

Musaev Sh.Sh.

**IMMOBILIZATION METHODS FOR
PEDIATRIC MANDIBULAR FRACTURES**

Monograph

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Authors:

Musaev Sh.Sh. - Associate Professor of the Department of Maxillofacial Surgery, Tashkent State Dental Institute, PhD.

Reviewers:

Yuldashev A.A. - Doctor of Medical Sciences, Associate Professor of the Department of Pediatric Maxillofacial Surgery of the Tashkent State Medical University.

Ibragimov D.D. - Candidate of Medical Sciences, Associate Professor of the Department of Maxillofacial Surgery and Pediatric Maxillofacial Surgery, Samarkand State Medical Institute.

The monograph examines the frequency and prevalence mandibular fractures, some issues of the etiology and pathogenesis of inflammatory diseases in the tissues of the periodontal complex, in particular, the effect of the immobilization method on the state of periodontal tissues leading to the development of inflammatory complications in the treatment of mandibular fractures in children. The methods of immobilization in the treatment of mandibular fractures in children, their features, possible complications and ways of their prevention are described in detail. Particular attention is paid to the preservation of the anatomical and functional integrity of the tissues of the periodontal complex. This monograph is intended for maxillofacial surgeons, dentists, clinical residents, masters and students of medical universities.

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LIST OF ABBREVIATIONS AND SYMBOLS

TMJ - Temporomandibular joint

UJ - Upper jaw

FVHI– Fedorov-Volodkina hygiene index

CDD - compression-distraction device

CBCT - Cone Beam Computer Tomography

CT - computer tomography

MPU - medical and preventive institution

CP - condylar process

MRCT - magnetic resonance computer tomography

LJ - Lower jaw

OPTG - orthopantomography

MF – Mandibular fracture

PMA - papillary-marginal-alveolar index

PTH- parathyroid hormone

MFR - Maxillofacial Region

MI - Maxillofacial Injury

n - is the number of examined patients

OC - osteocalcin

INTRODUCTION

To date, the treatment of injuries of the maxillofacial region remains one of the most urgent problems of dentistry. It is known that mandibular fractures in children and their complications have their own characteristics. According to the literature, "... the features of mandibular fractures in children include the observation of fractures of the "green branch" type, the minimum degree of displacement of fractures due to the thickness of the periosteum, the extremely rare use of surgical methods of treatment and, according to strict indications, due to the existing risk of damage to the growth zones of the mandible, inconvenience and difficulties when using dental wire splints due to incomplete formation of the anatomical region of the neck of milk teeth in children ..."¹. From year to year, the frequency of traumatic injuries and the frequency of complications after treatment worldwide is growing rapidly, which, in turn, indicates the need for improved methods of treatment and prevention of complications.

In recent years, there has been an increase in injuries to the maxillofacial region due to an increase in traffic accidents, children's playgrounds and roller coasters around the world. Currently, children with injuries of the maxillofacial area make up 25% of the number of patients undergoing treatment in hospitals. According to Russian researchers, the frequency of traumatism of the maxillofacial region in children is 10 per 1000 children (Korsak A.K., 2007; Ivanova M.S., Aleksandrova E.G., 2018). Increasing the frequency of traumatic injuries and post-procedural complications among children, the development of modern, less traumatic and effective methods of treating children with this pathology, the prevention of traumatic injuries in children, the prevention of complications observed during and after the treatment of injuries remains a priority of scientific research.

The program for the development of the medical sphere of our country sets tasks aimed at adapting the medical system to the requirements of world

¹Korsak, A.K., Kushner, A.N., Terekhova, T.N., Zenkevich, Yu.V. Pediatric surgical dentistry // Minsk: 2013, p.528

standards, reducing the risk of complications in the treatment of mandibular fractures, including inflammatory diseases of periodontal tissues among children. In accordance with the Action Strategy for the five priority areas of development of the Republic of Uzbekistan for 2017-2021, when raising the level of medical services to a new level, tasks such as "...improving the convenience and quality of specialized medical services, further reforming the emergency and emergency care system, prevention of disability....»². This, in turn, determines the introduction of low-traumatic methods of periodontal tissue immobilization in the treatment of mandibular fractures in children and the prevention of inflammatory diseases of periodontal tissues in children as one of the topical scientific areas.

This dissertation research, to a certain extent, serves to fulfill the tasks provided for in the State Program approved by Decree of the President of the Republic of Uzbekistan No. UP-4947 "On the Strategy for Actions for the Further Development of the Republic of Uzbekistan" dated February 7, 2017, No. UP-5590 "On Comprehensive Measures for the Cardinal improvement of the healthcare system of the Republic of Uzbekistan" dated December 7, 2018, Decrees of the President of the Republic of Uzbekistan No. PP-3071 "On measures to further develop the provision of specialized medical care to the population of the Republic of Uzbekistan in 2017-2021." dated June 20, 2017 and No. PP-3440 "Early detection of congenital and hereditary diseases in children in 2018-2022" dated December 29, 2017, as well as in other legal documents adopted in this area.

According to scientists from all over the world, mechanical injuries of the face and jaws in children occur in 56-79% of cases from domestic injuries, in 5-18% of cases from street injuries, in 3-17% of traffic accidents and about 4- 6% of cases from sports injuries (Korsak A.K., 2013). In terms of frequency of occurrence, mandibular fractures are second only to inflammatory diseases and account for 25% of all emergency patients requiring emergency care in hospitals (Semenov M.G., Vasiliev

² Decree of the President of the Republic of Uzbekistan No. UP-4947 "On the strategy of actions for the further development of the Republic of Uzbekistan" dated February 7, 2017.

A.B., 2000). According to the authors, mandibular fractures rank first among fractures of the bones of the facial skeleton and account for 70-90% of all fractures (Yakubov R.K., Fayziev B.R., 2012). Despite the constant improvement and optimization of the complex treatment of maxillofacial injuries, in particular mandibular fractures, the frequency of complications remains high (Magomedgadzhiev B.G., 2008; Mubarkova L.N., 2008; Mirsaeva F.Z., Izosimov A.A., 2009). Currently, among the conservative methods of treating mandibular fractures, immobilization with wire splints is widely used in practice. In addition to the advantages, this method has a number of disadvantages, including: an adverse effect on the tissues of the periodontal complex, oral hygiene and a significant decrease in the quality of life of patients, which are often encountered in medical practice. When wearing wire splints attached to the teeth, it is difficult to carry out professional and individual oral hygiene (Lepilin A.V., Erokina N.L. et al., 2008; Medvedev Yu.A., 2012; Zagorsky V.A., 2016; Boymuradov Sh.A., 2016; Zoirov T.E., Bobamuratova D.T., 2019). The etiological factors that cause violations of the state of oral hygiene include hypofunction of the major and minor salivary glands, in addition, the restriction of the movements of the mandible in all planes, due to the rigid and prolonged immobilization of the mandible, all this, in turn, negatively affects the physiological functions, in particular the state of salivation, with the help of which self-cleaning of the oral cavity and teeth occurs, as well as the appearance in the oral cavity of many additional retention points and points that contribute to the retention and accumulation of food debris, which in turn creates a favorable and optimal environment for the growth and reproduction of pathogenic microorganisms, inflamed periodontal tissues.(Vasiliev.A.V., 2001;Yakubov R.K., Faiziev B.R., 2012).

Thus, the high incidence of mandibular fractures among children, the minimum degree of displacement and mobility of fragments or their complete absence, the frequent manifestation of inflammatory processes in the tissues of the periodontal complex with the traditional method of immobilization creates the need to develop modern, less traumatic and more effective methods of

immobilization. This, in turn, determines the relevance of the research topic, which is devoted to the treatment of children with mandibular fractures.

CHAPTER 1. MODERN INTERPRETATION OF COMPARATIVE ASSESSMENT OF JAW IMMOBILIZATION METHODS FOR LOWER JAW FRACTURES IN CHILDREN

1.1. Prevalence and etiology of mandibular fractures in children

The problem of treatment of traumatic injuries of the maxillofacial area of childhood continues to be one of the urgent problems of dentistry and medicine in general. High rates of traumatism among children in recent years do not tend to decrease. It is generally accepted that the clinic of maxillofacial injuries, especially PJ and their complications in childhood, is characterized by certain features [1,5,48,82,102,110].

In recent decades, there has been an increase in the frequency of occurrence, aggravation of the condition of patients and "rejuvenation" of the age of injuries of the maxillofacial region. This is mainly due to the increase in vehicles, children's roller and other rolling devices (roller skates, electric scooters, skateboards, longboards, cruisers, hoverboards, etc.) and playgrounds, as well as a decrease in the attention of parents to their children due to a decrease in free time, which will affect the social side of the issue. According to the literature, patients with traumatic injuries of the maxillofacial area today account for about 30% of patients treated in hospitals of the maxillofacial area. The incidence of traumatism of the maxillofacial area in children is 10.0 per 1000 children [54,58,90,106].

It is known that in peacetime among the child population, non-gunshot mechanical injuries of the soft tissues of the maxillary fossa are more often observed. Less common are chemical and thermal burns of the tissues of the maxillofacial region, and gunshot injuries of the face occur in less than 1% of the child population. As a rule, the cause of mandibular fractures in children is domestic trauma and unorganized and organized sports - up to 84% [45,49]. Mandibular fractures are more common in boys aged 7 to 14 years [14,25,38,96].

In practical traumatology, doctors divide traumatic injuries into open and closed injuries. Open injuries include such injuries when there is damage to the

integumentary soft tissues (skin, mucous membranes). With these types of injuries, the wound can become infected and lead to inflammation of the surrounding tissues or sepsis. When the damage is closed, the skin remains intact and intact [2, 5, 25, 66, 104].

As a rule, first of all, mechanical damage occurs as a result of any mechanical impact of the object on the area of damage, i.e. there must be contact between the object and any part of the body. To determine the severity of mechanical injury, we need the kinetic energy ($E=mv^2/2$) of the traumatic factor, i.e. the severity of the injury in the literal sense depends on the mass of the traumatic agent and on the speed of the object. In addition, the shape and relief of the surface of the traumatic object, the localization of the impact, the area of the damaging effect, the anatomical and topographic morphology of organs and tissues, etc. [12, 20, 21, 56, 71].

It is accepted that, depending on the circumstances and place in which a traumatic injury was received, one can distinguish between industrial (industrial and agricultural) and non-productive (street, sports, domestic, transport, etc.) injuries. Among the child population, birth trauma can also be distinguished, which often occur in maternity hospitals during childbirth due to negligence and rudeness, both by medical staff and parents. Most often, traumatic injuries of the lower jaw, ribs, cervical spine, limbs and other areas of the body occur.

According to the literature data, among non-gunshot mechanical injuries of the maxillofacial area of childhood, the most common (56-79%) is domestic injury, less often street (5-18%) and transport (3-17%), the incidence of sports injury is about 4-6%. Sometimes (less than 1%) among older children there are also work-related injuries [12,66,85-107].

However according to Ali Mohammad Ali Aldheer (2017), a researcher from the Asir Central Hospital, in 56% of cases the cause of PJ was an accident, in 24% of cases a fall, in 16% of cases a fall from a bicycle and in 4% sports. In our opinion, this is due to the high rate of accidents in Saudi Arabia. PNP was common in children in the age group of 6-12 years (76%), and less common in

children under 6 years of age (24%). By sex: boys 88%, girls 12% of cases. According to the same author, PNJ occupied the first place among all fractures of the facial bones in terms of frequency of occurrence and occurred in 41% of cases [19,20,26,33,80,99].

The causes of household, most common injuries of the maxillofacial area in children are as follows: blows when falling on hard surfaces (most often when playing in playgrounds where the ground is covered with concrete or asphalt, when riding bicycles, roller skates or other devices), a blow to the face hard objects, falling from a height (most often in summer, when fruits of fruit trees ripen), animal bites (dogs, cats, horses, donkeys, etc.), injury from sharp objects, etc. [21,64,66,75,110].

Among the child population, street and transport types of mechanical injuries are less common, and they differ in the severity of damage to the soft and hard tissues of the maxillary fossa. When such types of injuries occur, mechanical damage to the teeth, especially the milk and bones of the maxillary fossa, is more often observed, more often the lower jaw. As a rule, when practicing organized and unorganized sports, children receive a sports mechanical injury. This type of damage is most often observed during playing sports (football and hockey). In winter, damage to the MFA is often observed among the child population when skiing and skating [35,44,59,60,95].

According to the literature, traumatization of the maxillofacial area is 2.2 times more common among boys than among girls, and fractures of the facial bones are 3-4 times more common. The need for hospitalization for trauma to the maxillofacial region in children occurs in approximately 20% of cases. The remaining 80% of patients are treated on an outpatient basis [12, 16, 80, 102, 109].

PLF among children in terms of frequency of occurrence ranks second after purulent-inflammatory diseases of the maxillofacial area and, according to various authors, is about 25% of patients in need of emergency treatment. Among the mechanical injuries of the maxillary bones, up to 90% are fractures of the jaws, of which 95% are mandibular fractures [1-8,25,64,121].

One of the features of PJ in children, in addition to fractures of the "green branch" type, is epiphysiolysis, i.e., the disintegration or resorption of a fragment of the mandible, often the head of the MO. This phenomenon is observed more often in high fractures of the MO of the mandibular dislocation or with displacement of the head of the MO. In such cases, a few months after the injury, X-ray images show complete or partial resorption of the broken head of the MO, followed by the formation of a false joint in this area. The movements of the lower jaw in this case are preserved in full. However, with a wide opening of the mouth, the lower jaw is displaced towards the lesion. If such an injury occurred in a young child, then in a few years he will experience a delay in the longitudinal growth of the lower jaw on the side of the lesion with the corresponding clinical and radiological symptoms [1,6,8,45,66,103].

In addition, one of the features of mandibular fractures in children is the frequent occurrence of "mirror" fractures that occur in the MO area when falling into the chin area [5,23,39,95].

It is generally accepted that LF within the dentition are always open fractures due to rupture of the oral mucosa and periosteum of the bone, fixed and tightly adjacent to the bone of the alveolar process of the LF. At the same time, pathogenic microorganisms can easily penetrate deep into the bone tissue and provoke inflammatory processes and complications [1,5,9,16,18,56,59,68].

Based on the foregoing, it can be concluded that PNJ are extremely common among the pediatric population and their treatment is an urgent problem in modern pediatric maxillofacial surgery. At the same time, an important aspect of solving the problem is the development of a set of preventive measures aimed at reducing the factors that cause traumatic injuries among children. It is also important to carry out sanitary and educational activities among parents and children on safety rules on the roads, kindergartens and schools, as well as when using various rolling devices (electric scooters, skateboards, longboards, cruisers, gyroscooters, etc.) and swings in playgrounds.

1.2. Methods of fragment immobilization in the treatment of mandibular fractures in children

The generally accepted principle of PJ treatment in children is the reposition of bone fragments to their original state and their reliable fixation in the correct position for the entire period of bone tissue consolidation, most often for an average of 21-28 days. This period may vary and depends on many factors, such as the age of the patient, location and type of fracture, etc. Immobilization in children is often performed under general intravenous anesthesia. If the age and condition of the child allows, then the procedure can be performed under local infiltration and conduction anesthesia [18,27,56,112].

The surgeon performs the reposition of fragments manually, based on x-ray images and the position of bite and occlusion, as well as on manual sensations. Fixation of bone fragments in the correct position and ratio is carried out more often by conservative methods, since surgical methods of treatment (osteosynthesis) in childhood are rarely performed and strictly according to indications, due to the fact that additional trauma in the fracture area, especially where the growth zones are located, are extremely undesirable and at the same time there is a high risk of violation of these same zones, with subsequent underdevelopment of the LF [2,4,10,28].

The choice of the method of immobilization of bone fragments of the mandible is the most difficult in childhood due to the characteristics of the growing body of the child. It is determined by the location and nature of the fracture, the age of the child, the presence of a sufficient number of stable teeth on the jaw fragments, the general condition of the child, etc.

Of the conservative methods of treating PJ in children, immobilization with the use of Tigerstedt double-jaw splints is the most frequently used in our Republic and has been used for more than a century. Although the method is easy to use, does not require expensive equipment and material support, it also has a

number of disadvantages. Due to the peculiarities of the structure and anatomical forms of milk teeth, such as the size of the crown part of the tooth, a poorly expressed anatomical neck, physiological tremas and diastemas between milk teeth, with a changeable bite, there are not enough stable teeth to fix the splints with the help of bronze-aluminum ligatures, physiological resorption of the roots occurs milk teeth and more often in children, the formation of the roots of permanent teeth is incomplete. These features are the problem of using Tigerstedt wire splints with hook loops for fixing mandibular bone fragments in children. However, in children over the age of 12-13 years, when there is a permanent bite, orthopedic immobilization methods can be used in the treatment of PJ. In such cases, the use of this method practically does not differ from the methods of treating MF in adults [1,3,9,16,19,22,54].

In case of subperiosteal PNJ in children and in case of PNJ without displacement of bone fragments of the LF and without violation of occlusion, a chin sling individually made of plastic materials with elastic traction to the head cap is used as a method of immobilization. A similar method of fixation is very often used in children under one year of age with TNF without displacement of bone fragments [25,64,89].

In foreign educational and scientific literature, the following methods of immobilization of the jaws with MF in childhood are distinguished (Perry M., Brown A., Banks P., 2015):

1. Direct fixation (osteosynthesis):

- Semi-rigid plates (mini-plates);

- Rigid plates (no compression);

- compression plates;

- delayed screws;

- Absorbable plates and screws.

2. Intermaxillary fixation (IMF):

- Adhesive orthodontic braces;

- Interdental wires (direct, loop, etc.);

Arched tires (Arch bars, Erich arch bar);

IMF screws.

3. External fixation.

4. Other methods (mostly historical or where the use of plates is not available):

transosseous wires;

circumferential (ring) wires;

Piercing spokes (Kirchner spokes).

According to Ali Mohammad Ali Aldheer (2017), an analysis of retrospective studies of Asir Central Hospital in the period from 2011 (July) to 2016 (June) showed that children with MF were treated in 72% of cases with the method of open reduction and fixation of fragments, in 28% of cases with the method closed reduction and fixation of fragments [89,95,98,110,119].

Most often, for the treatment of PJ, when a child has a temporary or removable bite, fixation of bone fragments is carried out using splints-kappa or dentogingival splints individually made of plastic materials. They are made, as a rule, on plaster models in the laboratory. It should be noted that splints made of plastic dental materials can be used only in cases where the VLF is located within the dentition. It can be used at any childhood and the main requirement is the presence of at least 3 stable abutment teeth on the mandibular fragment. In some cases, a splint can be made from self-hardening plastic in the patient's mouth. Individually made of plastic materials, dentogingival splints in children can be used in any type of bite (whether temporary, replaceable or permanent) if they are absent or, for example, there is not enough number of stable abutment teeth on the mandibular fragments. However, when using this method, it makes it difficult to breathe and eat, to conduct individual and professional oral hygiene, and also, under the immobilizing structure due to food residues getting stuck, the state of oral hygiene quickly deteriorates and inflammatory processes develop in periodontal tissues [54,57, 89.96].

In MF in children, when the fracture is localized within the dentition with displacement of bone fragments and the bite is disturbed, the surgeon first repositions the bone fragments manually and temporarily fixes them with wire ligatures. At the next stage, an impression is taken using an alginate impression material, then a model is cast from ordinary plaster and an individual splint is made from special dental polymeric plastic materials [32,38,86,96].

In the case when there is a two-sided MF with fragment displacement, the dentogingival splint individually made of plastic on the LF can be rigidly fixed and connected as a monolithic block with the splint on the HF. Such types of plastic monoblocks with a sling-like headband and an annular rubber traction make it possible to achieve a sufficiently reliable retention of mandibular fragments in the correct bite position. In addition, such immobilizing constructions can be used in the treatment of mandibular fractures located behind the dentition, in case of fractures of the MO, in addition, they can be used with an insufficient number of stable teeth on the mandible [45,46,98,110].

In case of MF in early childhood, as well as in cases where the number of abutment teeth is insufficient or they are absent on one of the fragments of the mandible, immobilization of the mandibular body fracture according to Black or Kilgren is performed. For this type of immobilization, a wire twist suture is used around the body of the mandible and on both sides of the splint from the fracture site. This method requires surgeons to have certain knowledge of the anatomical and topographic location of organs, vessels and nerves, in addition to the skills to perform this type of manipulation [5,8,19].

In permanent occlusion and when there are a sufficient number of abutment teeth on fragments of mandibles, it can be used to immobilize the methods used in adults with MF (using ligature tying of teeth, using a smooth brace, Tigerstedt's double tooth splint with hook loops, etc.). The fixation of such wire aluminum splints to the teeth is carried out using bronze-aluminum ligatures. However, these ligatures are a risk factor for the development of inflammatory processes in

periodontal tissues due to constant trauma to the marginal and papillary parts of the gums. In addition, the sharp ends of the ligatures, each time they are twisted, create a danger of puncturing the surgeon's rubber gloves and often in practice, especially young, inexperienced surgeons injure their hands. This, in turn, increases the risk of contracting dangerous infectious diseases for medical staff, since a large number of patients with MF are admitted during duty and under emergency conditions. In such cases, there is practically no way to check the patient for dangerous infections (hepatitis, HIV, etc.) [15,28,57,68].

The use of single-jaw splints, such as a smooth splint-bracket, is an indication for single mandibles within the dentition and when the fracture is located closer to the midline of the mandible, and also provided that there are at least three supporting stable permanent teeth on a small fragment of the mandible. In case of bilateral mandibular fractures, fractures of the distal parts of the mandibular body, fractures in the area of the mandibular angle and its branch, the indication is double-jaw splinting using Tigerstedt splints with toe loops and intermaxillary rubber traction. In this case, the LF is fixed to the upper jaw in the position of the correct bite. A very important point is to take into account the type of bite that the child had before the injury, since more than 30% of children have bite anomalies [15,19,85].

Surgical methods and methods of treatment of MF in childhood are used extremely rarely than in adults. In addition, each operation performed in children is planned strictly according to the indications due to the presence of a growth zone in some parts of the mandible. In general, the indications for osteosynthesis in childhood in the treatment of PJ can be given as follows: when it is not possible to reposition bone fragments and fix the mandible in the correct position using conservative methods. Such cases are most often observed in fractures of the MO of the mandible with a rather large displacement and distance of the fragments or with dislocation of the head from the fossa of the TMJ, as well as with multiple mandibular sinuses. Than in adults, there are much fewer options for applying methods of osteosynthesis surgery in childhood. The most commonly used wire

bone suture and bone mini plates. In case of fractures of the MO of the mandible, osteosynthesis with a Kirschner wire is often used. In older children with fractures of the body of the mandible, it is also possible to use percutaneous osteosynthesis of the mandible with a Kirschner wire. In children, due to the presence of rudiments of permanent teeth inside the mandibular bone, incomplete formation of tooth roots, the use of extra-osseous titanium mini- or micro plates in many cases is strictly limited [65,68,95].

Currently, in our country and abroad, many clinicians note that conservative treatment methods play an important role in modern traumatology, which are based on the need to create optimal conditions for accelerating the process of osteoregeneration, which contributes to the effective rehabilitation of patients [10, 125]. Preference is given to wire aluminum busbars due to their availability and ease of manufacture.

However, along with the advantages, traditional Tigerstedt bent wire splints have a number of disadvantages: (1) as a result of the oxidation of the splints, the accumulation of food residues, there are difficulties in caring for the hygienic condition of the oral cavity; (2) the need for custom tire manufacturing; (3) in a deep bite, splints interfere with proper closure of the dentition; (4) additional retention points arise; (5) soft tissues are cut through with ligatures and lead to inflammatory processes in periodontal tissues; (6) galvanic currents arise, etc. [78, 101, 106, 125]. After repositioning of the jaw fragments and applying a wire splint, it is not always possible to achieve a strong fixation, since there is a gap up to 23 mm in size between the fragments, which is confirmed by X-ray data [144].

A group of Korean scientists have proposed the use of a minimally invasive treatment using a wing-tire template for the treatment of PNF in children. For intermaxillary immobilization, they used a wing-shaped template 3 mm thick. 3D printed and orthodontic mini screws. According to the authors, the method developed by them has a number of advantages, including the ease of installation of the structure in the oral cavity and its removal, minimal damage to adjacent anatomical structures, such as the rudiments of permanent teeth, since CT data

obtained during the initial diagnostic evaluation do not require further examination [26.30].

The disadvantage of this method is additional expensive equipment (3D printers), as well as orthodontic mini-screws and CT scans for precise planning of the screw insertion site, which also require additional costs and time.

These circumstances explain the interest in the problem of treating such patients. The problems that need to be addressed include: determination of indications for one or another method of treating fractures, depending on a number of anatomical and functional features of the FFS in children, as well as the creation of more reliable devices for fixing fragments and immobilizing the lower jaw. This requires the use of advanced orthopedic splinting techniques with less traumatic and easy-to-perform fixation methods.

Thus, the treatment of children with MF is currently a complex and unresolved problem, and the presence of non-removable devices (braces) in patients during orthopedic treatment further complicates the treatment, making it difficult to perform individual oral hygiene. Violation of the diet, difficulties in caring for the oral cavity, gross violations of tissue trophism, especially periodontal tissues and bones, lack of stability of teeth in childhood - all these are negative aspects of conservative treatment of PLF, which must be eliminated by developing fundamentally new methods of therapy.

1.3. Etiology of complications in mandibular fractures in children

According to the authors, about 97% of patients with traumatic injuries of the bones of the face have PJ and about 40% of these fractures are complicated by various types of inflammatory diseases with varying severity (Lesova I.G., Ammar Basti, 2006). Inflammatory processes of soft or hard tissues in the fracture zone, in turn, affect the rheological, immunological and biochemical properties of blood, and also affect the state of local capillary circulation, which in turn leads to impaired consolidation of bone fragments and reparative regeneration of bone tissue in the fracture zone of the mandible.

There are studies aimed at studying the negative impact of double-jaw splints on periodontal tissues, in which it was concluded that double-jaw splints worsen the state of oral hygiene and lead to inflammatory diseases of the gums. Surgical treatments for PJ are an alternative to the orthopedic method of treatment, however, they can lead to the development of more severe complications, especially in early childhood (Ivanyushko T.P., Gankovskaya L.V., Kovalchuk L.V., 2000).

Possible complications in the treatment of MF in childhood are associated with many factors, such as the child's age, type of fracture, severity, treatment start date, treatment method, child's condition, etc. Often, complications in the treatment of MF in childhood arise due to medical errors at the stages of treatment. An analysis of possible errors and complications in this type of traumatic injuries of the mandible will allow avoiding and not committing them in the further practice of a pediatric maxillofacial surgeon.

The main rule for the use of splinting technology is the manufacture of a splint throughout the entire dentition, since very short splints cannot provide an even distribution of the load on the teeth and a full intermaxillary fixation. Especially with complex double and multiple VLF. A very important next rule is the correct bending of the toe hooks in wire aluminum bars. Very large and disproportionate toe hooks, curved on individual wire teeth splints, injure the gums that are under them, damage the mucous membrane of the lips and cheeks,

can provoke gingivitis of varying severity, lead to deep bedsores. The distance between them also plays an important role, since the very large distance between the hooks also does not allow even distribution of the load on the teeth,

One of the blunders when splinting with Tigerstedt double-jaw splints is that aluminum wire splints are fixed with copper wire. This leads to intense oxidation of two different metals, the appearance of galvanization in the oral cavity and the development of acute necrotizing ulcerative gingivitis in the future. The most alarming thing is that copper and aluminum oxides are aggressive, since they can enter the gastrointestinal tract along with saliva and food, adversely affect its mucous membrane and the body as a whole, especially if the patient has gastrointestinal diseases or ulcers, this can lead to exacerbation of these diseases [45,76,79].

Another point is the presence of sharp protruding ends of the wire teeth splints, not fixed with bronze-aluminum ligatures, which injure the buccal mucosa and gums. Patients may not notice this if the lower alveolar nerve is damaged, when numbness of the lips and chin occurs. Since, MF in the area of the body is sometimes accompanied by injury to the lower alveolar nerve, which causes anesthesia of half of the LF on the side of the injury. When conducting an operative method for the treatment of MF in childhood, medical errors are associated with the wrong choice of localization of the fixator. The optimal location is the alveolar region, where tensile strains are greater. According to many researchers and practicing surgeons, from the standpoint of biomechanics, this place is the most optimal [64,55,101].

In surgical practice, in the treatment of PLF, the use of double-jawed Tigerstedt splints with the imposition of rubber bands is resorted to due to their availability and ease of use of this method of immobilization. The presence of bronze-aluminum fixing ligatures in the space between the teeth, the uncontrolled pressure of the rubber bands, as a rule, have an excessive and adverse effect on the tissues of the periodontal complex, followed by the development of inflammatory diseases in the tissues [40,80,97].

The design immobilizing fragments of bone fragments of the LF makes it difficult to carry out individual and professional hygiene behind the oral cavity, contributes to the accumulation of dental deposits and food debris in them, thereby the growth and reproduction of pathogenic microorganisms in the oral cavity during the treatment of PN in childhood [65,98,113].

According to the results of studies by L.V. Pobozheva (2012), it was found that the use of immobilization with the help of Tigerstedt's double-jaw splints with toe loops when the state of oral hygiene in a patient with MF is unsatisfactory, will lead to the development of complications in the form of inflammatory processes in the tissues of the periodontal complex in such patients. patients with healthy periodontium, and also provokes the aggravation of the clinical picture of such patients with pathology of periodontal tissues. Moreover, these processes can be observed not only when the tires are removed, but also during the examination, about a month after the removal of the immobilizing structures.

1.4 Role of biochemical markers of bone formation and remodeling rate in assessing bone metabolism

Mechanical trauma is a powerful stress factor that causes changes not only in the musculoskeletal system, but also in other organs and tissues. The study of hormonal regulation of proliferation, differentiation of bone tissue cells, mineralization of the main substance in MF is an urgent and little-studied problem (Khvostova S.A., Sveshnikov K.A., 2008).

In recent years, scientists from different countries for the diagnosis and assessment of the state of bone metabolism are increasingly and actively developing new biochemical and immunological research methods that allow to give an adequate and complete characterization of the quality of formation, remodeling and resorption of bone tissue in injuries, in particular fractures. The biochemical criteria that determine the state of bone tissue remodeling include alkaline phosphatase (AP), osteocalcin (OC), calcitonin (CT) and other substances (Marchenkova O.N., 2005).

Osteocalcin is one of the informative biochemical markers that determine the formation of bone tissue and the rate of remodeling. It is considered a specific marker of reparative osteoregeneration and bone formation in humans.

The literature contains data on the value of the OC level, which can be used to predict the state of bone tissue formation, the effectiveness of correction and prevention of bone formation disorders in children. Currently available publications, according to the assessment of the level of OC in the blood serum in children, are ambiguous and this is primarily due to a significant variation in individual OC values (Scheplyagina L.A., Moiseeva T.Yu., Marchenko T.K., etc., 2011).

The strength of the bones of the child's body and the rate of Ca metabolism in the child's body largely depend on the degree of activity of calcium-regulating hormones. Among these regulators of Ca metabolism, parathyroid hormone (PTH), which is produced by special cells accumulated in the parenchyma of the parathyroid glands, is of the greatest importance. Given the ability of PTH to

control calcium-phosphorus metabolism, it can be considered a marker of bone remodeling.

PTH, together with vitamin D and CT, is the most important regulatory factor in the body of Ca and P homeostasis, which ensures the metabolism of minerals (Marchenkova O.N., 2015).

It is known that the endocrine system plays an important role in reparative osteoregeneration in the human body; in addition, it determines the rate and nature of the course of osteogenesis. Numerous studies have established that the hormones PTH and cortisol have the most active influence on bone metabolism in the body.

In acute and chronic stress conditions, the human body produces and releases cortisol into the blood, and hence its name as the “stress hormone”. Studies have shown that the hormone cortisol prevents the absorption of calcium from the intestines into the blood. This, in turn, affects the state of reparative osteoregeneration and plays an important role in the treatment of PLF, especially in children.

According to the results of the research carried out by Artyushkevich A.S. (2016) it was proved that with MF before immobilization, there is an increase in the serum content of PTH by 2 times and cortisol by 2.5 times. An increase in the concentration of PTH and cortisol in patients with MF indicates that the stress response of the endocrine system in the body not only does not contribute to bone regeneration, but even stimulates osteoporosis (Artyushkevich A.S., 2016). Since, PTH reduces the activity of osteoblasts, thereby reducing the concentration of calcitonin and osteocalcin. An increase in the concentration of cortisol in the blood is a risk factor for the development of dental diseases or contributes to their progression (Korenevskaya N.A., Gorodetskaya I.V., 2009).

There is evidence from experimental studies that inflammatory processes in periodontal tissues are accompanied by moderate hypercalcemia with a pronounced imbalance in the content of PTH and calcitonin, as well as a

progressive increase in the activity of alkaline phosphatase in the blood serum of animals (Goldenberg M.V., 2013).

In the available literature, we did not find publications devoted to the study of markers of bone metabolism and calcium regulating hormones in the treatment of MF in children. Although, the study of biochemical markers of bone tissue metabolism in the human body is of great importance for assessing the level of consolidation of jaw bone fragments, as well as the rate and nature of the course of osteogenesis in mandibular fractures in childhood, predicting the nature of fracture healing and the risk of inflammatory complications, as well as to assess the effectiveness of preventive measures.

The above provisions largely determined the purpose and objectives of this scientific study aimed at studying the state of bone metabolism markers, as well as the level of hormones affecting calcium metabolism in the blood in children with MF at different stages of treatment and to give a comparative assessment with different methods of immobilization of the jaws.

1.5 Treatment options for MF in children

The following consumables were used in this research work:

1. Titanium screws for intermaxillary fixation (mini-implants);
2. Composite light-curing filling materials;

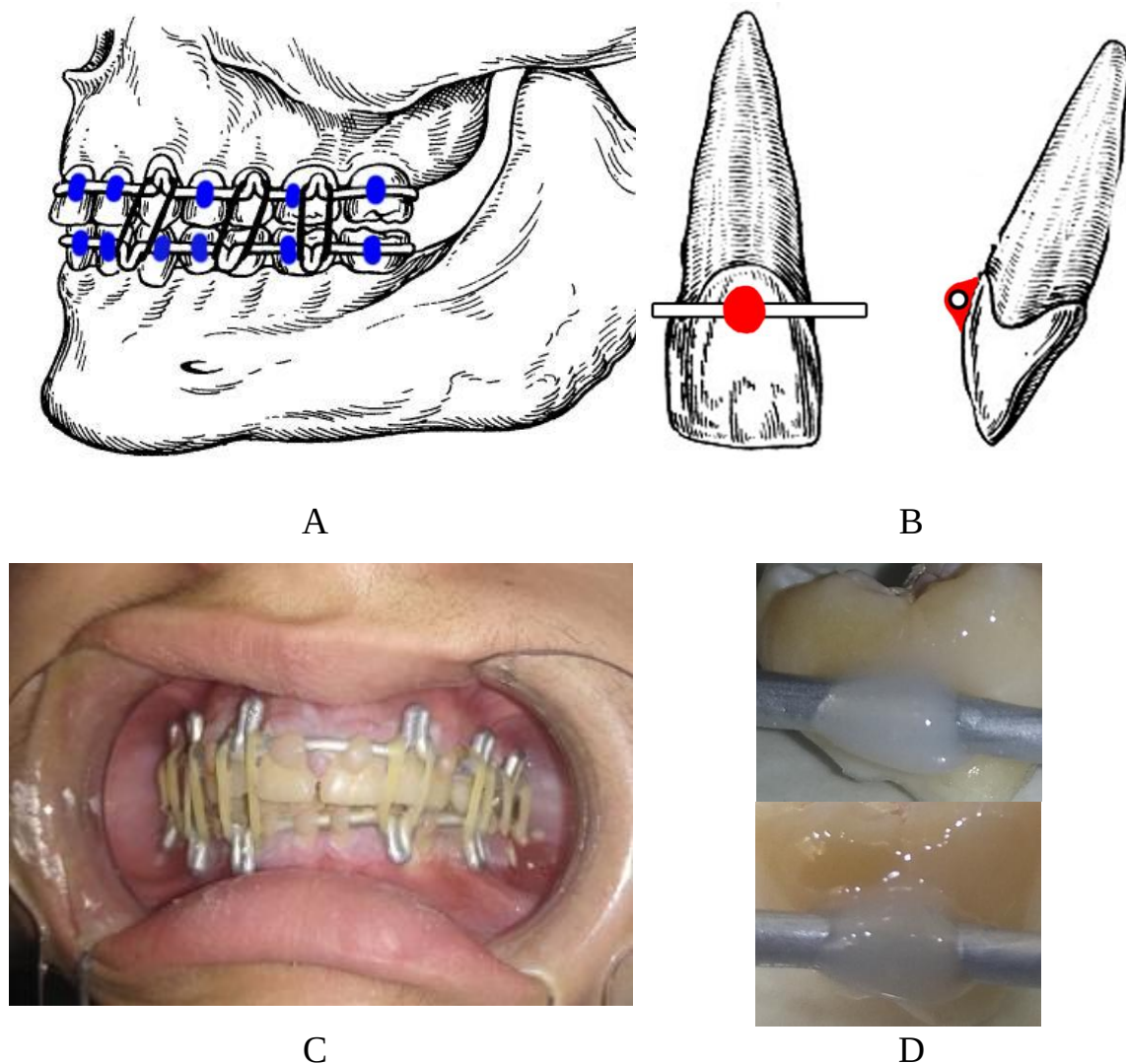
In the treatment of MF in children, the following methods of immobilization of the jaws were used in this work:

1. The traditional method of immobilization using Tigerstedt double-jaw splints. Immobilization was carried out according to the generally accepted method.

2. Immobilization using adhesive technology using light cured composite filling materials Estelite Sigma Quick and Estelite Flow Quick flowable composite.

To implement the method, the cervical part of the enamel of the teeth of the upper and lower jaws, as well as aluminum wire with a diameter of 1.4 mm. with hook loops (made according to the Tigerstedt method) are etched with a special dental etching gel (35% phosphoric acid) for 10 seconds. and completely washed, then isolate the teeth with a rubber dam or cotton rolls, carefully dry the enamel with an air gun and apply a thin layer of adhesive to the surface of the teeth where etching was performed. Polymerization is carried out for 15 seconds. polymerization lamp on each tooth. A thin layer of fluid composite filling material is applied to each tooth of the lower jaw in the area of the applied adhesive, an aluminum wire with hook loops is installed over the applied composite material and polymerized. A macro-filling composite filling material is applied over the aluminum bar on each tooth and evenly distributed so that the material envelops the aluminum wire from all sides, then polymerizes. The wire on the upper jaw is installed in exactly the same way. After fixing both wires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The wire on the

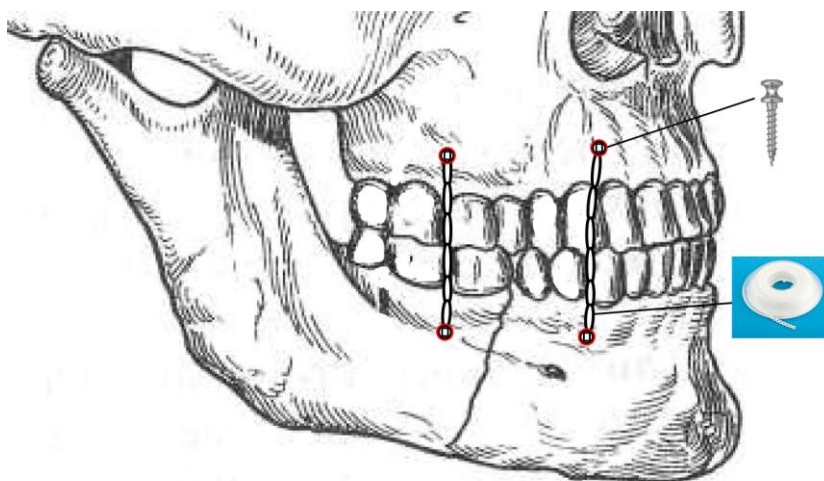
upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole.



Pic.1.5.1 Scheme (A, B) and application (C, D) of immobilization using adhesive technology using composite filling materials

3. Immobilization using mini screws for intermaxillary fixation (intermaxillary suspension).

A set of titanium mini-screws with instruments is designed for intermaxillary immobilization. In our studies, mini-screws with a diameter of 2.0 mm, a length of 9 and 11 mm were used. firms Konmet (Pic. 1.5.2).



Pic. 1.5.2 Scheme (A) and application (B) and immobilization using mini screws

The idea of creating a bony support for immobilization of the jaws with mini-screws in the treatment of MF is currently used in many medical institutions, when mini-screws are used as an immobilization support. Having fulfilled their supporting function, they are easy to remove after use, leaving no trace. Scientific works on the use of mini-screws as supports for intermaxillary fixation in case of MF in children in our country have not been carried out so far.

1.6 Biochemical research methods determination of the content of bone metabolism markers and hormones that affect reparative osteogenesis in children with MF

In our work, the following indicators were chosen as markers for determining bone metabolism in the blood serum of children with PLF: levels of calcium-regulating hormones (parathyroid hormone, calcitonin); the content of bone remodeling marker - osteocalcin, cortisol level, activity of alkaline phosphatase, ionized calcium (Ca^{+2}) and inorganic phosphorus P in the blood.

Serum osteocalcin in our study is a more informative and more reliable marker for determining the activity of osteogenesis in a growing organism. Calcium and phosphorus also play an important key role in the implementation of the basic physiological processes of the body, first of all, they play an important role in the process of osteohistogenesis. Alkaline phosphatase (mainly the bone fraction) plays an important role in the processes of mineralization of the bones of the child's skeleton.

When conducting biochemical studies, the calcium concentration was determined in whole heparinized blood. At the same time, to perform other methods during the study, we used blood serum, which was obtained by centrifugation for 10 minutes at 3000 rpm.

Blood sampling for the study was carried out from the cubital vein strictly in the morning on an empty stomach. All biochemical parameters of bone metabolism were determined by solid-phase chemiluminescent immunoassay on an IMMULITE 2000 automatic analyzer (Siemens Healthcare Diagnostics Inc., USA) using special reagent kits. The following sets of reagents were used to determine the biochemical parameters: the content of parathyroid hormone in blood serum was determined using the Immulite 2000 PTH-Intakt kit (L2KPP6); Calcitonin - using calcitonin kit IMMULITE 2000 (L2KCL2); osteocalcin - using the IMMULITE 2000 osteocalcin reagent kit (L2KON2).

Chapter 2. RETROSPECTIVE ANALYSIS AND CLINICAL ASSESSMENT OF DENTAL STATUS DURING TREATMENT OF PNF IN CHILDREN BY VARIOUS METHODS OF IMMOBILIZATION

2.1 Results of a retrospective analysis of MNV in children

To conduct a retrospective analysis, we analyzed the data on archival materials of the Department of Pediatric Oral and Maxillofacial Surgery of the TSSI clinic for the period 2016-2018. and studied the case histories of 327 sick children with fractures of the lower jaw. The following indicators were studied: the number of discharged patients, the structure and localization of injuries of the maxillary fossa, the number of victims with fractures of the lower jaw, the average bed-day of the victim with fractures of the lower jaw.

In total, we studied 327 case histories of children aged 1 to 18 years who were treated for mandibular fractures.

The proportion of patients with mandibular fractures among the victims during the study period was 49.6%. The average length of stay of the victim in bed is 5.2 days. Among the injuries, fractures of the mandible predominate. Of all types of mandibular fractures, bilateral fractures were registered in 129 cases (39.5%). In 108 cases (33.0%) the fractures were left-sided, in 90 (27.5%) cases right-sided (Table 2.1.1).

Table 2.1.1

The structure of mandibular fractures in children for the period 2016-2018 (n=327)

Type of mandibular fractures	abs	%
Bilateral mandibular fractures	129	39.5%
Left-sided mandibular fractures	108	33.0%
Right-sided mandibular fractures	90	27.5%
Total:	327	100

Various methods have been used to treat mandibular fractures in children. Including, in 270 cases (82.6%), immobilization of the jaws was performed using the Tigerstedt splint, in 15 cases with a smooth splint (bracket) (4.6%), in 39 cases

(11.9%), osteosynthesis was performed, in 3 cases (0.9%) immobilization according to the Ivy method was used (Table 2.1.2).

Table 2.1.2

Treatment of mandibular fractures in children for the period 2016-2018.

(n=327)

Type of treatment	abs	%
Jaw immobilization with Tigerstedt splint	270	82.6%
Immobilization with a smooth splint (bracket)	15	4.6%
Operation osteosynthesis of mandibles	39	11.9%
Ivy honey immobilization	3	0.9%
Total:	327	100

The ratio of patients by sex was as follows: the highest percentage of mandibular fractures in children was recorded in boys - 283 cases (86.6%), and in girls - 44 cases (13.4%). The main causes of fractures are presented in Table.2.1.3.

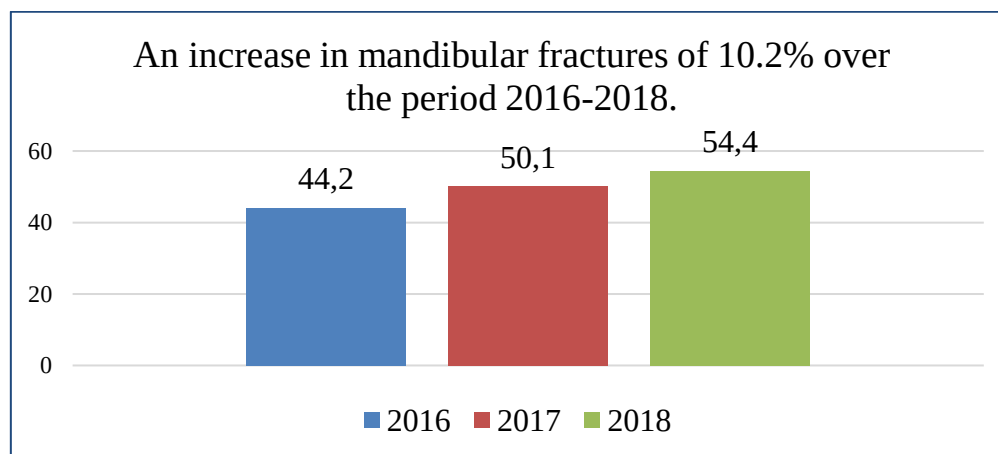
Table 2.1.3

Causes of mandibular fractures in children (n=327)

Accidental injury (fall)	74.6%
Intentional injury (strike)	21.1%
traffic accident	4.3%

It was established that during the studied period, there was a statistically significant increase in mandibular fractures in 10.2% (44.2% in 2016, 50.1% in 2017, 54.4% in 2018) (diagram 2.1.1).

Diagram 2.1.1



The data obtained give an idea of the prevalence and structure of mandibular fractures in children. As can be seen, the largest percentage of patients with mandibular fractures are predominantly boys (86.6%) living in the city. The bulk of these patients are admitted due to accidental injury, due to the high physical activity of boys. It should also be noted that in most cases, in the treatment of mandibular fractures in children, surgical intervention can be dispensed with both in case of unilateral and multiple fractures of the mandible.

Thus, the proportion of affected children with injuries of the maxillofacial area among all patients hospitalized in the department of pediatric maxillofacial surgery of the TSSI clinic over a three-year period was consistently high. Among the injuries of the maxillary fossa, the highest rate was in fractures of the lower jaw (49.6%). There was an increase in 10.2% of affected children with mandibular fractures over the period 2016-2018. which dictates the need to develop measures to improve specialized care and increase the effectiveness of treatment for this category of patients.

2.2. The results of the study of the state of oral hygiene and periodontal tissues in children with PLF

In our work, in the study of the state of hygiene, we assessed the IGFV index, the intensity and prevalence of inflammatory processes in the tissues of the periodontal complex was determined using the PMA index proposed by scientists Massler and Schour, after modified by Parma.

Examination of sick children with MF and children of the control group was carried out in the dynamics of treatment 3 times: before immobilization (upon admission to the department), on the 14th day of immobilization and on the day when the immobilizing structures were removed.

A study was made of the hygiene index according to Federov-Volodkina, the state and prevalence of inflammatory processes (PMA) in the tissues of the periodontal complex in children of all four groups. The control group included practically healthy children without dental diseases - 16 children aged 3 to 18 years. All patients with MF of the 1st, 3rd and 4th groups were recommended a generally accepted oral hygiene regimen using a solution of furatsilin, children of the 2nd group were recommended LISTERINE® “Children's” rinse.

As can be seen from Table 2.2.1 upon admission to the department, children with MF before immobilization, the average values of IGPV in children did not have statistically significant differences, and the obtained values ranged from 1.9 ± 0.09 to 2.2 ± 0.13 points. When comparing the results of the study with the control group, the state of oral hygiene in children with MF was significantly worse ($p < 0.05$).

At the initial admission, upon admission of children to the Department of the Department of Chemistry and Surgery of the TSDI clinic, all children were examined for inflammation of the gums. The results showed that in all sick children with MF the index values are more pronounced than in the control group. There were no clear differences in PI scores between the groups. However, small differences were found compared to the control group (Table 2.2.1).

The study of the state of oral hygiene (IGFV) in the dynamics of treatment

showed that in patients with MNF of the 2nd, 3rd, 4th groups, when examined on the 14th day of immobilization, the increase in IGFW was less significant than in patients with MF of the 1st group. Change in indicators in the first group from 2.2 ± 0.13 to 3.0 ± 0.18 points ($p < 0.001$ at $t = 3.6$), in the second group from 2.0 ± 0.08 to 2.3 ± 0.09 points ($p < 0.01$ at $t = 2.5$), in group 3 2.2 ± 0.05 to 2.6 ± 0.06 points ($p < 0.01$ at $t = 2.5$), in group 4 1.9 ± 0.08 to 2.4 ± 0.09 points ($p < 0.01$ at $t = 2.5$).



Rice. 2.2.1 The state of periodontal tissues before and after the removal of the Tigerstedt splint using LISTERINE® "Children's" and vitamin D on the 21st day after immobilization



Rice. 2.2.2 The state of the periodontal tissues after the removal of the Tigerstedt splint

Table 2.2.1

Comparative analysis of the dynamics of dental indices with various methods of lower jaw immobilization in children with MF

Index	stage number	1 group (n=26)	group 2 (n=24)	group 3 (n=20)	group 4 (n=22)	Control (n=16)
IGFV (score)	1	2.2±0.13	2;0±0.08	1.9±0.09	2.0±0.07	1.75±0.07
	2	3.0±0.18	2.3±0.09	2.4±0.08	2.3±0.06	
	3	3.9±0.19	2.6±0.09	2.5±0.07	2.4±0.08	
RMA (%)	1	25.3±2.39	22.2±1.24	27.2±1.49	27.2±1.49	17.0±1.1
	2	35.8±2.65	27.3±1.61	30.7±1.31	29.7±1.39	
	3	45.1±2.65	35.5±1.55	39.3±1.68	36.1±1.38	
PI (point)	1	0.6±0.04	0.6±0.06	0.5±0.04	0.6±0.03	0.5±0.03
	2	1.1±0.02	0.7±0.03	0.6±0.04	0.7±0.06	
	3	1.4±0.04	0.8±0.07	0.9±0.05	0.8±0.03	

PI during the examination on the 14th day of immobilization in patients of all groups showed further deterioration and amounted to in patients of group 1 with $PLF 1.1 \pm 0.02$ points, in group 2 0.7 ± 0.03 , in group 3 0.6 ± 0.04 and in group 4 0.7 ± 0.06 points.

When examining sick children with MF regarding the removal of immobilizing structures, it was found that in a state of hygiene there is a further deterioration in the level of hygiene in sick children with MF of all groups. Comparison of the state of hygiene during the third examination showed that more unsatisfactory hygiene was in children of the 1st group of patients with PLF, whose immobilization was carried out with the imposition of Tigerstedt splints - 3.9 ± 0.19 versus 2.6 ± 0.09 (group 2), 2.5 ± 0.08 (group 3) and 2.4 ± 0.07 points (group 4) ($p < 0.01$).



1st day of immobilization



21st day of immobilization

Pic. 2.2.3 Intermaxillary suspension with mini screws

Analysis of the results of PI on the day of removal of immobilizing structures also showed a shift towards deterioration in all groups of patients compared with the initial data. At the same time, higher differences were obtained in patients of group 1 -1.4 ± 0.04 vs. 0.6 ± 0.04 points ($p < 0.01$).

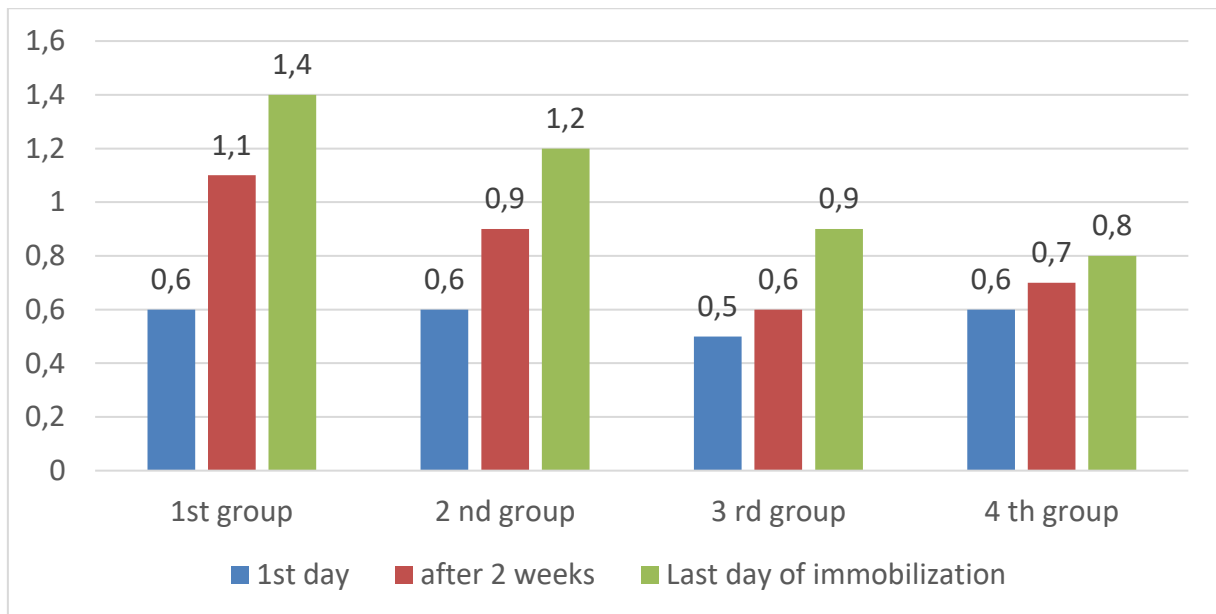


Diagram 2.2.1. Comparative analysis of the dynamics of the periodontal index (PI, AL Russel) with various methods of immobilization of the lower jaw in children with MF

The study during the study of the severity of inflammation in the tissues of the periodontal complex in the dynamics of treatment using various methods of immobilization showed that inflammation in the dynamics of treatment increases, and reaches its maximum in groups 1 and 3 (on the 21st day of immobilization), and in the 4th group on the second study (on the 14th day of immobilization). At the same time, the results at the final stage of the examination showed the lowest percentage values of PMA and were found in patients of groups 2 and 4 - 35.5 ± 1.55 and $36.1 \pm 1.38\%$, respectively ($p < 0.05$).

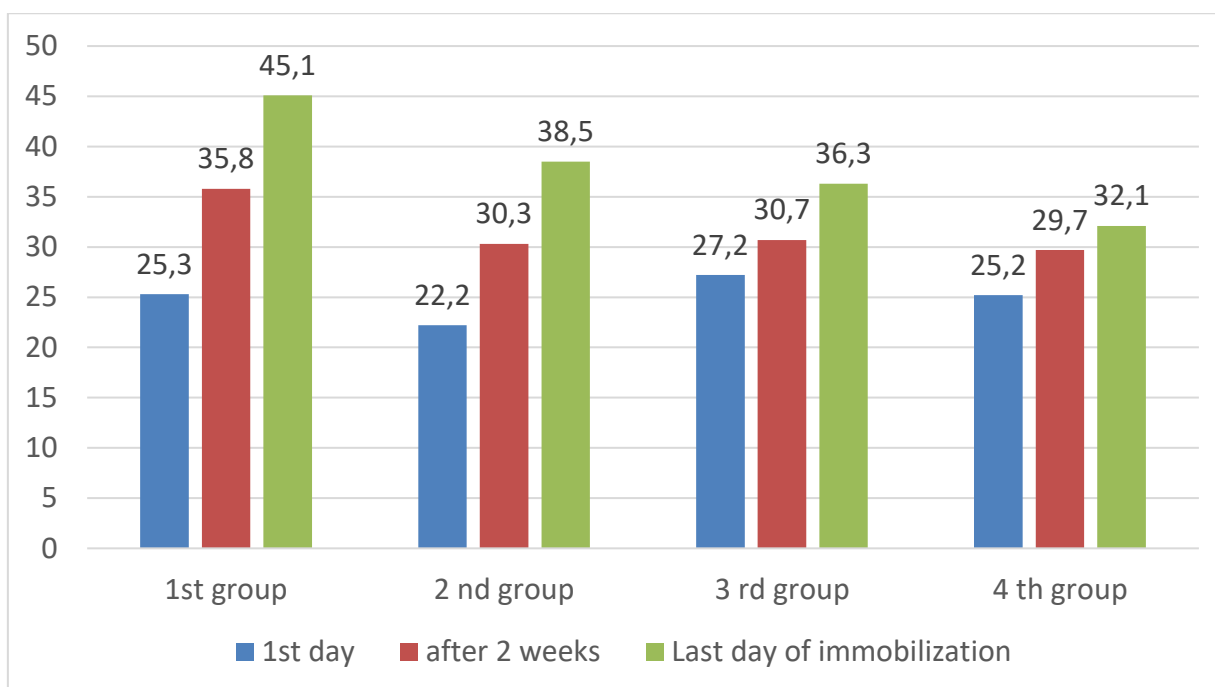


Diagram 2.2.2. Dynamics of RMA with different methods of immobilization

Analysis of changes in the level of oral hygiene, the state of periodontal tissues and the severity of gingival inflammation (Table 2.2.1) relative to the initial values (in %) showed the advantages of the methods used in groups 3 and 4, as well as immobilization with Tigerstedt splints using LISTERINE® rinse "Children's" and vitamin D (group 2) before the traditional method of immobilization with Tigerstedt splints (group 1).

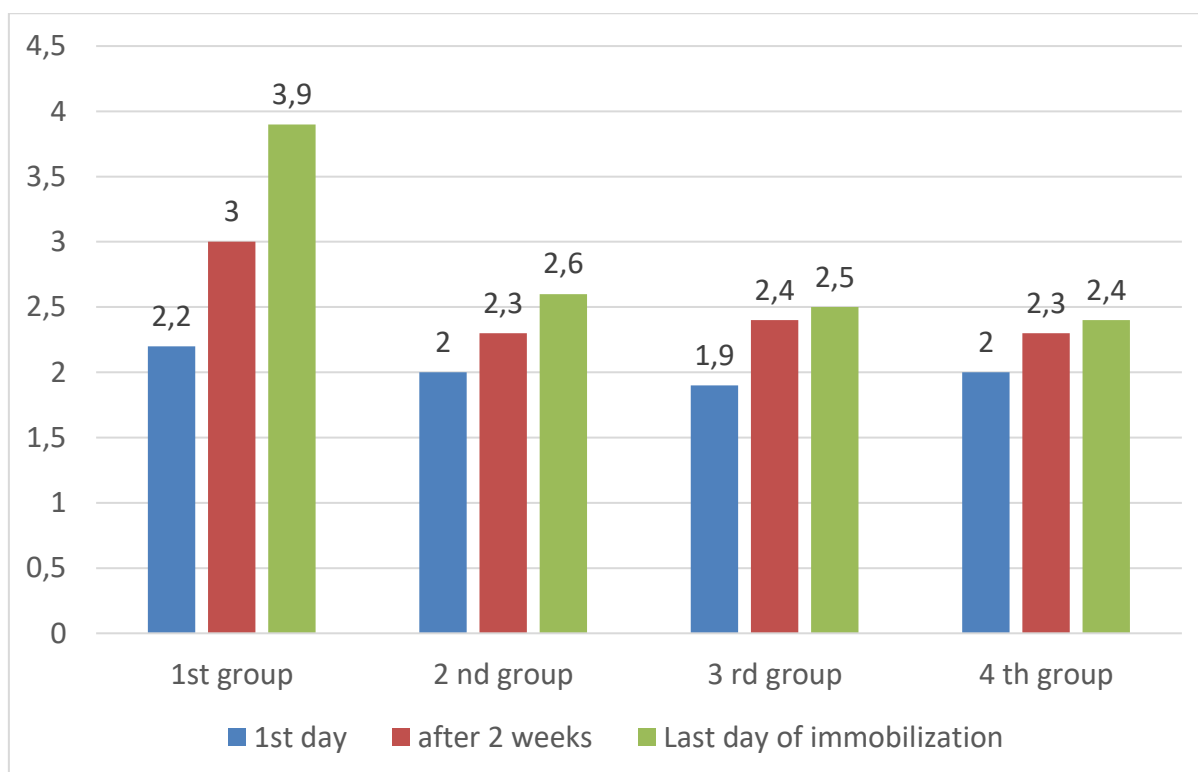


Diagram 2.2.3. Dynamics of IGFV with different methods of immobilization

Analysis of the results obtained in the study of IGFV in group 1 on the 14th day of immobilization in children with MF increased by 40%, in groups - in groups 2, 3 and 4, the values of IGFV were, respectively, 18, 26 and 15%. On day 21, the increase in the values of IGFV was already 74, 37, 46 and 30%. The dynamics of the PMA index was also similar and in group 1, when determining the PMA index on the 14th day of immobilization, the indicator increased several times by 42% from the initial initial value during the initial examination. In the groups of children with INF 2, 3 and 4 - by 32, 37 and 22%. On the day when the immobilizing structures were removed, the increase in the values of the PMA index in groups 1, 2, 3 and 4 amounted to 76, 57, 49 and 44%, respectively, relative to the initial initial values of the index when examining children with MF during the initial examination.

Chapter 3. CLINICAL AND LABORATORY EVALUATION OF PARODONTAL TISSUES MICROCIRCULATION, BONE TISSUE METABOLISM AND BONE DENSITY DURING MF TREATMENT IN CHILDREN WITH VARIOUS IMMOBILIZATION METHODS

3.1. Comparative assessment of the state of microcirculation of periodontal tissues with various methods of immobilization using laser Doppler flowmetry

During LDF of periodontal tissues in children with intact periodontium, LDF indicators increase due to functional teething (Davidyan O.M., Davreshyan G.K., Kodzhakova F.R. et al.; 2020). Therefore, for a correct comparative assessment, we studied the microcirculation of periodontal tissues in 16 practically healthy children of the corresponding age groups and used them for comparison.

Diagnosis When conducting a study of the state of microcirculation, we used probing the surface tissues of the periodontal complex with laser radiation. In this case, the processing of the laser radiation reflected from the tissue is based on the isolation of the registered laser signal of the Doppler shift from the irradiator, in which the oscillation frequencies of the reflected signal are proportional to the erythrocyte velocity.

We studied such indicators as PM, which by its values represents the effectiveness of LDF, as well as the full diagnostic characteristics of superficial basal perfusion with such a standard deviation and coefficient of variation results.

In the process of analyzing LDFgrams in healthy children with a healthy periodontal complex, the following values of capillary perfusion were established: PM averaged 12.7 in the group of children aged 3-5 years $\pm$ 1.16 c.u., in children 6-12 years old - 13.23 $\pm$ 1.13 c.u., and in children 13-18 years old - 11.84 $\pm$ 1.26 c.u. in table 3.1.

The indicator of microcirculation of tissues of the periodontal complex in the dynamics of treatment decreased in sick children with MF and amounted to 8.8 in the age group of 3-5 years $\pm$ 1.12, in the group of 6-12 years 9.7 $\pm$ 1.15 and in

children 13-18 years old 7.62 ± 1.11 c.u. The PM values obtained in the course of the conducted studies also indicate that in children aged 6-12 years, in comparison with other age groups, healthy children in the control group and children with MF had more active microcirculation ($p < 0.05$).

This can be explained by the fact that in children with MF of this age group, the physiological process of changing milk teeth to permanent teeth is continuously going on. In addition, there is a process of reformation of the tissues of the periodontal complex. In the course of the study, cases were recorded in which a deterioration in the efficiency of microcirculation in sick children with MF was revealed in comparison with healthy children in the control group by 1.2 times in all age groups.

The results of the standard deviation in children with a healthy intact periodontal complex, in the age group of 3-5 years it was - 1.06 ± 0.03 c.u., in children 6-12 years old - 0.94 ± 0.05 c.u., in children 13-18 years old - 1.04 ± 0.06 c.u. Results pindicator of the standard deviation in sick children with MF tended to decrease before the immobilization of fragments and showed the following values: in children aged 3-5 years, the standard deviation was - 0.98 ± 0.04 c.u., in children aged 6-12 years old - 0.78 ± 0.05 c.u., and in children in the age group of 13-18 years old - 0.89 ± 0.06 c.u. At the same time, in sick children with PLF, low values were statistically significant in children in the age groups of 6-12 and 13-18 years ($p < 0.05$). The root-mean-square deviation parameter characterizes a non-constant, variable blood circulation perfusion in the microvasculature of the periodontal complex tissues and, in particular, indicates a decrease in the values in the LDF study of the average modulation in all frequency ranges of capillary blood flow.

Table 3.3.1

Indicators of periodontal microcirculation according to LDF in healthy children and children with MF before immobilization ($M \pm m$) (n=108)

Groups	Age (years)	Index of microcirculation n, c.u.	Standard deviation, c.u.	Coefficient of variation, p.u.	Efficiency of microcirculation n, c.u.
Healthy children (control group)	3-5	12.7 $\pm$ 1.16	1.06 $\pm$ 0.03	6.64 $\pm$ 0.42	1.37 $\pm$ 0.02
	6-12	13.23 $\pm$ 1.13	0.94 $\pm$ 0.05	7.65 $\pm$ 0.44	1.45 $\pm$ 0.07
	13-18	11.84 $\pm$ 1.26	1.04 $\pm$ 0.06	6.95 $\pm$ 0.41	1.39 $\pm$ 0.02
Children with PNF	3-5	8.8 $\pm$ 1.12	0.98 $\pm$ 0.04	8.49 $\pm$ 0.55	1.10 $\pm$ 0.03
	6-12	9.7 $\pm$ 1.15	0.78 $\pm$ 0.05	9.63 $\pm$ 0.48	1.18 $\pm$ 0.03
	13-18	7.62 $\pm$ 1.11	0.89 $\pm$ 0.06	8.75 $\pm$ 0.38	1.13 $\pm$ 0.04

The coefficient of variation (Kv) in LDF studies of tissues of the periodontal complex in the examined groups of children reflects the general dependence on the modulation of tissue perfusion blood flow, and the results of the value of this indicator, according to our observations, was the highest in children with MF. Vasomotor activity of microvessels in the group of healthy children showed the following values: 6.64% $\pm$ 0.42, 7.65% $\pm$ 0.44, 6.95% $\pm$ 0.41p.u., in the group of sick children with MF - 8.49% $\pm$ 0.55, 9.63% $\pm$ 0.48, 8.75% $\pm$ 0.38 p.u. according to age groups (p<0.05).

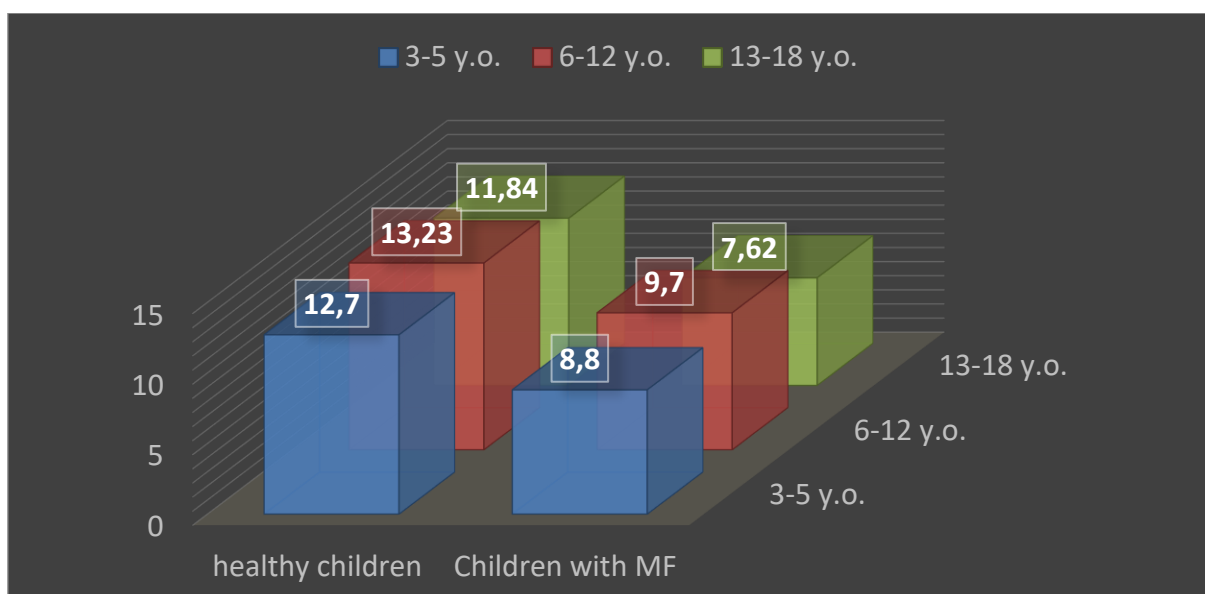


Diagram 3.3.1. Index of periodontal microcirculation according to LDF data in healthy children and children with MF before immobilization ($M \pm m$) ($n=108$)

The dynamics of changes in the parameters of microcirculation of tissues of the periodontal complex according to LDF with different methods of immobilization on the 14th and on the last day of PJ treatment in children of different age groups are presented in tables 3.2 and 3.3.

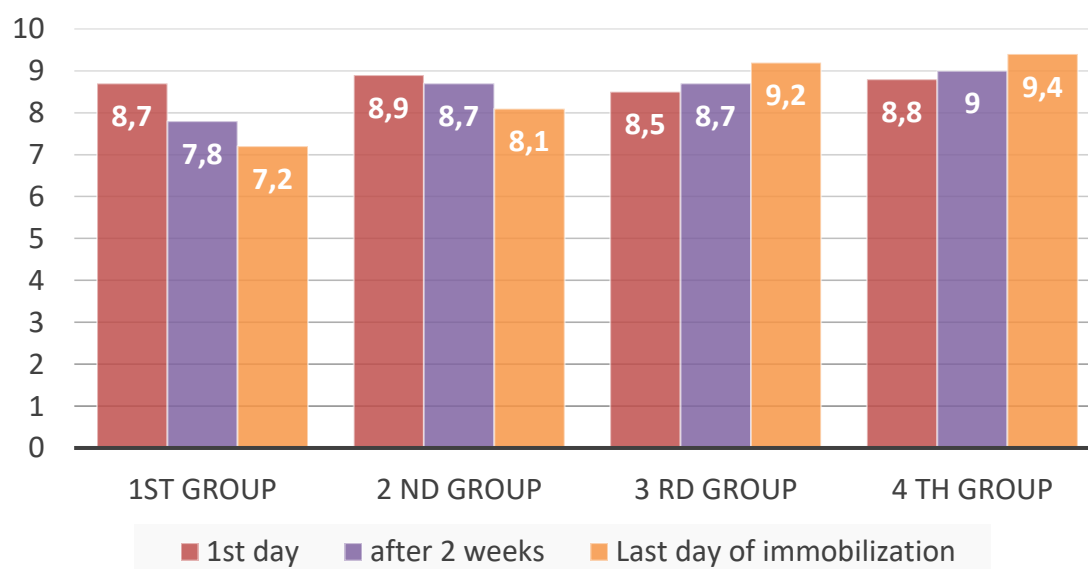


Diagram 3.3.2. Dynamics of indicators of periodontal microcirculation according to LDF in children with MF during treatment with different methods of immobilization

3.2 Comparative analysis of ultrasonic osteometry parameters with different immobilization methods

Studies of the ultrasound conduction of the bone tissue of the mandible in sick children with MF were carried out by measuring the speed and time of passage of ultrasonic vibrations, and they made it possible to quantify the state of the degree of consolidation of fragments of the mandible (Petrenko V.A., Burdin V.V., 2006).

The aim of our study was initially to study the dynamics of changes in the time of passage of ultrasonic vibrations MF during the period of immobilization of fragments in the treatment of MF in children using various methods of immobilization of LF fragments.

Ultrasound osteometry in the treatment of MF in children was performed at an oscillation frequency of 120 ± 36 kHz. The diagnostic head transmitting ultrasonic waves was installed on the distal to the LF fragment, and the receiving one, on the contrary, on the proximal side. The distance between the diagnostic sensors was strictly fixed and amounted to 94 mm.

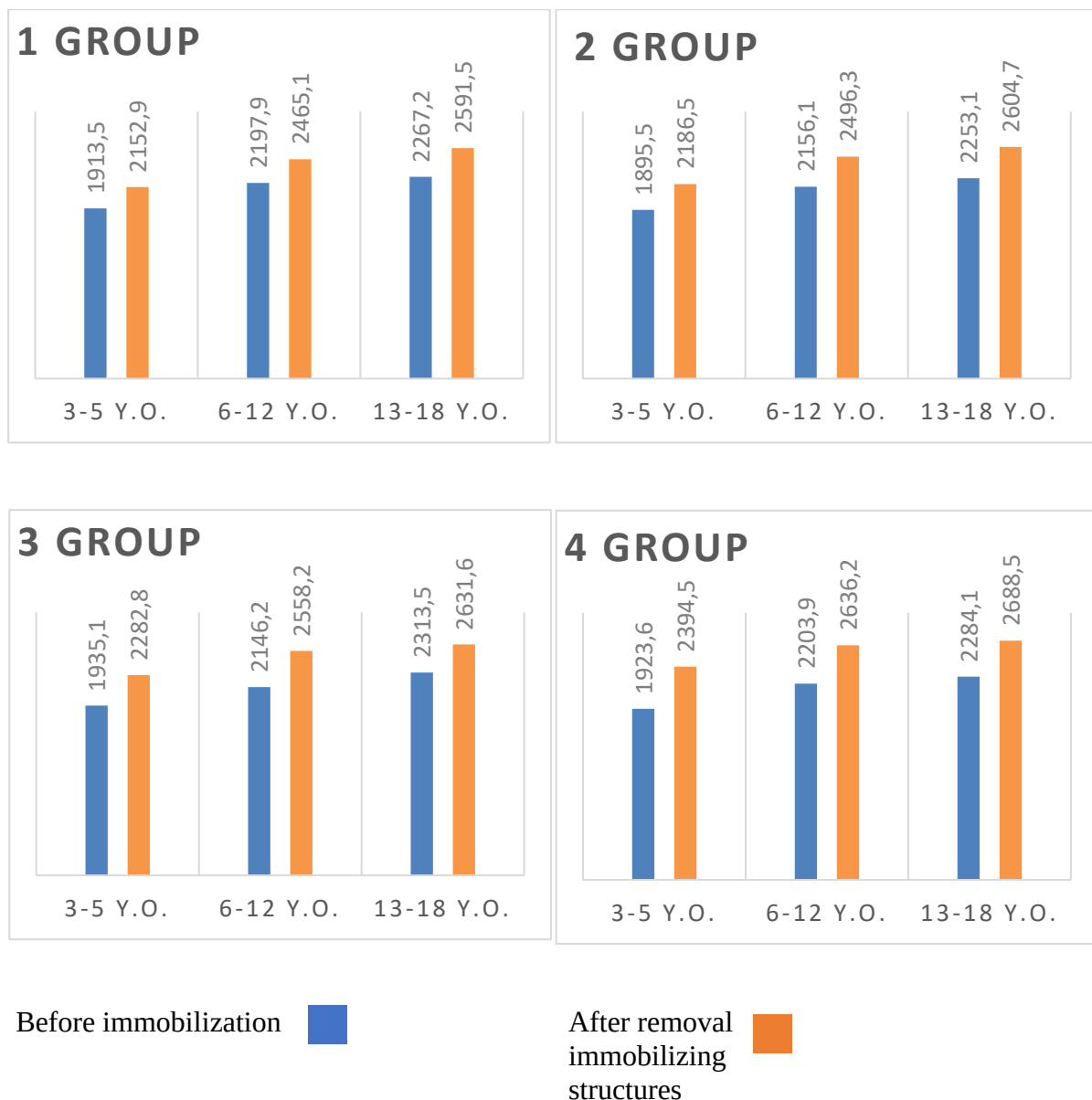
Studies were performed in all groups of sick children with PLF. Measurements were taken before immobilization and after removal of the immobilizing structure, usually 21 days after immobilization.

When comparing the relative bone mineral density in children of the same age group, but with different methods of immobilization, statistically significant differences were revealed when measured in the MLF area.

Table 3.2.1.

Overall average values of ultrasonic osteometry in children with MF using various methods of immobilization (n=92)

Groups	3-5 years		6-12 years old		13-18 years old	
	Before immobilization	After removing imm. feature	Before immobilization	After removing imm. feature	Before immobilization	After removing imm. feature
1 group	31.8±0.7	29.8±0.4	32.8±0.7	29.8±0.4	31.8±0.7	29.8±0.4
2 group	31.7±0.5	26.2±0.2	32.1±0.6	26.2±0.2	31.7±0.5	26.2±0.2
3 group	31.4±0.8	25.1±0.6	31.9±0.6	25.1±0.6	31.4±0.8	25.1±0.6
4 group	31.1±0.6	24.8±0.5	32.2±0.7	24.8±0.5	31.1±0.6	24.8±0.5



Pic. 3.2.1 Overall average values of ultrasonic osteometry in children with MF using various methods of immobilization (n=92)

It was found that the speed and time of passage of ultrasonic oscillations before the start of immobilization in all groups of examined sick children averaged 27.7 ± 0.5 m/sec. ($p < 0.05$). After removal of the fixing structure, the time of passage of ultrasound on the side of the injury in children who were immobilized by the traditional method (Group 1) was longer than in the other groups. In other groups, they were shorter, which indicates a denser bone tissue in the fracture zone in these children.

So, the greater the density of the medium, the faster the ultrasound passes and vice versa, the looser the medium, the slower the sound will pass. Thus, it can

be concluded that when using immobilization methods that help maintain the anatomical and functional integrity of the tissues of the periodontal complex, the risk of inflammatory processes decreases, thereby improving the biochemical parameters of the blood, in particular the state of bone metabolism, which in turn affects the quality and the rate of consolidation of fragments in the treatment of MF in children.

3.3 Comparative analysis of the results of biochemical studies of the blood of children with MF using various methods of immobilization

The study of blood biochemical parameters that affect the process of osteogenesis and play a role in the development of inflammatory processes in periodontal tissues in children with MF in the dynamics of treatment using various methods of immobilization was carried out.

In our work, the following indicators were chosen as markers for determining bone metabolism: the levels of calcium-regulating hormones (parathyroid hormone, calcitonin), the content of bone remodeling marker - osteocalcin, the level of the hormone cortisol, alkaline phosphatase activity, the concentration of ionized calcium and inorganic phosphorus in the blood.

Determination of biochemical parameters of bone tissue metabolism was carried out simultaneously: before the start of treatment, on the 14th day of immobilization and after the removal of immobilizing structures. A total of 232 studies were conducted.

Before immobilization. As a result of the study, it was found that in children aged 3-5 and 6-12 years with MF before immobilization, ALP (217.79 ± 1.73 and 234.22 ± 2.08 U/l) and the level of P (2.03 ± 0.02 and 1.58 ± 0.02 mmol/l) in serum blood counts were much higher than in healthy children of the control group ($p < 0.05$) (Table 1).4.3.1).

The content of OK in children aged 3-5 and 6-12 years old with MF was significantly lower than in healthy children of the same age and amounted to 68.12 ± 1.16 and 83.44 ± 0.51 ng/ml. In general, in children with PLF, the level of TC in the blood serum was below the norm (Table 3.3.1).

When studying the level of ionized Ca in children in the age groups of 3-5 and 6-12 years old with MF before immobilization (as well as on the 14th day of immobilization and after the removal of immobilizing structures), no significant

changes were observed compared with the values of children in the control group ($p < 0.05$).

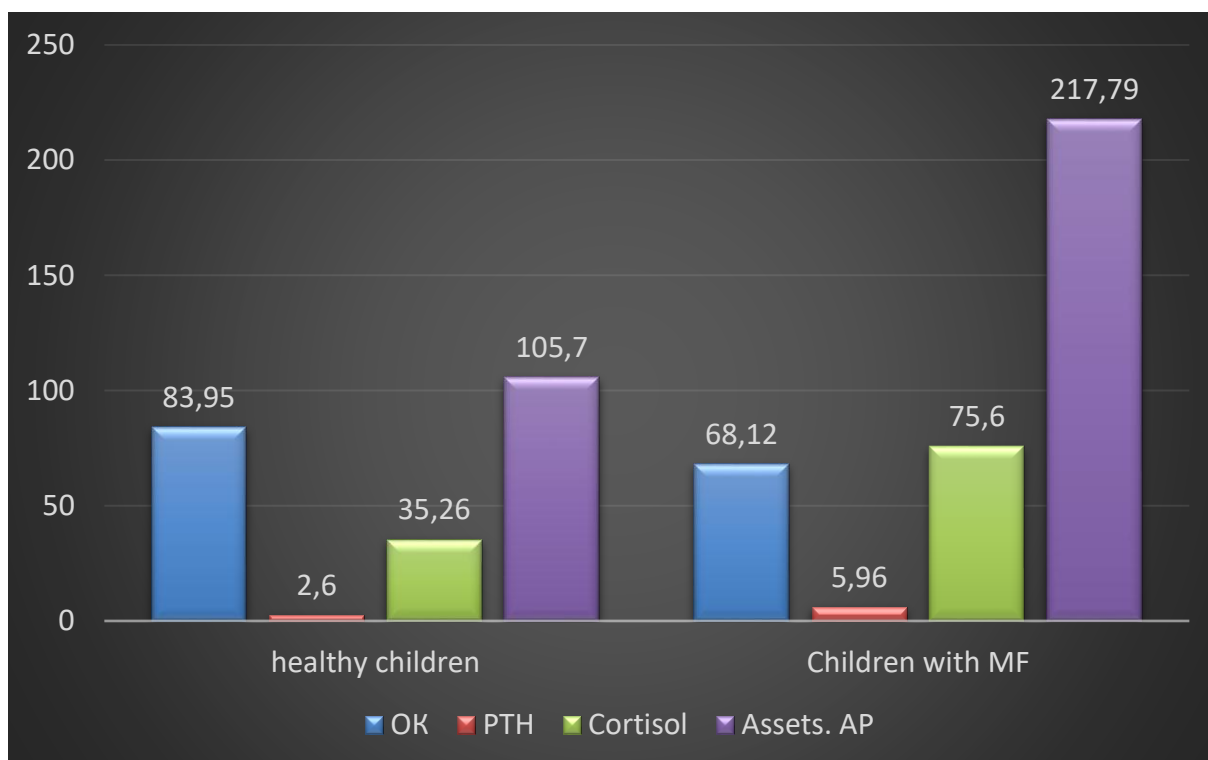


Diagram 3.3.1. Biochemical parameters of blood in healthy children and children with MF before immobilization

In the course of the biochemical studies in the 1st group of sick children who underwent immobilization of bone fragments using the traditional method, the serum level of OC in the older age group was significantly higher than in children aged 3-5 years. The study of the concentration of inorganic phosphorus showed the opposite, in older age groups it showed lower values than in children 3-5 years old ($p < 0.05$). In the group of healthy children in the control group, the same situation was observed as in the groups of sick children with MF (Tables 3.3.1-3.3.3).

A biochemical study of blood serum on the 14th day of immobilization in sick children with MF showed the following: in sick children with MF of the 1st group, who underwent immobilization of fragments by the traditional method in the age groups of 3-5 and 6-12 years, the content of OK in the blood serum showed statistically significant low values in comparison with the values in children of

the other three groups of patients with MF ($p<0.01$) (Table 3.3.2). In addition, the serum concentration of OK in the blood of sick children with MF of the first group, who underwent immobilization of fragments by the traditional method in children in the age group of 6-12 years and in children of groups 2, 3 and 4 in the age group of 3-5 years, decreased compared to with results before immobilization ($p<0.05$) (Table 3.3.2).

In the course of studying ALP in the blood serum of sick children with MF at this stage of immobilization by fragments remained elevated, while there was no difference in the values of ALP between groups of sick children with PLF. In addition, the ALP values were as high as at the stage before the immobilization of mandibular fragments (Table 3.3.2).

The study of the level of ionized calcium in the blood serum of sick children with MF did not change and no statistically significant changes were obtained. However, in sick children with MF in the age group of 3-5 years of groups 2, 3 and 4, the concentration was lower than before the immobilization of fragments and vice versa, in children of this age in group 1, the concentration of ionized calcium in the blood serum was high compared with the results before immobilization of fragments ($p<0.05$) (Table 3.3.2).

In the course of the study of the content of inorganic phosphorus in the blood serum of sick children with MFP of the 1st group in the age group of 3-5 years, high rates were obtained - 1.80 ± 0.05 mmol/l., however, in children of groups 2, 3 and 4, on the contrary, this indicator was lower compared to the results before the immobilization of fragments ($p<0.05$). In addition, in children of groups 2, 3 and 4 of the younger age group, this indicator was significantly lower than in group 1, 1.34 ± 0.02 mmol/l. ($p<0.01$). In children of the older age group, on the contrary, the indicators were significantly higher compared to the results of children who underwent immobilization by the traditional method (Table 3.3.2).

Table 3.3.1.

Biochemical parameters of blood in healthy children and children with mandibular fractures before treatment ($M \pm m$) (n=108)

Groups	Age (years)	OK content, ng/ml	Content of PTH, pg/ml	Cortisol content, nmol/l	Alkaline phosphatase activity, U/l	Ca ²⁺ content, mmol/l	P content, mmol/l
Healthy children (control group)	3-5	83.95 $\pm$ 2.20	2.60 $\pm$ 0.31	35.26 $\pm$ 1.22	105.70 $\pm$ 3.24	1.16 $\pm$ 0.03	1.18 $\pm$ 0.03
	6-12	104.02 $\pm$ 1.80	2.85 $\pm$ 0.24	34.42 $\pm$ 0.91	102.00 $\pm$ 2.56	1.09 $\pm$ 0.02	1.22 $\pm$ 0.02
	13-18	106.3 $\pm$ 2.21	3.21 $\pm$ 0.31	33.21 $\pm$ 1.22	106.90 $\pm$ 3.24	1.01 $\pm$ 0.03	1.26 $\pm$ 0.03
Children with PNF	3-5	68.12 $\pm$ 1.16	5.96 $\pm$ 0.16	75.6 $\pm$ 0.61	217.79 $\pm$ 1.73	1.31 $\pm$ 0.01	2.03 $\pm$ 0.02
	6-12	83.44 $\pm$ 0.51	6.16 $\pm$ 0.09	74.66 $\pm$ 0.48	234.22 $\pm$ 2.08	1.12 $\pm$ 0.02	1.58 $\pm$ 0.02
	13-18	98.61 $\pm$ 0.53	6.24 $\pm$ 0.10	70.13 $\pm$ 0.62	237.81 $\pm$ 1.99	1.18 $\pm$ 0.11	1.82 $\pm$ 0.02

Table 3.3.2.

**Biochemical parameters of blood in children with MF on the 14th day
with different methods of immobilization (M±m), (n=92)**

Groups	Age (years)	OK content, ng/ml	Content of PTH, pg/ml	Cortisol content, nmol/l	Alkaline phosphatase activity, U/l	Ca+2 content, mmol/l	P content, mmol/l
1 group	3-5	57.94±1.43	5.89±0.13	76.1±0.79	208.85±5.99	1.18±0.03	1.80±0.05
	6-12	72.89±0.78	6.35±0.2	75.81±0.97	215.58±1.78	1.19±0.03	1.61±0.03
	13-18	74.11±0.74	6.81±0.21	69.12±1.05	210.12±1.81	1.11±0.02	1.34±0.02
2 group	3-5	72.40±1.43	4.91±0.13	55.21±0.79	209.3±5.99	1.13±0.03	1.82±0.05
	6-12	91.91±0.74	5.45±0.21	52.66±1.05	221.1±1.81	1.22±0.02	1.60±0.02
	13-18	93.51±0.71	4.92±0.22	51.22±1.16	219±2.00	1.15±0.01	1.71±0.01
3 group	3-5	71.13±1.86	4.88±0.22	57.33±0.47	214±1.28	1.07±0.03	1.55±0.03
	6-12	93.91±0.78	5.18±0.24	50.92±0.86	228±1.9	1.21±0.01	1.83±0.01
	13-18	93.15±0.87	4.71±0.21	49.86±0.83	231±2.13	1.23±0.02	1.77±0.02
4 group	3-5	70.2±1.43	4.6±0.13	56.3±0.79	210±5.99	1.17±0.03	1.65±0.05
	6-12	90.6±0.71	4.71±0.22	54.2±1.16	221±2.00	1.23±0.01	1.7±0.01
	13-18	94.5±0.78	4.3±0.24	51.6±0.86	215±1.90	1.13±0.01	1.81±0.01

The results of the analysis of biochemical studies of blood serum in children with CSF on the last day of immobilization of fragments after the removal of immobilizing structures showed that in sick children with CSF of the 1st group in which the immobilization of fragments was carried out by the traditional method of double-jaw splinting, the concentration of OK in the blood serum was still lower than in the children of the other three groups and was 61.71 ± 1.43 ng / ml at the age of 3-5 years, at the age of 6- 12 years old - 77.62 ± 0.78 ng / ml, and at the age of 13-18 years - 80.57 ± 0.83 ng / ml. ($p < 0.01$) (Table 3.3.3). In addition, in children of group 1 who underwent immobilization of fragments by the traditional method of double-jaw splinting the concentration of OK in the blood serum decreased compared to the results before the immobilization of fragments. Analysis of the results of indicators of the concentration of OK in the blood serum in sick children with MNP of the other three groups showed the opposite and did not undergo pronounced deviations. However, in children in the age group of 6-12 years, it turned out to be lower than the value of the same indicator on the 14th day of immobilization of fragments ($p < 0.05$) (Table 3.3.3).

A study on the study of ALP in the blood serum of sick children with MF of all groups and regardless of the age group, the indicator tended to decrease compared to the results obtained at previous stages of the survey, however, the ALP indicator still remained above normal values compared to the indicators of control children groups (Table 3.3.3).

The study of the content of ionized calcium in the blood serum of children with MF varied within the normal range by age, however, in sick children with MF in the age group of 3-5 years of groups 2, 3 and 4, the indicator was lower compared to the results obtained at the stage before immobilization mandibular fragments ($p < 0.05$) (Table 3.3.3).

The study of the content of inorganic phosphorus in the blood serum of sick children with MF in all groups showed that the values of inorganic P values are lower compared to the results obtained at the stage before immobilization and at

the stage of 14 days of immobilization of fragments. However, the values remained above the norm compared with the indicators of children in the control group according to age criteria (Table 3.3.3).

Table 3.3.3.

Biochemical parameters of blood in children with MF on the last day of treatment with different methods of immobilization ($X \pm m$), (n=92)

Groups	Age (years)	OK content, ng/ml	Content of PTH, pg/ml	Cortisol content, nmol/l	Alkaline phosphatase activity, U/l	Ca+2 content, mmol/l	P content, mmol/l
1 group	3-5	61.71 $\pm$ 1.43	6.97 $\pm$ 0.13	79.3 $\pm$ 0.80	181.2 $\pm$ 5.99	1.21 $\pm$ 0.03	1.92 $\pm$ 0.05
	6-12	77.62 $\pm$ 0.78	7.46 $\pm$ 0.20	79.64 $\pm$ 0.96	190.1 $\pm$ 1.65	1.23 $\pm$ 0.03	1.69 $\pm$ 0.03
	13-18	80.57 $\pm$ 0.83	7.93 $\pm$ 0.20	73.4 $\pm$ 1.00	186.4 $\pm$ 1.68	1.19 $\pm$ 0.02	1.46 $\pm$ 0.03
2 group	3-5	77.91 $\pm$ 1.34	5.23 $\pm$ 0.14	56.42 $\pm$ 0.68	176.2 $\pm$ 2.16	1.16 $\pm$ 0.01	1.92 $\pm$ 0.01
	6-12	97.15 $\pm$ 0.60	4.81 $\pm$ 0.15	53.75 $\pm$ 0.63	179.6 $\pm$ 1.86	1.25 $\pm$ 0.01	1.71 $\pm$ 0.03
	13-18	100.14 $\pm$ 0.75	4.23 $\pm$ 0.21	53.04 $\pm$ 1.20	180.1 $\pm$ 2.13	1.23 $\pm$ 0.02	1.82 $\pm$ 0.02
3 group	3-5	79.15 $\pm$ 1.63	4.41 $\pm$ 0.05	55.09 $\pm$ 0.58	149.7 $\pm$ 1.41	1.17 $\pm$ 0.01	1.68 $\pm$ 0.03
	6-12	102.64 $\pm$ 0.78	4.58 $\pm$ 0.11	48.65 $\pm$ 0.40	151.3 $\pm$ 3.20	1.23 $\pm$ 0.01	1.97 $\pm$ 0.02
	13-18	104.25 $\pm$ 1.10	4.03 $\pm$ 0.03	46.93 $\pm$ 0.21	153.4 $\pm$ 2.37	1.26 $\pm$ 0.01	1.89 $\pm$ 0.03
4 group	3-5	82.26 $\pm$ 1.11	3.85 $\pm$ 0.03	52.4 $\pm$ 0.35	130.7 $\pm$ 0.88	1.21 $\pm$ 0.02	1.76 $\pm$ 0.02
	6-12	106.1 $\pm$ 0.68	4.15 $\pm$ 0.07	51.09 $\pm$ 0.35	134.8 $\pm$ 1.07	1.26 $\pm$ 0.01	1.84 $\pm$ 0.03
	13-18	108.8 $\pm$ 0.81	3.88 $\pm$ 0.12	47.84 $\pm$ 0.26	142.2 $\pm$ 1.94	1.19 $\pm$ 0.02	1.96 $\pm$ 0.03

CONCLUSION

According to scientists from all over the world, mechanical injuries of the face and jaws in children occur in 56-79% of cases from domestic injuries, in 5-18% of cases from street injuries, in 3-17% of traffic accidents and about 4-6% of cases from sports injuries (Korsak A.K., 2013). In terms of frequency of occurrence, PNJ are second only to inflammatory diseases and account for 25% of all emergency patients in need of emergency care in hospitals (Semenov M.G., Vasiliev A.B., 2000). According to the authors, TJs occupy the first place among fractures of the bones of the facial skeleton and account for 70-90% of all fractures (Yakubov R.K., Fayziev B.R., 2012). Despite the constant improvement and optimization of the complex treatment of injuries of the maxillofacial area, in particular the mandible, the frequency of complications reaches 10-41% (Magomedgadzhiev B.G., 2008; Mubarkova L.N., 2008; Mirsaeva F.Z., Izosimov A.A., 2009). Currently, among the conservative methods of treating PJ, immobilization with wire splints is widely used in practice. In addition to the advantages, this method has a number of disadvantages, including: an adverse effect on the tissues of the periodontal complex, oral hygiene and a significant decrease in the quality of life of patients, which are often encountered in medical practice. When wearing wire splints attached to the teeth, it is difficult to carry out professional and individual oral hygiene (Lepilin A.V., Erokina N.L. et al., 2008; Medvedev Yu.A., 2012; Zagorsky V.A., 2016; Boymuradov Sh.A., 2016; Zoirov T.E., