



Treatment Tactics for Patients with Concomitant Cranio-Maxillofacial Trauma

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Abstract

Cranio-maxillofacial injuries of the bones of the upper and middle zones of the facial skeleton, combined with skull base fractures and severe brain injuries (brain contusion, subarachnoid hemorrhage), separation of the bones of the facial skeleton from the brain, damage to the supraorbital and infraorbital neurovascular bundles, fractures of the lower jaw, fractures of the upper and lower extremities, ribs. In most cases, they are accompanied by the development of a life-threatening condition, abundant liquorrhea and intense pain from the area of traumatic injury. Such injuries require a separate treatment strategy, namely, to be carried out within 24-72 hours, the intervention should be minimally invasive and radical, based on the use of fixation devices and endoprostheses designed for osteosynthesis and elimination of defects in a certain anatomical area, taking into account its architectonics.

We presented the results of treatment of 70 patients with combined trauma of the cerebral and facial parts of the skull (subbasal, suborbital and supraalveolar fractures) who used methods of fixation of the bones of the middle zone of the face, such as osteosynthesis with fixators from nitinol, osteosynthesis with bone suture, osteosynthesis according to the Adam's method, osteosynthesis with bone plates.

The use of bone plates and fixators made of nitinol, as well as the principle of "damage control" made it possible to improve the results of treatment, reduce the frequency of complications, reduce the number of deformities, the development of traumatic sinusitis, diplopia and enophthalmos, and reduce the period of temporary disability by 2 times.

Keywords: Polytrauma; Cranio-maxillofacial Injuries; Glasgow Coma Scale; Middle and Upper Face Zones; Osteosynthesis; Implant

Introduction

The relevance of the topic is determined by the large proportion of fractures and deformities of the maxillofacial pathology in the structure of maxillofacial pathology, the existing tendency to increase and unsatisfactory treatment outcomes, the low efficiency of traditional methods of surgical interventions, and

the combination of traumatic injuries in this area. In this regard, it should be noted that traumatic injuries of the bones of the middle zone of the face rank second among fractures of the maxillofacial region - 18-23% [5,7,8].

Cranio-maxillofacial injuries of the bones of the upper and middle zones of the facial skeleton, combined with fractures of the skull base and severe brain injuries (brain contusion, subarachnoid hemorrhage), separation of the bones of the facial skeleton from the brain, damage to the supraorbital and infraorbital neurovascular bundles, fractures of the lower jaw, fractures of the upper and lower extremities, ribs. In most cases, they are accompanied by the development of a life-threatening condition, abundant liquorrhea and intense pain from the area of traumatic injury. At the same time, the terms of treatment and rehabilitation of patients with fractures and deformities of CLD are much longer in the presence of concomitant damage to the border organs and systems and craniocerebral injury [6].

It is known that Polytrauma is a complex pathological process caused by damage to several anatomical areas, in this case, the facial and cerebral parts of the skull, with a pronounced syndrome of mutual weighting. It is characterized by the development of a life-threatening condition, acute violation of water-electrolyte metabolism, asphyxia, shock and massive destruction of the bone skeleton with damage to soft tissues. In polytrauma, there is a "syndrome of mutual burden", due to which early diagnosis, emergency surgical interventions in combination with adequate resuscitation measures are the key to successful treatment [1].

When choosing rational surgical tactics, in particular, the time and means of fixing fractures, an objective assessment of the severity of injuries and predicting the result of treatment are crucial.

Some authors indicate that osteosynthesis of the jaws should be postponed and carried out within 3-5 days to several weeks. However, it is well known that for a faster removal of the patient from a critical shock state, it is necessary to stop the pain impulse from the area of traumatic injury associated with the mobility of bone fragments, to stop the cerebrospinal fluid in case of fractures of the upper jaws. In patients with cranio-maxillofacial trauma, the first stage includes emergency surgical assistance to stop the liquorrhea by compression fixation of the maxillary bones to the base of the skull and elimination of the source of infection of the cranial cavity with an ascending infection.

The second stage is a comprehensive Anti-shock therapy in the intensive care unit in order to restore the physiological processes of the body. The third stage, the beginning of which corresponds to the period of 24-72 hours, involves the "final" surgical aid, consisting of the removal of tampons from the maxillary sinuses, reconstructive interventions to restore the walls of the orbits and maxillary sinuses [3,4]. Therefore, there is a need for early surgical intervention in traumatic injuries of the brain and bones of the facial skeleton, which should be carried out within 24-72 hours, be low-traumatic, radical and technically simple.

Objective

To study the effectiveness of providing care to patients with cranio-maxillofacial injuries using the "damage control" strategy of surgical care for severe and extremely severe injuries and wounds or the tactics of "Damage Control" based on the use of different methods of bone fixation.

Materials and Methods

The work is based on clinical observations of 70 patients with cranio-maxillofacial injuries due to polytrauma, who were treated at the Clinic of Oral and Maxillofacial Surgery of the NGIUV on the basis of the Department of Oral and Maxillofacial Surgery of the City Hospital No1 of the city of Novokuznetsk in the period from 2011 to 2025.

5 (14% of patients) had Le Fort III fractures, in 45.7% of cases (16 people) - Le Fort. II, in 40.3% of cases (14 patients) - Le Fort. I (Table 1).

Area of damage	Number of patients (n = 70)
Fracture MO SZL Le Fort III	10 (14%)
Fracture of the MO SZL Le Fort II.	32 (45,7%)
Fracture of the MO SZL Le Fort. I	28 (40,3%)
Total	70 (100%)

Table 1: Distribution of patients by localization of injuries.

Among them, brain injuries were found in 95.2% of the victims. Injuries of the walls of the paranasal sinuses were diagnosed

in 100% of patients. In particular, the maxillary sinuses were damaged in 100% of cases, the ethmoid sinuses in 85%, and the frontal sinuses in 7% of cases.

Damage to the neurovascular infraorbital bundles was detected in 86% of cases. Fractures of the nasal bones in 81%, facial wounds in 14.2% of the victims. Skull base fracture was diagnosed in 28.3% of patients, mandibular fractures in 9.67%, fractures of the upper and lower extremities, ribs, and other bones (scapula, hip) in 19%.

Surgical treatment of patients with cranio-maxillofacial injuries consisted of osteosynthesis of the bones of the middle zone of the face, using various methods and elimination of extensive defects of the paranasal and frontal sinuses. To fix bone fragments, we used nitinol fixators with the effect of thermal memory and superelasticity, bone suture, suspension of the upper jaws according to the Adam's method, bone plates (Table 2).

Treatment method	Subbasal fractures (n = 14)	Suborbital fractures (n = 16)	Supraalveolar fractures (n = 5)
Osteosynthesis with Nitinol fixators	2	2	1
Bone suture osteosynthesis	1	8	3
Osteosynthesis according to the Adam's method	8	2	-
Osteosynthesis with bone plates	2	4	1

Table 2: Surgical treatment methods.

To eliminate defects in the walls of the paranasal and frontal sinuses, implants made of titanium were used. Implants were made

according to spiral computed tomography, more often implants designed to eliminate defects in the lower wall of the maxillary sinus, preventing enophthalmos and binocular diplopia (Table 3).

№	Treatment method	Development of deformities	Post-traumatic sinusitis	Neurological complications	Orbital complications
11	Osteosynthesis with Nitinol fixators	3,1 ± 0,6%	3,2 ± 0,5%	6,4 ± 0,7%	6,4 ± 0,7%
22	Bone suture osteosynthesis	58 ± 4%	6,9 ± 1,5%	7 ± 1,5%	16,5 ± 2%
33	Osteosynthesis according to the Adam's method	48,4 ± 3%	13 ± 1,5%	5 ± 1,5%	14 ± 1,7%
44	Osteosynthesis with bone plates	3,2 ± 0,5%	3,2 ± 0,5%	3,2 ± 0,5%	5,4 ± 0,7%

Table 3: Number of complications depending on the method of treatment.

The number of complications exceeds the number of patients, since one victim had several of them. For example, maxillary sinusitis and infraorbital neuropathy, post-traumatic deformity and enophthalmos.

When comparing the groups, we used the method of nonparametric statistics for two independent samples – the Mann-Whitney test. In order to assess the dynamics of treatment, the Friedman criterion was used. The difference in features in the comparison groups was considered significant at the level of significance of the difference $p < 0.05$.

