

OPTIMIZATION OF DIAGNOSTIC TACTICS FOR MANDIBULAR FRACTURES ASSOCIATED WITH TRAUMATIC BRAIN INJURY

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Abstract

Research by numerous domestic and international researchers indicates an increase in trauma, as well as an increase in the frequency and severity of maxillofacial and associated injuries. Disability due to trauma ranks third, and the consequences of injuries to the dentofacial system are most frequently found in individuals aged 17 to 49 years – 90%.

In traumatic brain injury, traumatic brain injury leads to a complex pathogenetic mechanism in the disease process, revealing various cerebrofacial symptoms, which significantly impact adaptation and compensation processes in the body as a whole.

The aim of this study was to improve surgical outcomes in patients with lower facial bone injuries by optimizing surgical tactics with corrective therapy for cerebrofacial damage.

Keywords

mandibular fractures, cerebrofacial trauma, rheoencephalographic indices, brain autoregulation, osteoreparation of jaw bones.

Relevance of the topic. Mandibular fractures are a common injury that can lead to functional, aesthetic, and psychological problems in patients [1, 2, 4, 9, 10]. According to literature, patients with maxillofacial injuries currently account for approximately 30% of all patients admitted to maxillofacial surgery (MF) departments [3, 5, 7, 8, 11].

Patients requiring treatment for MF injuries may have various types of injuries, from mild bruises and sprains to serious fractures accompanied by displacement of bone fragments [5, 6, 9, 10, 15]. Such injuries are often accompanied by impaired chewing, hearing, and even breathing, which is a serious problem for

the patient and requires immediate medical attention [2, 5, 9, 14]. With proper and timely treatment, the severity of complications is reduced and the likelihood of successful rehabilitation is improved, allowing patients to return to normal activities [1,11,13].

To achieve optimal results in the treatment of maxillofacial injuries, it is important to use modern methods and technologies. According to the literature, the timing and extent of surgical interventions remain an unresolved issue. Regardless of whether the injury is isolated or combined, the fundamental principle of surgical tactics is the complete restoration of integrity and normalization of all functions of the damaged bone.

The underlying mechanisms of the fatal effects of surgical aggression have not been fully elucidated, but it is clear that they manifest as systemic inflammation with microvascular changes, steadily increasing edema in the interstitial tissues, and multiorgan failure.

Study materials and methods. From 2020 to January 2024, 32 patients with combined lower jaw and facial bone injuries and TBI were treated in the Otolaryngology Department, which also included beds in the Maxillofacial Pathology Department. These included 28 men (87.5%) and 4 women (12.5%). The comparison group included 31 patients with isolated lower facial bone injuries with cerebrofacial lesions. A control group of 31 patients with mandibular fractures without underlying pathology comprised 31 patients. All study patients underwent functional studies (rheoencephalography), computed tomography, immunological examinations, and microbiological studies.

Results and discussion. During the clinical and dental examination, the clinical picture of facial bone fractures in patients in the main and comparison groups was similar in complaints: pain and swelling at the fracture sites, the difference was in the presence of neurological symptoms in the main and comparison groups. Depending on the fracture location and the degree of pronounced post-traumatic edema, there was a problem of difficulty opening the mouth in 30 (93.7%) of those injured in the main group, 30 (96.7%) people in the comparison group and the control group. In the main group of patients, the state of impaired occlusion in the bite was noted in 26 (79.1%) patients of the MG, 28 (87.4%) in the CG and 24 cases (77.5%) in the CG. Bleeding from the oral cavity was caused in 64% of cases in the MG and 65% in the CG, 64% of cases in the CG. These cases occurred in patients with jaw bone fractures within the marginal boundaries of the dental arch, accompanied by ruptures of the oral mucosa.

In all groups, classic symptoms were detected by palpation in 100% of cases: fragment mobility and crepitus.

Nosebleeds were detected in 63% of cases in the MG patients, 64% in the SG, and 64% in the control group (3.2%) (Table 1).

11 (14.6%) patients in the MG and 7 (11.2%) in the CG complained of diplopia, a complication of the presence of an orbital inferior wall fracture. No diplopia was observed in the control group due to the absence of brain damage.

Table 1. Symptoms (general and local) of fractures of the facial bones of the skull

	OG	CG	KG
Double vision	11 (14,6%)	7(11,2%)	0
Post-traumatic edema	32(100%)	31(100%)	31(100%)
Pain at the fracture site			
Nosebleed	19(59,4%)	22(70,9%)	10(3,2%)
Difficulty opening the mouth	30(93,7%)	30(96,7%)	30(96,7%)
Disocclusion	25(78,1%)	27 (87,1%)	24 (77,4%)
Oral bleeding	64%	65%	64%
Nosebleed	19(59,4%)	22(70,9%)	10(3,2%)
Mobility and crepitus of the fracture fragments	100%	100%	100%

The neurological status of patients with TBI was assessed from the day of hospitalization to the third, sixth, and tenth days in two compared groups of patients. The difficulty in collecting anamnestic data from patients upon admission was due to psychoemotional agitation and/or impaired consciousness in patients with TBI. We paid particular attention to loss of consciousness (96% of cases) in patients in Groups I and II.

Pain in patients with craniofacial trauma is caused by two factors simultaneously: the first is the presence of traumatic brain injury, and the second is the facial bone injury itself. In cases of combined traumatic brain injury and zygomatic fracture, facial pain often masked headaches caused by TBI, while the patient could not clearly identify the location of the pain.

Signs of concussion: nausea and vomiting associated with concussion are explained by two factors: bleeding from the facial skeletal injury site into the oropharynx and nasal passages in 19 (59.4%) patients in the MG group and 22 (70.9%), as well as an increase in VD in patients with brain injury.

The dynamics of regression of general cerebral symptoms in the MG group are shown in Figure 1.

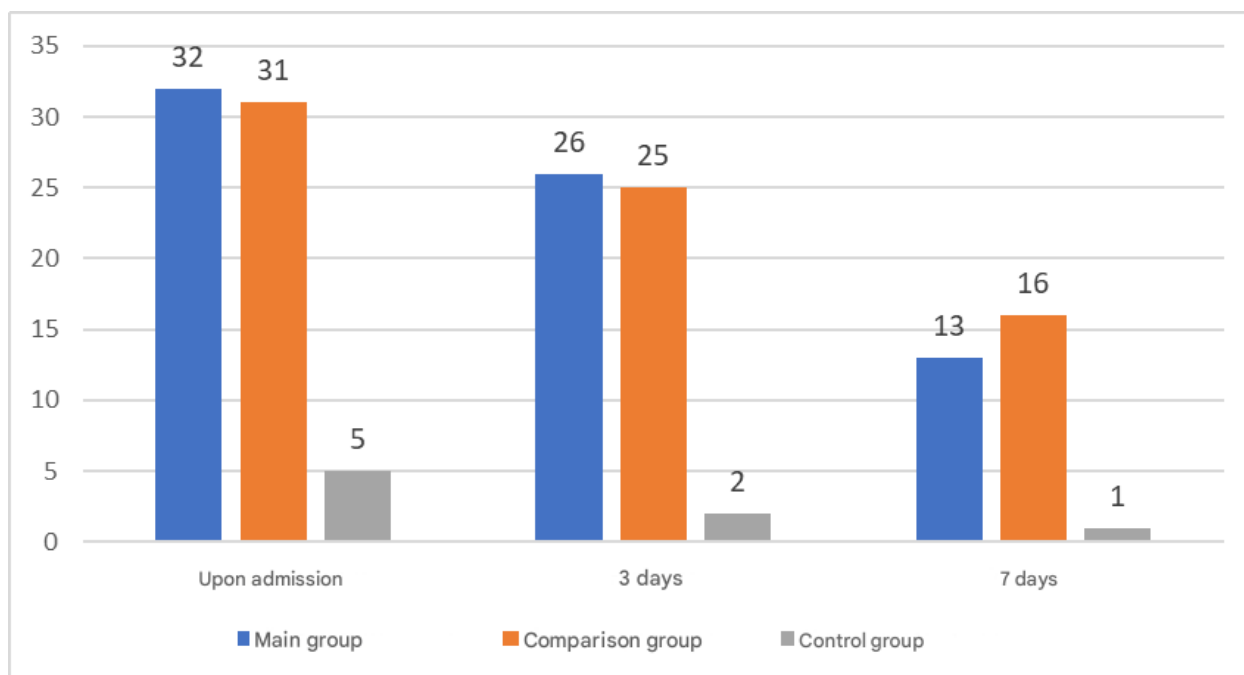


Fig. 1. Dynamics of regression of general cerebral symptoms in patients of all groups.

Figure 1 shows the dynamic changes in general cerebral disorders. By the third to fourth day, half of the patients showed a regression of local symptoms: headache, nausea, and the nausea itself decreased, and patients also complained less of dizziness. Headache, the primary symptom of general cerebral disorders, was present in the remaining 50% of patients with facial bone fractures and brain concussion or brain contusion, as well as some patients in Group III with isolated trauma. During this period, patients with regression of general cerebral symptoms underwent the proposed open reduction of displaced fragments using cortical screws. By the sixth day, patients with midface trauma combined with CFT demonstrated almost complete regression of general cerebral symptoms in 72.4% of cases. General cerebral dysfunction persisted after nine days in only two (3.2%) patients in Group I with midfacial bone damage associated with cerebral contusion. In seven (11.4%) patients in the CG, persistent general cerebral dysfunction persisted until the tenth day due to inadequate treatment.

A comparative analysis of rheoencephalographic parameters in the MG and CG during the first three days revealed the following characteristics:

- The rheographic index (RI) (decrease in vascular volumetric filling) in the MG group was 0.079 ± 0.02 Ohm (73.3%), which corresponded to values at the lower limits of the normal zone, and in the CG (59.16%) it was 0.062 ± 0.022 Ohm; - the value of peripheral vascular resistance (PVR) was $72.19 \pm 13.8\%$ in the MG, which significantly exceeded the permissible level of the digital value (102.5% above the norm) and, accordingly, $77.65 \pm 6.42\%$ in the SG (110.5%);
- the value of the maximum rapid blood filling rate (MRBF) in the MG patients

was reduced by 28.5% (0.83 ± 0.4 Ohm/s) and by 20% in the SG patients (1.06 ± 0.5 Ohm/s;

- the dirotic index changed sharply due to the presence of a state of severe spasm in the vascular arterioles, which immediately affected its digital values and amounted to $66.1 \pm 14.5\%$ in the OG, which exceeded the permissible norm by 34.2%, and, accordingly, in the CG $70.61 \pm 12.8\%$ is higher than the normal value by 41.42%;

- the IVO increased by 85.2% in the OG and amounted to $33.05 \pm 2.45\%$, and in the CG it exceeded the permissible level by 55.2% ($32 \pm 2.05\%$). To summarize the above, within the framework of the results of scientific research, in the first three days after receiving an injury, patients of both groups with combined TBI showed a specifically topotypical pattern of REG changes in the arterial and venous blood flow of the CB according to the main diagnostic criteria, namely a noticeable decrease in the blood filling of the pulse, a significant increase in the tone of the resistive vessels, an increase in the tone of the distributing arteries, pronounced spasm of small-caliber arteries and arterioles and a surge in venous pressure.

Table 2. Data from REG studies in victims of the OG and SG in the 1st to 3rd day after the injury

Indicator Name	OG N=20	CG N=16	Normal zone
Average Rheographic Index, Ohm	$0,079 \pm 0,02$	$0,062 \pm 0,022$	0,11 - 0,15
Peripheral Vascular Resistance Index, %	$72,19 \pm 13,8$	$77,65 \pm 6,42$	55 -70
Maximum Blood Filling Velocity, Ohm/s	$0,83 \pm 0,4$	$1,06 \pm 0,5$	1,30 - 1,85
Dicrotic Index, %	$66,1 \pm 14,5$	$70,61 \pm 12,8$	50 - 65
PES, %	$102,52 \pm 6,57$	$91,36 \pm 2,17$	80-95
Venous Outflow Index, %	$33,05 \pm 2,45$	$32 \pm 2,05$	5 -20

Note: $p < 0.05$ comparative analysis of the values of the OG, SG in comparison

with the normal zone.

- The rheographic index, showing the degree of blood filling of large arteries, in this category of patients showed a decrease in the total blood flow: in the OG it was 0.079 ± 0.002 Ohm (67.4% of the lower limit of the norm) and 0.062 ± 0.022 Ohm in the SG (60.32% of the norm);

- An increase in the peripheral vascular resistance indicator, reflecting the overall lumen of small arteries (increased tone of resistive vessels) - $72.19 \pm 13.48\%$ in the main group - 18.52% compared with the norm, and $77.65 \pm 6.42\%$ in the comparison group - 123.5% of the upper limit of the norm;

- the maximum rapid filling velocity of the blood flow decreased by 24.2% (0.83 ± 0.4 Ohm/s in the OG and by 26% in patients with CH (1.06 ± 0.5 Ohm/s));

- Severe spasm in small-caliber arteries and arterioles - the DCI value was $66.1 \pm 14.5\%$ in the OG, which amounted to 141% and $70.61 \pm 12.8\%$ in CH - 159.2%;

- Difficulty in the movement of the venous outflow index - IVO was increased by 28.5% in the OG and amounted to $33.05 \pm 2.45\%$, in CH - 80% ($32 \pm 2.05\%$).

Thus, in patients in observation groups I and II, rheoencephalographic parameters in the CB and VBB basins during the first seventy-two hours after injury revealed a decrease in the CBF and a marked increase in vascular tone in the distributing and resistive arteries.

Rheographic parameters in patients in both observation groups revealed distinct vasospasm in the CB and VBB basins, all of which explained the transient changes and disruption of the pathogenetic mechanism of AMC. The mean PC values in patients in the MG are presented in the diagram (Fig. 13).

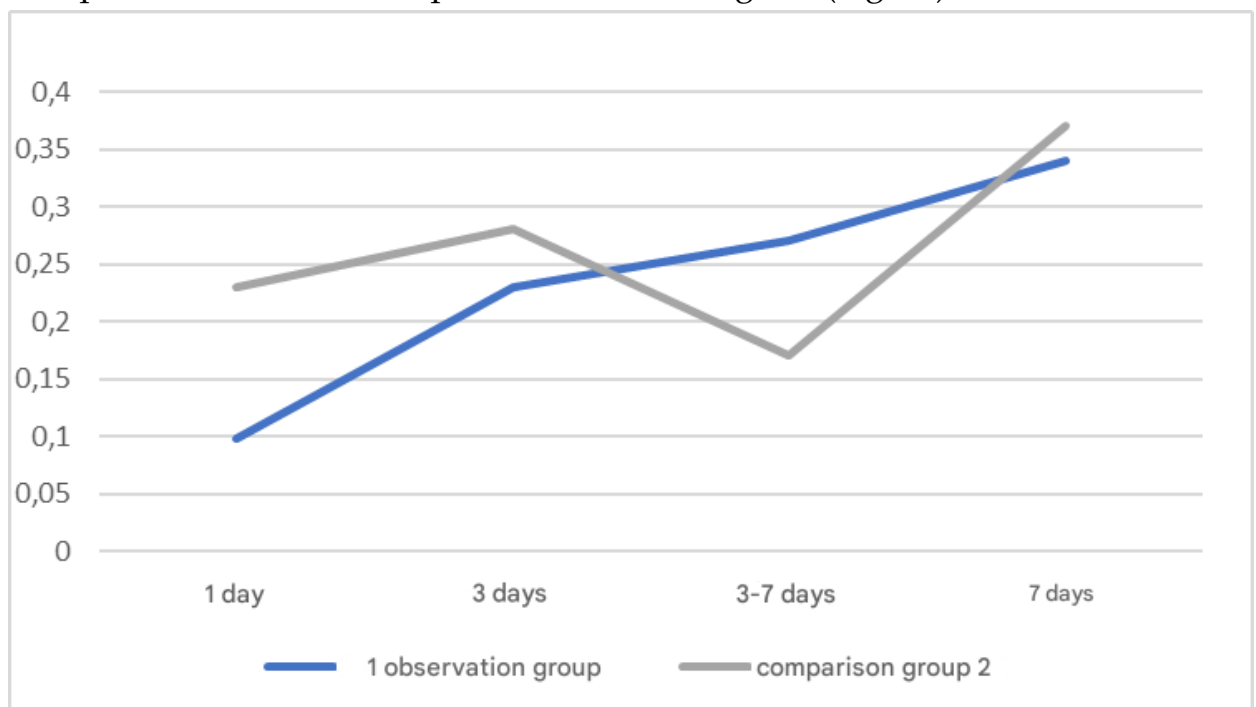


Fig. 2. Diagram of the process of restoration of RI in OG and SG (N= 0.12 -

0.16 Ohm).

In the course of further study of MC in patients of groups I and II (from the 4th to the 7th day), the indices of self-restoration of different links of the blood flow were determined, but with different degrees of intensive restoration over time in all examined groups. Characteristic features of the restoration of REG criteria (its arterial and venous components) in CB are shown in Tables 2 and 3. The basic characteristic feature in the resuscitation of REG criteria of cerebral blood flow in victims of the MG (with the proposed optimized surgical tactics) in comparison with REG data in patients of the SG was the distinctive dynamics of the decline in the diagnosed blood flow disorders. The period of restoration of REG values, namely the rheographic index (RI); the indicator of the total lumen of small vessels (TLSV); The small vessel condition index (SVI) and the venous outflow index (VOI) in all SGs were increased by 1.8-2.0 times ($p < 0.05$), these changes demonstrated a “negative pathophysiological response” from late and untimely surgical intervention.

Table 3. Data from REG examinations of victims of the OG and SG on days

Indicator Name	OG n=20	CG n=20	Normal zone
Average Rheographic Index, Ohm	0,098±0,040 _M	0,15±0,042 _{0M}	0,11 - 0,15
Peripheral Vascular Resistance Index, %	73±6,76	85±12,4	55 -70
Maximum Blood Filling Velocity, Ohm/s	1,23±0,21	1,34±0,57	1,30 - 1,85
Dicrotic Index, %	67,83±6,23	71,7±13,12	50 - 65
Peripheral Vascular Elasticity, %	101,47±14,35	113,8±15,17	80-95
Venous Outflow Index, %	22±6,15	24,2±12,12	5 -20

4-6 after injury

Note: $p < 0.05$ when comparing the MG and SG groups.

In patients with a history of midfacial trauma combined with traumatic brain

injury and concussion symptoms, as well as in a comparison group of patients with isolated zygomatic bone and arch fractures with symptoms of cerebral contusion and cerebral contusion, similar changes were observed in these patients in the first 72 hours after injury.

A study of blood flow in small arteries and arterioles at the injury site revealed the most severe and long-lasting changes in patients with cerebral contusions, as opposed to isolated injuries, which are predominantly associated with concussion.

The clinical situations of all patients with midfacial fractures, as monitored by rheoencephalographic parameters, are characterized by disruptions in the processes of variable autoregulation of cerebral circulation. By the fourth day, a tendency toward restoration of blood flow was observed, but this process was less active in patients with concussions. The establishment of normal values of perfusion and saturation parameters was directly proportional to the auto-restoration of cerebral blood flow regulation.

Conclusions: 1. Restoration of autogenous regulation of cerebral circulation based on the clinical picture and functional indicators correlating with the normalization of microcirculation are key in the clinical and functional aspect for a specialist to select an adequate and optimal tactic in patients with traumatic brain injury.

2. The recovery period of REG indicators (rheographic index - 0.1-0.15 Ohm; peripheral vascular resistance index - 55-70%) serves as a safe indicator for performing radical surgery on the affected side of the midcranium in patients with CFT.

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