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COMPREHENSIVE TREATMENT OF INJURIES TO THE TRIGEMINAL NERVE BRANCHES IN FACIAL FRACTURES

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Abstract:

The proportion of maxillofacial trauma (MPT) has increased in recent years in the structure of general trauma. At the same time, according to the maxillofacial surgery and traumatology departments, in the structure of hospitalised patients with maxillofacial trauma account for more than one third of all patients, which indicates the medical and social significance of this pathology [1, 3, 5]. Often, maxillofacial fractures involve nerves and lead to the development of paresthesias, neuropathy and neurosensory dysfunction (NDS). NSD can be persistent due to various manipulations, surgery and other factors [2, 6, 7].

Keywords: maxillofacial trauma, trigeminal nerve, complex treatment, peripheral branches.

INTRODUCTION.

Traumatic injuries of the trigeminal nerve are one of the most common causes of persistent pain and other neurosensory disorders in the face. Injuries to the peripheral branches of n.trigeminus can occur both immediately at the time of direct exposure to a damaging factor due to bruising, stretching, or nerve fiber rupture, and after some time due to inflammatory complications (posttraumatic osteomyelitis), infections, secondary displacement of fragments, etc. [4, 8, 11]. The choice of the tactics of complex treatment should be based on an understanding of the regularities and course of regeneration processes in the peripheral nerves, the severity and nature of nerve fiber damage, the features of the somatic status of the patient, etc. [9, 12] The complex of therapeutic measures in traumas of the maxillofacial region should also be timely with parallel application of the most appropriate effective surgical methods of treatment aimed at the elimination and treatment of fractures of the facial skeleton, and medication therapy for neurological disorders, followed by a rehabilitation period [11, 13].

PURPOSE OF THE STUDY:

To study and evaluate the effectiveness of complex treatment of peripheral trigeminal nerve injuries in maxillofacial bone fractures.

MATERIALS AND METHODS:

Clinical studies were conducted at the Samarkand Branch of the Republican Specialized Research Centre for Traumatology and Orthopedics. Observations were based on clinical and laboratory examination of 60 patients with fractures of maxillofacial region (fractures of maxilla, mandible, zygomatic bone and/or zygomatic arch), including 37 (61, 6%) male and 23 (38, 3%) female; in age aspect: 38 (63, 3%) patients aged 18-30 years and 22 (36, 7%) - 31-50 years; control group included 20 conditionally healthy persons.

Based on the objectives of the study, 60 patients with traumatic fractures of the middle and lower thirds of the face with injuries of the trigeminal nerve branch were divided into 3 groups by random sampling, depending on the type of the conducted complex of therapeutic measures:

Group 1 consisted of 20 patients whose complex treatment included surgical treatment (fracture repositioning, osteosynthesis immobilization) and traditional drug therapy, which consisted of the prescription of antibacterial drugs, mouthwash with 0.02% chlorhexidine bigluconate solution. For pain, non-narcotic analgesics or non-steroidal anti-inflammatory drugs Analgin 50% 2.0 v/m, diclofenac 2.0 ml 3 times a day were prescribed. To restore the function of damaged nerve fibers, patients were treated with glucocorticosteroids - a one-week course of dexamethasone 8-12 mg daily; NSAIDs - ibuprofen 600-800 mg 3 times daily for 2-3 weeks; vitamin therapy - cyancobalamin (vitamin B12) 500 μg, alternating with 10-15 subcutaneous injections of 5% (1 ml) thiamine (vitamin B1) solution.

Group 2 consisted of 20 patients who besides surgical treatment and conventional therapy were

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treated locally with the drugs Neuromidin (1 tablet (20 mg) 1-3 times a day; the daily dose varies depending on the severity of damage to the trigeminal nerve branches, taking into account the maximum daily dose of 200 mg) and Nucleo CMF Forte (2 ml daily injections, course duration - 9 days);

The 3rd group consisted of 20 patients to whom, along with surgical treatment, inclusion of "Neuromidin" and "Nucleo CMF Forte" in the complex of traditional medicinal therapy, the procedure of electroneurostimulation (ENS) was also added in order to restore sensory and motor functions of the peripheral branches of the trigeminal nerve.

The control group included 20 people without traumas of the maxillofacial region, somatically healthy without pathology of the central and peripheral nervous system for further comparative analysis of the recovery of the studied physiological indicators in the dynamics of treatment and rehabilitation.

On admission to the department, all patients were initially and subsequently examined by an oral surgeon, a neurosurgeon (neurologist), and in some cases by narrow specialists depending on the location of the injury (ENT doctor, ophthalmologist). A clinical and neurological examination was performed according to standard procedures, and attention was paid to the symptoms of injuries to the trigeminal nerve branches (paresis, paresthesia, hyper- and hypoesthesia, etc.). The main complaints of the patients were determined, the anamnesis was studied, if the patient's condition allowed - life history, epidemiological anamnesis, if necessary this information was also obtained from relatives or persons accompanying the patient; the general condition was assessed - vital functions, general examination; if pathology of internal organs was revealed, patients were examined by profile specialists. The examination of the maxillofacial region focused on determining asymmetry, bite disturbances, localisation of the fracture by testing and determining stress symptoms, haematomas and soft tissue swelling, and displacement of bone fragments.

Areas of hyper- and hypoesthesia were identified in the study of superficial and deep facial sensitivity. Attention was paid to the presence of facial skin numbness, pronounced pain, paresthesias, which indicate a traumatic lesion of peripheral nerve fibers.To objectively assess the zone of cutaneous sensitivity disturbance, Avdeeva V.A. et al. (2011) proposed "Method for assessment of paresthesia zone in traumatic inferior alveolar neuritis" that enables to reveal the borders of hyposthesia zones using a tactile test. To assess skin sensitivity impairment in malar bone and arch fractures, as well as fractures of the zygomatic arch and maxilla, we adapted the aforementioned examination method, taking into account the areas innervated by the zygomatic and infraorbital nerve, which are most frequently traumatized in this case. Electrodontodiagnostics was also used to assess the functional status of the inferior alveolar nerve as well as the superior alveolar branches (anterior, middle, posterior) when they are traumatically injured.

The state of the motor portion of the third branch of the trigeminal nerve was assessed by palpation of the masticatory and temporal muscles according to electroneuromyography (ENMG), in the long term by the presence of atrophy of the masticatory muscles on the affected side and the violation of the lower jaw movement pattern when opening and closing the mouth.

The results were further studied and evaluated using statistical methods of data analysis.

RESULTS OF THE STUDY.

Among the hospitalised patients, 35 (58.3%) had an isolated fracture of the mandible, 15 (25%) had a fracture of the zygomatic bone and upper jaw, and 10 (16.7%) had an isolated fracture of the zygomatic arch and/or zygomatic bone. Of these, 41 (68.3%) patients had fractures with displacement and 19 (34.7%) had fractures without displacement (Table 1).

Complaints of pain in the localised area of the fracture predominated. The need for analgesics on the day of admission was high, i.e. more than 90% of patients were taking non-narcotic analgesics, of which 5 (8.3%) had no analgesic effect.

In 37 (61.7%) patients with displaced fractures, complaints of numbness of the skin in the projection of the zones of innervation of the peripheral branches of the trigeminal nerve predominated. In 22 (62.9%) out of 35 patients with mandibular fractures bite disorders of open, deep, cross-bite type were registered, in 13 (37.1%) - there was no bite disorders. Painful and restricted mouth opening of various degrees was recorded in 44 (73.3%) patients.

Table 1.

Distribution of patients into study groups according to the applied treatment package

Localisation of a traumatic fracture of the maxilla	Total	Группы		
		1	2	3
		Surgical treatment + TT	Surgical treatment + TT + Neuromidine,	Surgical treatment + TT + Neuromidine,

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			Nucleo CMF Forte	**Nucleo CMF Forte + ENS**
mandible	**35**	11	12	12
Cheekbone and maxilla	**15**	5	5	5
Cheekbone and arch	**10**	4	3	3
Total	**60**	**20**	**20**	**20**

The severity of damage to the peripheral branches of the trigeminal nerve correlated with the diastasis of the fragments detected by radiological examination (MSCT, OPTG). At a displacement of the bone fragments over 1.0 cm, a severe degree of nerve damage was observed in 13 (21.7% of cases) patients, at a displacement within 0.5-1.0 cm, a moderate degree in 29 (48.3%) patients and at a displacement up to 0.5 cm, a mild degree in 21 (35%) patients.

Clinical and radiological examination of patients revealed the following distribution of mandibular fractures by severity: unilateral fractures - 20 (57.1%), bilateral fractures - 11 (31.4%), triple fractures - 4 (11.2%). According to the localisation, the fractures of the lower jaw were distributed as follows: the angle of the lower jaw - 14 (40%), the mandibular region and the mental foramen - 7 (20%), the condylar process - 5 (14.3%), the body of the lower jaw (Fig. 1) - 5 (14.3%), the branch of the lower jaw proper - 4 (11.4%).

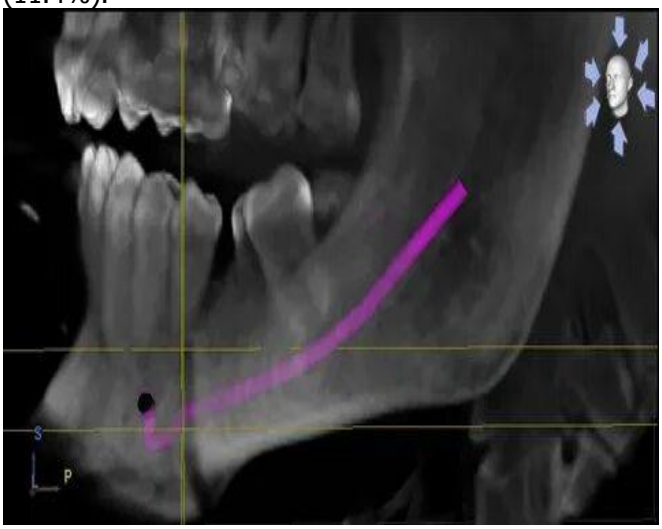

Fig. 1. Left mandibular body fracture with dislocation (colour indicates projection of mandibular canal and inferior alveolar nerve outlet)

On palpation of Vale's points (the exit sites of the second and third branches of the trigeminal nerve), there was painfulness on the injured side; there were vegetative disorders (skin hyperemia, hyper salivation, swelling of the skin and mucous membranes).

The study of the motor portion of the trigeminal nerve in patients with mandibular fractures revealed disorders in 11 (18.3%) patients: all patients had hypertonicity on the affected side when palpating the masticatory and temporal muscles; in 4 (6.7%) patients palpation caused pain sensations. The area of decreased sensitivity was most often localised to the skin of the lower eyelid, cheekbone, lower lip and chin area. In the oral cavity, hypoesthesia disorders were fixed on the mucous membrane in the area of the mandibular fracture and distally from it. By means of objective estimation of the skin sensitivity disturbance zones according to the method of Avdeeva V.A. et al. (2011), the borders of hypoesthesia zones were revealed with the tactile test. The results showed the average degree of the impairment of sensitivity in the patients of the studied groups (values within the limits of 1.1-2 conventional units).

Analysis of ENMG data in patients on the day of admission in hyperaesthetic disorders revealed signs of mild axonal damage of the motor portion of the trigeminal nerve, and lengthening of the latent period of the reflex response was registered. the most significant deviations of the SRVc indices from the normal values were observed in displaced fractures of the lower limb. In patients with a bilateral fracture of the MS in the area of the left chin orifice and right corner, ENMG showed signs of partial retardation along the sensory fibres and afferent irritation along the mandibular portion of the trigeminal nerve on both sides, more on the left with a distal ischemic component. It was also determined that the impaired nerve fibre conduction was due not only to displacement of the bone fragments but also to swelling of the surrounding soft tissues, which was an additional factor of compression of the trigeminal nerve branches. SPI tended to decrease mainly along the sensory fibers of the 3rd branch of the trigeminal nerve on both sides, more on the left side. The M-response was formed with some curve deviations along the masticatory muscle groups, while the S-response was reduced along the mandibular portion and the lower lip due to soft tissue swelling.

ENMG examination in unilateral fractures made it possible to assess the degree of pathological changes in the functioning of the trigeminal nerve branches on the affected side compared to the healthy side. According to ENMG results, there was a minimal

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decrease of SPI on the third branch of the trigeminal nerve on the right side (16.1 m/s). M-response was formed, but tended to decrease in the masticatory and maxillary-lingual muscle groups at a moderately increased PR of 10-12 mA with single additional waves. There were signs of partial conduction disturbances along the mandibular portion of the trigeminal nerve on the right peripherally with swelling and muscle-fascial disturbances along the masseter and mandibular-lingual groups. ENMG showed signs of moderate afferent irritation along the branches of the trigeminal nerve more frequently, and there were also myofascial disturbances along the mandibular portion without conduction disturbances in mandibular fractures. At fractures of zygomatic bone and/or arch, maxilla with damage of peripheral branches of trigeminal nerve (II branch), ENMG results showed partial delay in sensory fibres (SPI is 15.8±0.3 m/s) and afferent irritation. There was also a phenomenon of compression of peripheral nerve fibres by soft tissues due to swelling.

In hypesthetical disorders signs of axonal-demyelinating lesion of motor fibres of the trigeminal nerve were revealed (marked prolongation of early and late components of reflex response by 51.7% and 23.3%, respectively), significant reduction of impulse conduction speed along the afferent fibres of the trigeminal nerve by 31.7%.

Thus, all of the subjects had nerve fibre conduction abnormalities of varying degrees according to the electrophysiological findings.

On the 14th day of treatment, the intensity of pain sensations slightly decreased in Group 1 patients who received conventional therapy, with patients experiencing moderate and mild pain. In patients with hyperaesthetic disorders, pain sensitivity disorders persisted in 15 patients, and tactile sensitivity disorders persisted in 13 patients. In patients with hyperaesthetic disorders, tactile and temperature sensitivity disorders persisted in 8 patients and deep sensitivity disorders persisted in 2 patients. The area of numbness on the facial skin was unchanged.

Mean value of EDS before treatment was 102.41±1.84, after treatment - 89.31±1.58. After treatment, the values of EDM improved by 12.8%. The results of repeated EDM one month later showed that 8 patients' values were normalised, 7 patients still had elevated threshold of excitability, 5 patients showed no positive dynamics. The ENMG data showed that after a course of traditional therapy the latent period of the reflex response decreased by 40% in patients with hyperaesthetic disorders, the early components of the reflex response exceeded the normal values by 18%, the late ones by 11%, and the speed of nerve impulse conduction increased by 18% only.

In Group 2 patients the intensity of pain sensations slightly decreased - in the majority of patients mild pain was sensed. In patients with hyperaesthetic disorders, pain sensitivity disorders persisted in 13 patients, and tactile sensitivity disorders persisted in 10 patients. In patients with hyperaesthetic disorders, disturbances in tactile and temperature sensitivity persisted in 6 patients and in deep sensitivity in 2 patients. The area of numbness on the facial skin was relatively unchanged.

The mean value of the EDS before treatment was 101.34±1.84, after treatment -86.14±1.58. After treatment, the EOD values improved by 15%.

The results of repeated EDS one month later showed that 12 patients had normalized parameters, 5 patients still had elevated threshold of excitability, and 3 patients had no positive dynamics.

ENMG data showed that in patients with hyperaesthetic sensitivity disorders after the course of traditional therapy the latent period of reflex response decreased by 30%. In patients with hyperaesthetic disorders early components of reflex response exceeded the normal values by 12%, late components - by 9%, the speed of nerve impulse conduction increased by 20%.

Group 3 patients experienced a slight decrease in the intensity of pain sensations, with most of them experiencing mild pain. In patients with hyperaesthetic disorders pain sensitivity disorders persisted in 9 patients and tactile sensitivity disorders persisted in 7 patients. In patients with hyperaesthetic disorders, tactile and temperature sensitivity disorders persisted in 4 patients, and deep sensitivity disorders persisted in 1 patient. The area of skin numbness decreased by 20% in area and severity compared to the indicators on the day of admission (Table 2)

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Table 2.
Monitoring of sensory-paresthetic disorders (hypo/hyperesthesia) before and after treatment

Groups	Disorders		Pain	Tactile	Temperature	Deep
1	hyp	before	2 (10%)	5 (25%)	6 (30%)	2 (10%)
		after	0	4 (20%)	4 (20%)	2 (10%)
	hyper	before	18 (90%)	15 (75%)	2 (10%)	0
		after	15 (75%)	13 (65%)	0	0
2	hyp	before	4 (20%)	7 (35%)	4 (20%)	4 (20%)
		after	0	4 (20%)	2 (10%)	2 (10%)
	hyper	before	16 (80%)	13 (65%)	2 (10%)	0
		after	13 (65%)	10 (50%)	0	0
3	hyp	before	2 (10%)	7 (35%)	7 (35%)	4 (20%)
		after	0	3 (15%)	1 (5%)	1 (5%)
	hyper	before	18 (90%)	13 (65%)	3 (15%)	0
		after	9 (45%)	7 (35%)	0	0

The mean pre-treatment EOD was 102.44±1.47 and post-treatment EOD was 63.94±2.58. After treatment, the EDE indices improved by 37.5% (Fig. 2), which indicates a more pronounced positive change in the indices compared to the other study groups. The results of repeated EDE one month later showed that 16 patients' indices were normalized, 3 patients still had an increased excitability threshold, and 1 patient showed a slight positive trend.

It should be noted that all group 3 patients had positive dynamics of varying degrees. The ENMG data showed that in patients with hyperaesthetic sensitivity disorders the electroneuromyograms of the healthy and affected sides were almost indistinguishable.

Patients with hyperaesthetic sensitivity disorders recorded early components of the reflex response after the ENS course, and the amplitude of the oscillations increased by 35%.

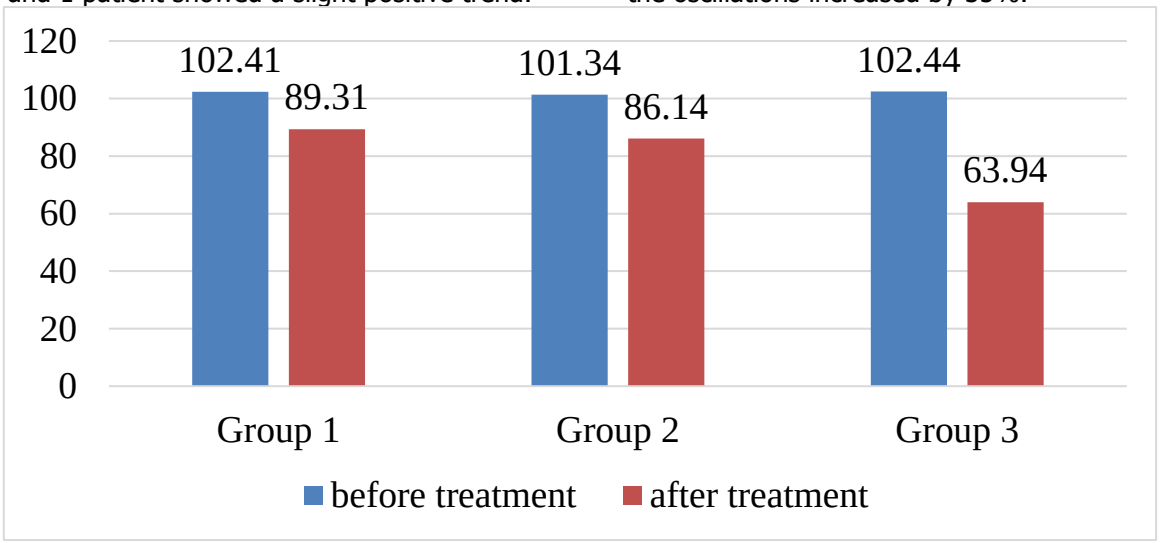

Fig. 2. EOD scores of the study groups of patients before and after treatment

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In the fracture zone, the average optical density after one month was 127.2±5.6. The optical density of intact bone averaged 133.7±12.95 units. According to the formula, the average value of the optical density index one month after injury was: 1=0.96±0.1. On the day of admission 1=0.69±0.1, after traditional treatment 1=0.84±0.1.

The above data indicates that the rate of bone fracture consolidation was higher after complex treatment with ENS than after conventional therapy.

CONCLUSION.

Thus, the results of clinical and functional studies suggest that the complex treatment of maxillofacial bone fractures accompanied by damage to the peripheral branches of the trigeminal nerve shows a more positive dynamics of restoration of sensory and motor functions of nerve fibres, and also contributes to relatively rapid consolidation of fragments in comparison with the traditional method of treatment.

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