rates of electroexcitability, also noted in the 2nd and 3rd zones, with an average of 32-40-day treatment significantly decreased 40,5±3,9 μa 59,7±3.7 V μa in the control group and higher in the control group to 65.1±5,4 μa, 85,7±5,1 μa. In the control group, the differences were also statistically significant in 2-the 2nd zone. In patients with severe LAN damage, the indicators of skin electroexcitability in the study areas on the 32-40th day of treatment in the main group were 1.3-1.4 times less ($p < 0.01$)than the values of electroexcitability in the control group (Table 4). In 73.2% of patients in the control group, clinical symptoms remained at the

same level. Whereas, in the main group, there was a positive trend in the form of a decrease in the area of paresthesia, a reduction in the pain syndrome.

Table 3 – Indicators of electrical excitability of the skin of the chin area and lower lip on the 32-40th day of treatment

Degree of severity of LAN damage	*1st zone*		*2nd zone*		*3rd zone*		*4th zone*	
	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn (mcA)	Counter. (mcA)
Easy	25,4±1,4	27,9±1,4	34,3±3,2	36,5±4,4	27,5±3,4	40,5±4,6	26,1±1,4	27,2±1,7
Average	33,6±2,7	51,8±3,4	40,5±3,9	65,1±5,4	59,7±3,7	85,7±5,1	42,1±1,5	58,3±1,7
Heavy	51,2±3,6	100,3±4,7	75,7±4,4	121,8±5,2	89,4±4,8	135,6±5,0	64,2±3,8	101,9±3,7

Thus, according to the electroexcitability measurements, carried out on the 32-40th day of treatment, it can be concluded, that in all four zones, the values of electroexcitability decreased in patients whose therapy included the drugs combilipen and ethylmethylhydroxypyridine succinate. After 6 months of treatment, in patients with mild to moderate damage to the lower alveolar nerve, the electrical excitability indices significantly decreased ($p < 0.05$) and did not exceed the normal values in both study groups.

Table 4 - Indicators of electrical excitability of the skin of the lower lip and chin ar-ea after 6 months of treatment

LAN damage severity	*1st zone*		*2nd zone*		*3rd zone*		*4th zone*	
	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)	Osn. (mcA)	Counter. (mcA)
Easy	23,4±1,4	25,9±1,4	26,3±1,5	26,5±1,5	22,5±1,4	28,5±1,6	23,1±1,4	25,2±1,4
Average	25,6±1,4	27,8±1,5	30,5±1,7	35,1±2,2	32,4±1,9	34,2±2,1	23,1±1,5	26,1,1±1,5
Heavy	32,2±1,7	35,3±2,2	35,1±2,2	45,1±3,2	36,2±2,4	43,2±3,1	28,2±1,7	34,8±2,3

Clinical symptoms of damage to the lower alveolar nerve in the form of numbness of the skin of the lower lip, pain during palpation of the lower lip and impaired sensitivity of the mucosa on the side of the injury were completely stopped in the main group and remained in 1 patient of the control group.

In the case of severe damage in the main group of patients, the indicators of electrical excitability in all the studied zones also did not exceed the normal values ($p < 0.05$). However, in the control group at 12 (63.1 per cent) of the patients, indications of electroexcitability was increased in the 2-th and 3-th areas and ac-counted for 45.1±3,2 μa 43,2±3,1 μa, respectively, which was accompanied by clinical symptoms, which manifested itself, numbness and crawling "needles" in the 2-th and 3-th areas.

The area of paresthesia in patients of the main and control groups, was determined by the number of zones involved. At admission in 40 patients with mild severity of the main and control groups, the area of paresthesia covered 2-the 2nd and 3-3rd zones. In 16 patients, paresthesia spread to 2-4-zones 2-4. У 6 Paresthesia was observed in 6 patients in all four study areas. The division of patients, by area of paresthesia, in the main and control groups was the same. On 10-the 10th day after admission, it was noted that the reduction of paresthesia zones was more pronounced in patients of the main group. In the main group, there were no patients with an area of paresthesia that would cover all 4 zones. The number of zones involved was reduced to two and only covered the 2ndand 3rdzones. Whereas in the control group, in one patient, the paresthesia zone did not decrease and comprised all four zones.

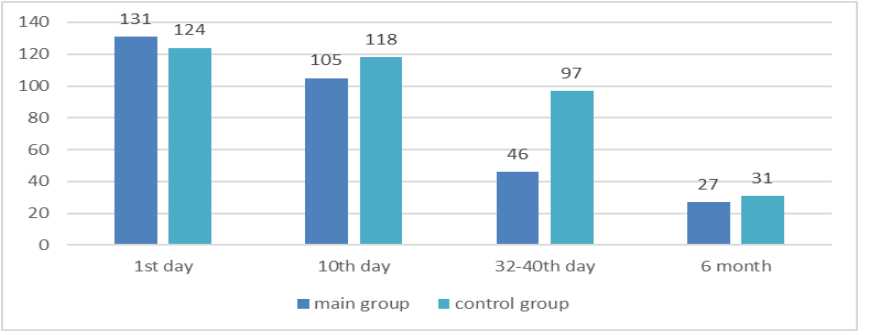

Figure 1 - Dynamics of indicators of electroexcitability of the skin of the lower lip and chin in the MC of the control and main groups with severe severity in 2-the 2nd zone

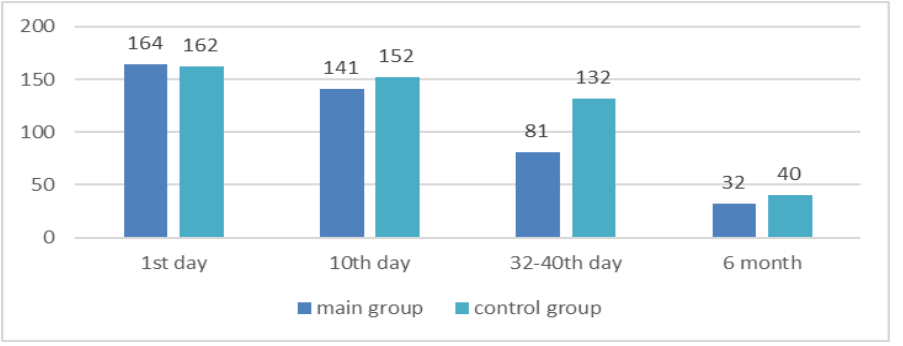

Figure 2 - Dynamics of indicators of electroexcitability of the skin of the lower lip and chin in the MC of the control and main groups with severe severity in 4-the 4th group

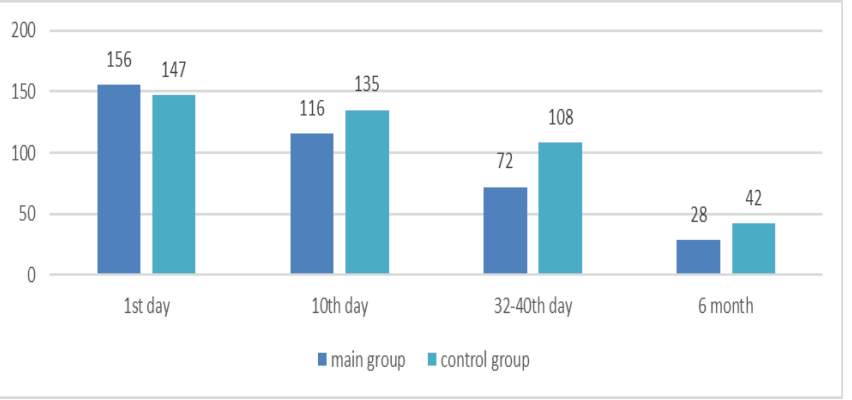

Figure 3 - Dynamics of indicators of electrical excitability of the skin of the lower lip and chin in the MC of the control and main groups with severe severity in 3-the 3rd zone

On the 32-40th day of treatment, all patients of the control and main groups with mild severity did not show any clinical manifestations of paresthesia of the lower lip and chin area. In only one patient of the control group, minor manifestations of paresthesia remained in 2-the 2nd and 3-3rd zones. With moderate damage, the area of paresthesia in 82.5% of patients in the main and control groups, was occupied by 1-3zones. Only 17.5% of patients had paresthesia symptoms in all four zones at the time of admission. On 10-the 10th day after admission, in patients of moderate severity in the main and control groups, the clinical symptoms of paresthesia decreased, but the area of the lesion remained at the same level.

Based on the definition of electrical excitability skin of the lower lip and chin, on the side of the damage was revealed that the square footage paresthesia of the lower lip, the corner of his mouth, the skin of the chin, gums on the side of the damage, to 32-40-y day decreased from 103 patients compared with the control group and captured the only two zones - 2-I and 3-I. Due to the effect of ethylmethylhydroxypyridine succinate on microcirculation soft tissue oedema on the dam-aged side 74 was significantly less pronounced in 74 patients who received this drug as part of complex therapy on 3-the 3rd day of treatment. According to the results of indicators of electrical excitability of the skin of the lower lip on the 32--40th day of the study, it is reliably seen, that there is a decrease in indicators in all 4 study zones in the main group compared to the control group. This proves, that the use of ethylmethylhydroxypyridine succinate and combilipen contributes to a faster recovery of the lower alveolar nerve function, a reduction in clinical symptoms, and a shorter rehabilitation period for patients with lower alveolar nerve damage.

Conclusion

In our study, to determine the degree of damage to the LAN, and localization of the hypo-, hyper- and paresthesia zones, we used a study of facial skin electrical excitability. For this purpose, several zones of study of facial skin sensitivity were identified on the affected side. For localization and delineation of these zones, a

conditional division into quadrants was made using conditional points: the middle of the distance from the lower lip to the protruding part of the chin is point A, point B is the - middle of the distance from the corner of the mouth to the edge of the lower jaw. When these points are connected, a horizontal line is formed. Point C was located in the middle of the distance of half of the lower lip. The vertical line omitted from point C intersected the horizontal line and formed the 1stя, 2ndя, 3rdand 4thconditional zones.

The minimum values of the current intensity that caused the first sensation in the patient (tingling, tingling, etc.) were determined. D.), which he immediately informed the doctor about. The electric current was applied in a pulsed mode with increasing strength from 0 to 160 μA. This study was performed on the 1st day after admission, on the 10th and on the 32nd-40th day, at the time of removal of dental splints, as well 6 as 6 months after injury.

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