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PREDICTING OUTCOMES OF COMPLEX TREATMENT OF PATIENTS WITH MANDIBULAR FRACTURES BY OPTIMISING ITS LOCAL COMPONENT

Pulatova Shakhzoda Karimovna
PhD, Acting Associate Professor Sh.K. Pulatova
Asian International University, Bukhara, Uzbekistan
Department of Dentistry
e-mail: pulatova.shaxzoda@bsmi.uz

Annotation.
The article presents the results of complex treatment of 157 victims with traumatic fractures of the lower jaw who were hospitalised in the department of maxillofacial surgery of the Bukhara Regional Multidisciplinary Medical Centre. Standard methods of treatment of patients of the main group were supplemented by local influence of infrared laser and applications of ointment 'Traumel-S'. The key point was jaw immobilisation using cortical screws. The effectiveness of this approach in the treatment of mandibular fractures was proved by clinical, microbiological, immunological and radiation methods of research.

Key words: maxillofacial traumatism, nonspecific immunity, bone callus, bioregulatory therapy, posttraumatic complications.

Relevance. Fractures of the mandible have not lost their significance at the present stage of medical development, which is associated with a high frequency of their occurrence. Their share in the structure of various injuries of maxillofacial region is 75-90%. At the same time, mandibular fractures are most often diagnosed in men of working age, which determines the problem of complex treatment of this category of patients, which is of medical, social, and economic importance [5, 4, 9]. Despite the observed low rate of infectious complications of fracture consolidation when using modern methods of fixation, they are still encountered [1, 6, 8]. According to many authors, today antibacterial drugs (antibiotics) are unreasonably widely used to prevent purulent-inflammatory complications of injuries, sometimes substituting natural immunity and nonspecific defence of the organism [2, 7]. The necessity of natural immune system load and the doubtfulness of further progress of antibacterial therapy are pointed out by many authors [3, 8, 9].

Nowadays, the situation is fully mature, when it is necessary to intensify the introduction of techniques that do not suppress and do not replace, but naturally stimulate the body's defence systems (local, general, specific and non-specific). In addition, it should be taken into account that in response to a fracture there is an increased release of calcium and phosphorus from the bone both locally and systemically. Reduction of bone tissue mineral saturation in the defect area is favoured by the presence of local acidosis resulting from acute inflammatory process both in the mandible itself and in the surrounding tissues.

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All this against the background of bacterial aggression, as well as metabolic and microcirculatory disorders in the damaged bone prevents its structural and functional recovery, complicates the treatment of this pathology and prolongs the rehabilitation of patients [3, 5, 9].

In this regard, it is necessary to further introduce the methods of evaluating the effectiveness of complex treatment of patients with traumatic injuries of the mandible. It is necessary to take into account the mechanisms of etiopathogenesis of inflammatory complications of jaw fractures, which will improve the quality of specialised care for the injured. Therefore, the search for the most rational ways of solving this problem continues without losing its relevance to this day.

Purpose of the study. It consists in comparative characterisation of the methods of complex treatment of the victims with fractures of the mandibular bone.

Materials and methods. Clinical studies were conducted on the basis of the maxillofacial surgery department of the Bukhara Regional Multidisciplinary Medical Centre. Observations were based on clinical and laboratory study of 157 patients diagnosed with mandibular fracture (single, double and multiple; unilateral and bilateral), of which:

- 1st group: 46 patients (29.30%)
- 2nd group: 54 patients (34.39%)
- 3rd group: 57 patients (36.31%).

Among the total number of patients, males were 121 (77.07%) and females were 36 (22.93%) aged between 18 and 60 years.

The control group included 30 conditionally healthy individuals.

As shown in Table 1, mandibular fractures were more common in those aged 18 to 44 years (65% of patients). 85% of the hospitalised patients were admitted for emergency indications. All cases of mandibular fractures had different origins. The main cause of mandibular fracture was trauma due to impact or fall. Such injuries could occur in a variety of situations, such as car accidents, sports injuries, fights, or workplace accidents. Often, a mandibular fracture could occur from a fall on the chin due to the head hitting a hard surface (in epileptic patients). Also, mandibular fractures have been observed in people over 60 years of age due to age-related changes in bone tissue.

Table 1

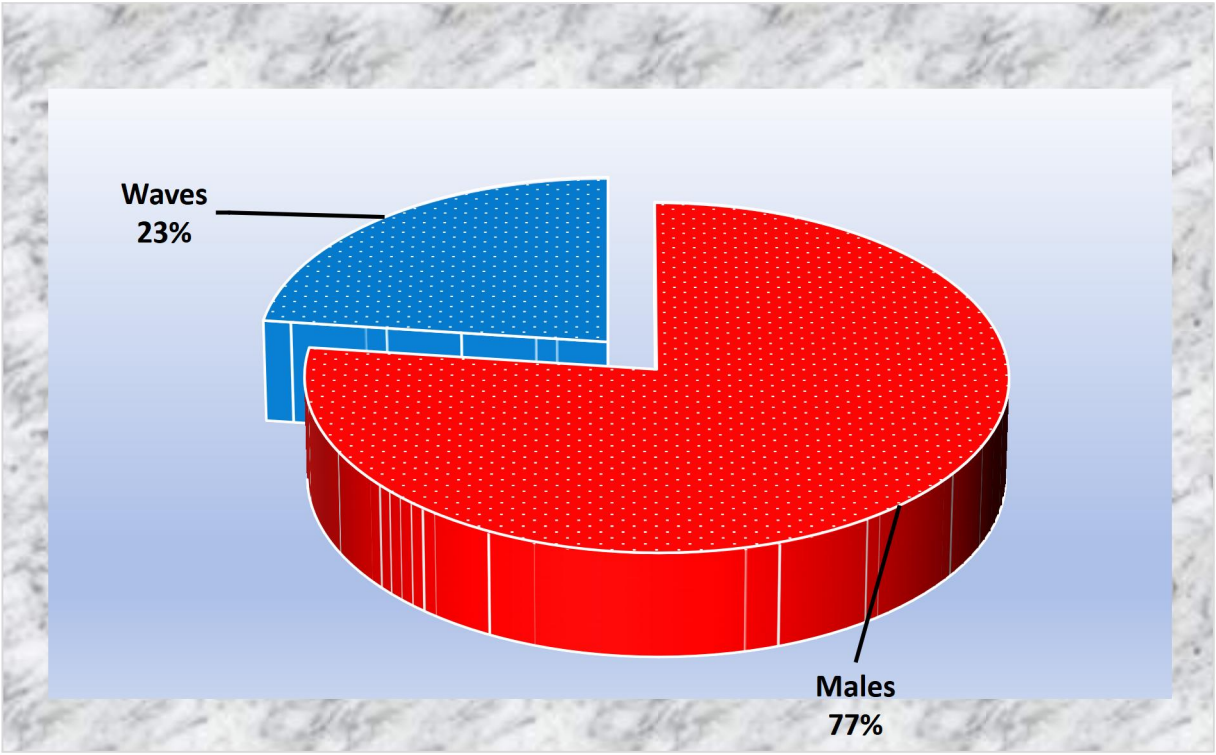
Distribution of patients of the examination groups (n=157) by sex and age

Age, years	Males		Waves	
	abs	M±m,%	abs	M±m,%
18-44	106	87,6±3,0	33	91,67±4,61
45-59	15	12,4±3,0	3	8,33±4,61
60-75	0	0±0	0	0±0

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over 75 years old	0	0±0	0	0±0
P	Hi- Pearson square = 0,354; p = 0,765			

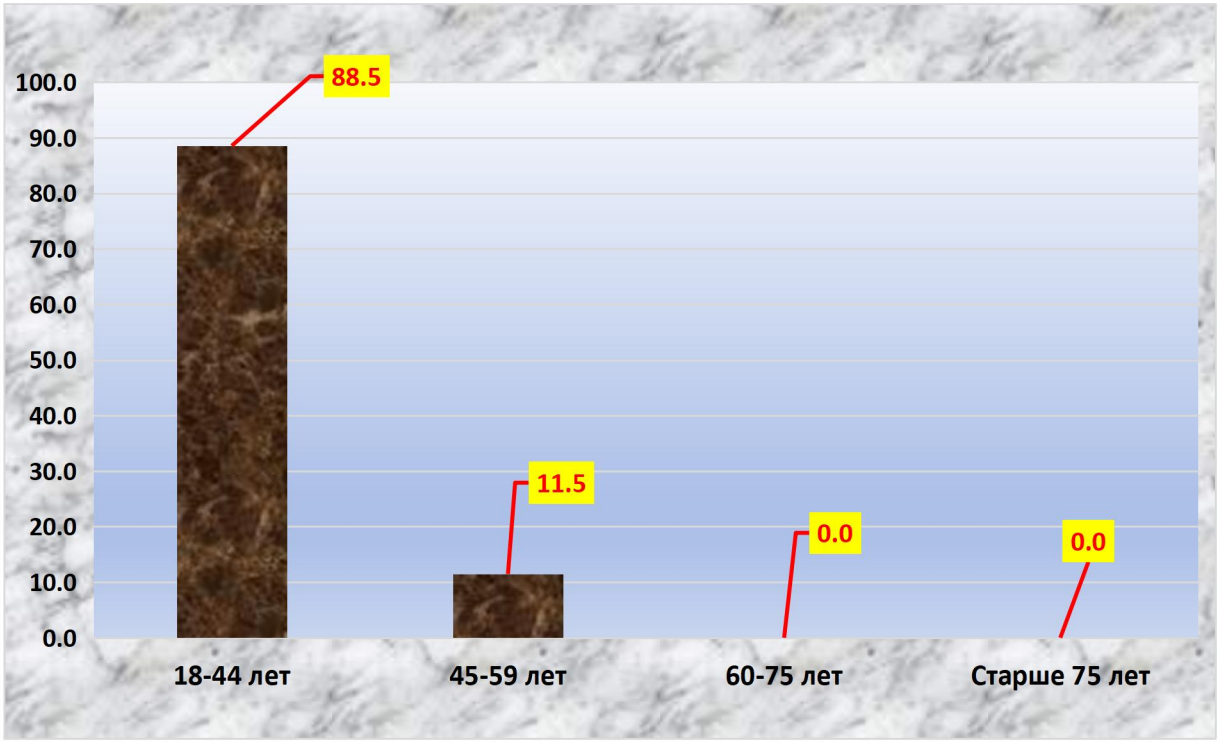
Analysis of the average hospitalisation time (Table 2) showed that the greatest number of referrals occurred on the 1-3rd day after injury. This is due to the fact that in the first days after the injury, patients seek medical assistance from emergency physicians and traumatologists. After that, in the presence of complex fractures or complications, they were referred to the maxillofacial surgery department for treatment.



Pic. 1st. Distribution of patients by gender (%)

It was also observed that some patients presented on the 7th-10th day after injury, indicating a delay in receiving medical attention. This can lead to additional complications and longer treatment and rehabilitation times.

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Puc. 2. Distribution of patients by age (%)

The average hospitalisation period was 7-10 days, with some patients being treated for up to 2-3 weeks, depending on the severity and nature of the fracture.

Table 2

Periods of hospitalisation of patients with mandibular fractures (n=157) from the moment of injury

Time of hospitalisation	Number of patients		P
	abs	M±m,%	
on the 1-2nd day	81	51,59±3,99	Hi-square=114,215; p = 0,000
on the 3-5th day	34	21,52±3,27	
on the 5-7th day	23	14,56±2,81	
on 7-10th day	12	7,59±2,11	
more than 10 days	7	4,43±1,64	
Total	157	100±0	

The study of mandibular fracture localisation revealed that in the majority of patients, the fracture line is located in the angle region (52.5% of cases), followed by fractures in the mental foramen and mandibular body (25.4% of cases, respectively), with

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fractures in the canine region occurring less frequently (13.9%). The frequency of central fractures is 8.2% (Table 3).

Table 3

Distribution of patients (n=157) by localisation of mandibular fracture within the dentition at the time of patient hospitalisation

Typical localisation of a mandibular fracture without displacement	Number of patients		P
	abs	M±m,%	
Frequency of central fractures	12	7,64±2,12	Hi-square=73,443; p = 0,000
In the canine region	22	14,01±2,77	
In the region of the mental foramen and mandibular body	40	25,48±3,48	
Fractures in the region of the angle	83	52,87±3,98	
Total	157	100±0	

Based on the objectives of the study, 157 patients with mandibular fractures were randomly divided into 3 groups depending on the type of local therapy (Table 4):

Table 4

Distribution of patients by study groups (n=157) depending on the applied complex of local treatment

Typical localisation of mandibular fractures without displacement	Study groups					
	Conventional therapy		TT+Traumel-S		TT+Cortical screws+Infrared radiation+Traumel-S	
	abs	M±m, %	abs	M±m, %	abs	M±m, %
Central fractures (n=12)	3	6,52±3,64	6	11,11±4,28	3	5,26±2,96
Fractures in the canine region (n=22)	6	13,04±4,97	7	12,96±4,57	9	15,79±4,83
In the region of the mental foramen and body of the n/h (n=40)	11	23,91±6,29	13	24,07±5,82	16	28,07±5,95
In the region of the angle (n=83)	26	56,52±7,31	28	51,85±6,8	29	50,88±6,62

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P	χ^2 = 25,255; p = 0,000		χ^2=22,889; p=0,000		χ^2= 26,298; p = 0,000	
P	Hi-Pirson square = 1,758; p = 0,941					
Total	46	29,30±3,63	54	34,18±3,77	57	36,08±3,82
P	Hi-square = 1,000; p = 0,607					

The 1st comparison group consisted of 46 patients in whom local treatment consisted of bimaxillary splinting with Tigerstedt splints, prophylactic administration of antibacterial therapy in the form of intramuscular injections of various antibiotics - cefazolin, ceftriaxone, designed for bactericidal action on Gram-positive and Gram-negative microorganisms. In cases of haematomas and pronounced edema of regional soft tissues intravenous infusions of Metrogil were used. Rinsing of the oral cavity with furacilin solution in dilution 1:5000. Vitamin therapy in the form of parenteral administration of vitamin preparations was prescribed for the purpose of general strengthening therapy and prevention of dysbacteriosis development.

The 2nd comparison group consisted of 54 patients who received applications of Traumel-C ointment in the fracture area as part of the local therapeutic complex after traditional splinting of the jaws according to Tigerstedt and antiseptic treatment of the oral cavity;

the 3rd - main group consisted of 57 patients in whom jaw immobilisation was carried out with cortical screws, the complex local therapy daily after the previous antiseptic treatment (traditional therapy) included applications of ointment 'Traumel-C' containing active components of plant and mineral origin, in the form of application to the damaged area and massaging until its complete absorption, and infrared radiation therapy (IRT).



Pic. 3. Application of cortical screws with intermaxillary immobilisation with orthodontic wire

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Pic. 4. Orthopantomogram of a patient with a central oblique fracture of the mandible and a fracture in the region of its angle on the right side without displacement with applied cortical screws

Taking into account the nature of the mandibular fracture and the course of the disease, all patients were prescribed complex treatment: in the first day after hospitalisation - therapy with broad-spectrum antibacterial drugs, and then selective administration of antibiotics taking into account the composition and sensitivity of the microflora, detoxification therapy was prescribed to prevent toxic complications and accelerate the healing process and included colloidal and crystalline solutions (glucose solution 5%, saline solutions - 0.9% sodium chloride, haemodez, reopolyglucin), desensitising therapy was recommended to reduce allergic reactions that may accompany traumatic conditions and included antihistamines such as dimedrol, suprastin and others. Vitamin therapy was used to increase general and local immunity and to prevent dysbacteriosis. Symptomatic treatment included analgesics and non-steroidal anti-inflammatory drugs to reduce pain, as well as other necessary means depending on the disease clinic.

In local treatment of mandibular fractures, in cases of hematoma opening, dressing with antiseptic treatment and drainage replacement was performed. For this purpose, 3% hydrogen peroxide solution, furacilin 1:5000, chlorophyllipt 5% and other antimicrobial agents were used.

Further, the patients of the 2nd and 3rd groups (after the TII procedure) were used applications of ointment of vegetable and mineral elements containing active components ‘Traumel-S’ in the form of application to the damaged area and massaging until its complete absorption.

“Traumel-S” is a combined preparation. The main components of “Traumel-S” are plant extracts including arnica, calendula, chamomile, as well as other natural substances such as methylparaben, propylparaben and dimethyl sulfoxide.

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The action of 'Traumel-S' is based on its antimicrobial, anti-inflammatory, local anaesthetic, regenerating and anti-edema properties. The drug increases local blood circulation, stimulates tissue regeneration and reduces oedema.

Local therapy with infrared radiation was used to accelerate healing in mandibular fractures. The procedure was carried out with the help of a special device 'INFRARED RADIATOR S.A. MED HOLDING OOO' (Republic of Uzbekistan), Wavelength: approximately from 800 nm to 2500 nm, with the main range around 900-1000 nm. Radiation power: in the range of 20 to 200 mW/cm2, but may depend on the model of the device used. Duration of the procedure: 5 to 10 minutes, depending on the patient's individual response (Fig. 5).



Multidisciplinary Medical Centre with a maximum absorption λmax of 100 J/cm² with an exposure time of 5 minutes. Infrared laser radiation was locally applied to the fracture area using a device operating at a wavelength of 808 nm with radiation energy of 2 W/cm².

The distance from the end of the light guide to the skin surface in the area of localisation of the traumatic jaw injury was 0.5-2.0 cm depending on the patient's thermal discomfort. Total irradiation time was 5 minutes, in cases of double fractures polypositional irradiation was performed by smooth movement of the terminal over the entire surface of the damaged area.

The procedure was performed once a day, the duration of the session depended on individual needs and was determined by the rehabilitation physician. The number of treatments varied depending on the severity of the fracture and the rate of bone consolidation.

Infrared radiation affects the tissues, increasing their metabolic processes and accelerating cell regeneration. This helped to accelerate wound healing, reduce swelling and inflammation, and reduce pain.

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The clinical effectiveness of therapy was determined by the following characteristics: fracture healing time, reduction of pain, improvement of general condition, normalisation of body temperature, bone fragment consolidation time, improvement of microcirculation, reduction of oedema, acceleration of tissue regeneration, reduction of the risk of complications, data of blood laboratory tests (quantitative and qualitative composition of leukocytes, COE), biochemical, microbiological and immunological studies.

The clinical efficacy of therapy of mandibular fractures with infrared radiation depended on many factors, including the type and characteristics of the fracture, duration and mode of treatment, as well as individual characteristics of the patient.

In the study involving patients from groups I, II and III, microbiological analysis was performed using aerobic and anaerobic culturing methods. The material was collected 1, 7, 14 and 30 days after the start of treatment on an empty stomach at the same time in the morning. Samples for research were taken from the oral cavity, delivered to the laboratory of the Department of Microbiology, Virology and Immunology of BGMI within 24 hours. Various media were used for culturing including 5% blood hemin agar, AC medium and medium for the determination of Enterococcus spp. Identification was performed using API-20A test kit. For anaerobic cultures, an anaerostat with a gas mixture of N2, H2 and CO2 in certain proportions was used. The analysis revealed a sharp increase in colonisation of the oral mucosa in patients (Table 5).

Table 5

Dynamics of microflora in patients of all studied groups before treatment (M±σ)

Bacterial species	Study groups			
	Group 1, n=46	Group 2, n=54	Group 3, n=57	Mean value in all groups
Str. sanguis	4,2±0,57	5,8±0,59*	5,7±0,55*	5,29±0,91
Str. intermedius	4,2±0,63	3,8±0,54**	3,9±0,48***	3,95±0,57
Str. sahvanus	5,2±0,55	5,4±0,53***	5,31±0,58	5,31±0,56
P. anaerobius	5,4±0,6	4,4±0,61*	4,3±0,66*	4,66±0,79
Enterococcus spp	3,9±0,27	3,8±0,55	3,7±0,56	3,79±0,49
Corynebactenum spp	3,2±0,61	4,19±0,62*	4,1±0,54*	3,87±0,73
Enterobactenum spp	4,2±0,55	3,6±0,52*	3,8±0,61**	3,85±0,61
Prevotella intermedia	3,7±0,54	3,1±0,59*	3,19±0,57*	3,31±0,62

Note: ** - reliability of differences of arithmetic mean values in relation to 'group 1' (*** - P<0.05; ** - P<0.01; * - P<0.001); - in relation to 'group 2' (- P<0.05; - P<0.01; - P<0.001) is marked.*

According to the data presented in Table 5, the initial quantitative estimates of Streptococcus sanguis were 5.27±0.24, P. anaerobius 4.73±0.45, Corynebactenum spp 3.87±0.18, Streptococcus intermedius 3.93±0.29, and Prevotella intermedia 3.34±0.22,

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indicating a significant presence of anaerobic microorganisms in the oral cavitary environment.

The study of cytokine profile of oral fluid revealed an increase in key cytokines including IL-6 (14.81±1.12 pkg/ml, norm 7.2±0.37 pkg/ml) and IL-10 (34.94±2.27, norm 26.04±1.17) indicating intense inflammatory processes. The level of C - reactive protein (CRP) (5.2±0.80, norm 2.2±0.33), reflecting general inflammatory activity, was also increased. The data are presented in Table 6.

Table 6

Results of cytokine content analyses in all clinical groups before treatment.

1st group n=10			2nd group n=10			3rd group n=10		
IL-6 (0-10 pg/ml)	**IL-10 (0-31 pg/ml)**	**СРБ (blood) 1-3 mg/l**	**IL-6 (0-10 pg/ml)**	**IL-10 (0-31 pg/ml)**	**CRP (blood) 1-3 mg/l**	**IL-6 (0-10 pg/ml)**	**IL-10 (0-31 pg/ml)**	**CRP (blood) 1-3 mg/l**
12,7	78,9	4,5	17,7	92,5	6,8	12,4	27,4	2,2
22,8	52,3	3,7	22,5	68,4	3,5	7,9	19,6	1,4
13,9	38,9	4,2	9,2	34,2	3,1	12,9	42,1	2,9
15,5	47,1	2,2	4,8	36,9	3,8	6,3	17,6	3,7
16,3	35,6	5,6	29,6	52,1	5,8	15,1	55,4	1,3
25,2	28,9	4,8	5,2	27,1	2,6	5,8	22,8	1,1
8,9	36,5	5,1	12,9	28,3	8,8	12,1	41,4	1,6
7,2	45,2	6,6	16,1	45,3	5,5	6,8	32,8	2,5
8,8	31,6	4,9	6,6	68,9	7,3	18,7	58,2	3,3
11,5	49,9	7,0	28,7	87,1	6,7	12,1	42,5	1,7

All groups show a strong positive correlation between IL-6, IL-10 and CRP, which may indicate a relationship between these biochemical parameters $p < 0.001$.

Results and their discussion.

Assessment of the progress of the treatment process in mandibular fractures included monitoring of various parameters. This included the dynamics of clinical symptoms (edema, pain, functional disorders), radiological data to assess the position of bone fragments and fracture consolidation, as well as laboratory and functional recovery indicators. Infrared laser light therapy applied in the third group resulted in positive effects: reduction of oedema, reduction of pain and improvement of blood circulation. It also stimulated metabolism, improved the supply of nutrients to the tissues and accelerated fracture healing. Most local signs of injury disappeared after 4-5 sessions of physiotherapy to complement the main treatment. It is important to note that the formation of connective tissue callus in patients of the third group on the day was faster than in patients of the first group.

Parameters of microbiological examination on the 30th day of therapy are shown in Table 7.

Table 7

Dynamics of microflora in patients of all studied groups on day 30 of treatment (M±σ)

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Bacterial species	Study groups			
	Group 1, n=46	Group 2, n=54	Group 3, n=57	Mean value in all groups
Str. sanguis	5,1±0,48	7,19±0,55*	7,3±0,59*	6,61±1,13
Str. intermedius	3,7±0,64	6,2±0,56*	6,1±0,6*	5,42±1,27
Str. sahvanus	4,1±0,53	6,1±0,57*	6,3±0,51*	5,58±1,1
P. anaerobius	4,8±0,68	3,1±0,57*	2,9±0,6*	3,54±1,03
Enterococcus spp	3,8±0,57	0,9±0,08*		2,25±1,51
Corynebactenum spp	3,4±0,58	0,6±0,06*		1,9±1,46
Enterobactenum spp	3,6±0,63	0,91±0,06*		2,16±1,41
Prevotella intermedia	2,7±0,5			2,7±0,5

Note: ** - reliability of differences of arithmetic mean values in relation to 'group 1' is marked (*** - P<0.05; ** - P<0.01; * - P<0.001); - in relation to 'group 2' (- P<0.05; - P<0.01; - P<0.001).*

From the table it can be observed that the mean value of Str. Sanguis increased in group 2 and 3 by the 30th day of treatment and decreased to 5.1±0.21 in group 1, Str. intermedius increased to 6.2±0.22 in group 2, 6.1±0.24 in group 3 by the 30th day, and in group 1 it remained at the same level as on day 14 of therapy. Enterococcus spp, Corynebactenum spp, Enterobactenum spp, Prevotella intermedia were not detected in group 2 and 3 on day 30 after placement of the constructs and initiation of antibacterial and anti-inflammatory therapy, while in group 1, where traditional therapy was used, the values were: Enterococcus spp - 3. 8±0.19, Corynebactenum spp - 3.4±0.20, Enterobactenum spp - 3.6±0.20 and Prevotella intermedia - 2.7±0.21.

As for IL-6 and IL-10, these indices also came to normal in the 3rd group of patients, and in the second and first groups we got comparatively the same result (Table 8).

Table 8

Indicators of IL-6 and IL-10 after treatment

1 group n=10			**2 group n=10**			**3 group n=10**		
IL-6 (0-10 pg/ml)	**IL-10 (0-31 pg/ml)**	**C-reactive protein (blood) 1-3 mg/l**	**IL-6 (0-10 pg/ml)**	**IL-10 (0-31 pg/ml)**	**C-reactive protein (blood) 1-3 mg/l**	**IL-6 (0-10 pg/ml)**	**IL-10 (0-31 pg/ml)**	**C-reactive protein (blood) 1-3 mg/l**
12,1	34,1	2,4	14,1	36,6	2,1	12,4	27,9	1,1
12,5	28,2	2,9	12,2	28,8	3,0	7,2	22,1	2,8
9,9	29,2	2,8	7,9	31,0	1,9	5,5	28,5	1,4
9,2	29,1	2,0	7,5	32,9	2,1	9,9	32,7	1,7

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19,3	25,2	3,1	23,2	24,4	2,9	7,2	18,7	2,2
19,6	22,6	3,1	5,1	22,6	1,8	4,9	22,3	1,6
11,2	27,3	2,1	12,1	27,2	3,8	13,1	28,9	2,2
7,3	26,2	3,2	10,3	24,5	3,6	6,3	25,4	2,9
9,5	19,9	2,3	5,8	18,8	3,1	7,9	11,5	1,7
14,8	48,1	3,2	16,4	44,2	2,9	8,3	32,4	1,1

Based on the data of the table, we see a significant improvement of the indicators after the therapy in all treatment groups. In the first group of subjects the average value of IL-6 was 12,54±0,82, before treatment - 14,28±1,77, IL-10 before treatment - 44,49±4,37, and after treatment decreased to 28,99±2,24, in the second group the indicators of IL-6 before treatment - 15, 33±1.88, after treatment - 11.46±1.17, and IL-10 - 54.08±6.22 before treatment and 29.1±2.29 respectively after therapy, in the third group IL-6 before treatment - 11.01±0.98 and 8.27±0.97 after, IL-10 - 35.98±2.49 and 25.04±1.47 respectively.
The comparative analysis showed that the complex treatment including intermaxillary fixation with cortical screws provides faster and better healing in comparison with traditional methods. The efficacy of the applied complex treatment in the main group in terms of bone consolidation time 20.2% faster than in the comparison group has been reliably proved. This confirms the effectiveness of this approach in the treatment of mandibular fractures, especially in cases of severe injuries.

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