As a clinical example of osteosynthesis using nitinol fixators, we present an extract from the medical history of patient S., 21 years old, who was admitted with a diagnosis of a fracture of the upper jaw of the subbasal type, a fracture of the nasal bones, a brain contusion of moderate severity, nasoliquorrhea, dystopic angiopathy. Upon admission, he complained of pain in the upper jaw, weakness, nausea, headaches, pathological occlusion. An objective examination reveals facial asymmetry due to swelling of the soft tissues of the midface, malocclusion due to the lack of teeth closure in the area of incisors, canines and premolars, pathological mobility of the upper jaw. Cerebrospinal fluid with an admixture of mucus and blood is excreted from the nose (Figure 1).



Figure 1: Appearance of patient S. before surgery.

An X-ray of the bones of the facial skeleton reveals a violation of the integrity of the bones according to the subbasal type (Figure 2).



Figure 2: X-ray of patient S.

According to the ISS - Injury Severity Score, its severity is estimated at 3 points: head / neck: skull injuries without bone

fractures, with loss of consciousness for 15 minutes without focal neurological symptoms, post-traumatic amnesia up to 3 hours, fracture of the bones of the facial skull with displacement of fragments and damage to the paranasal sinuses. Glasgow Coma Scale – GSC, 1977, the severity of the condition was 14 points. On the second day after admission to ETH, osteosynthesis of the upper jaw and nasal bones was performed. Fixation was carried out in the area of the lower edge of the orbit on the left with a mini-bracket made of nitinol, zygomatic-alveolar ridges on the left and right with S- and C-shaped staples. The nasal bones were fixed with mini-brackets (Figure 3).



Figure 3: X-ray after osteosynthesis.

The postoperative period proceeded without complications. The patient was seen 6 and 12 months after surgical treatment. The bite is physiological, there is no facial asymmetry. Brain function is not impaired (Figure 4).

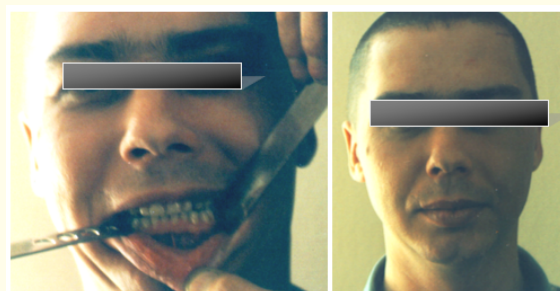


Figure 4: Appearance of patient S. after surgery.

In another case, patient P., 42 years old, was admitted with a diagnosis of moderate brain contusion, subarachnoid hemorrhage, fracture of the frontal bone and base of the skull.

By Injury Severity Score (ISS) 3 points: Head/neck: skull injuries without bone fractures, fractures of the facial skull bones with displacement of fragments and damage to the paranasal sinuses. Along the shGlasgow Coma Scale (GSC, 1977) assessment of the severity of the condition - 14 points.

After clinical and radiological examination, a fracture of the upper jaws was diagnosed according to Le Fort II, III on the left, Le Fort III - on the right with displacement of bone fragments. Fracture of the inner wall of the left orbit and the inner edge of the brow ridge. Fracture of the nasal bones, traumatic tooth extraction (Figure 5).



Figure 5: X-ray of patient P.

On the second day after admission to ETH, osteosynthesis of the upper jaw was performed. Revision of the frontal and maxillary sinuses. The sinuses are drained in typical places. The upper and lower jaws are fixed with fixators made of titanium nickelide. To eliminate the bone defect in the area of the zygomatic-alveolar ridge and stabilize the position of the right zygomatic bone and the upper jaw, an endoprosthesis made of titanium nickelide with a shape memory effect and titanium mesh was installed, which was additionally strengthened with two U-shaped fixators (Figure 6).



Figure 6: X-ray of patient P.

In three months, dental prosthetics were performed, after 5 months - correction Regulations bones of the nose. He started working as a miner three months after the injury.

In case of concomitant injuries of the brain and sinuses, an important task is their sanitation and elimination of existing bone defects, in combination with propulsion of the periorbital tissue into the lumen of the frontal and maxillary sinuses (Figure 7).

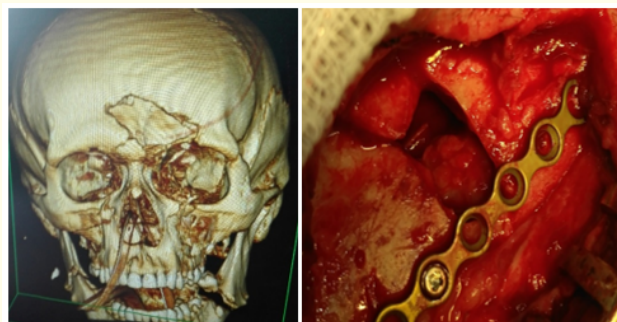


Figure 7: Fracture of the anterior and inferior walls of the frontal sinus.

Trauma of the cranio-maxillofacial region with damage to the anterior and inferior walls of the frontal sinus, contusion of the brain. Severity 4 points: skull injuries with bone fractures with loss of consciousness for more than 15 minutes with the development of focal neurological symptoms, posttraumatic amnesia up to 3 - 12 hours, multiple fractures of the bones of the cranial vault. During the surgical intervention, the periorbital tissue was moved into the orbital cavity, the existing defect of the lower wall of the orbit was replaced by a silicone implant (Figure 8).

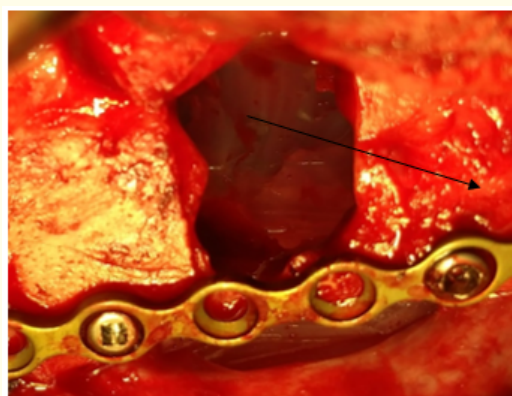


Figure 8: Elimination of periorbital tissue propulsion into the frontal sinus.

Further, the bone fragments of the anterior wall of the frontal sinus are set in an anatomical position and fixed with titanium plates (Figure 9).

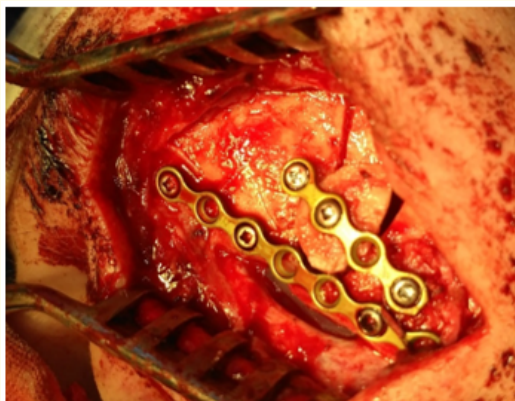


Figure 9: Osteosynthesis by bone plates of the anterior wall of the frontal sinus.

Conclusions

- Based on the analysis of the results of treatment of 70 patients with polytrauma (2011–2025), the expediency of using the principle of “damage control” in the treatment of patients with cranio-maxillofacial trauma, i.e. surgical treatment within 24–72 hours, was proved. The intervention should be minimally invasive, radical, and technically simple.
- One of the ways to improve the quality of treatment and rehabilitation of victims with trauma of the bones of the upper and middle zones of the face is the selection of methods of osteosynthesis and elimination of defects of the bone walls of the frontal and maxillary sinuses, performed taking into account the architectonics of this area.
- The use of bone plates and fixators made of nitinol, as well as the principle of “damage control”, made it possible to improve the results of treatment of patients with polytrauma, significantly reduce the frequency of complications compared to the group of patients who used fixation according to the Adam’s method and bone suture. In particular, to reduce the number of deformities by 3 times, the development of traumatic sinusitis, diplopia and enophthalmos, to reduce the period of temporary disability by 2 times.

- Surgical treatment of bone fractures in the middle zone of the facial skeleton is effective only in combination with measures aimed at eliminating the pathology of neighboring organs and systems.

Conflict of Interest

This study was not funded. There is no conflict of interest. The authors disclose no conflicts of interest.

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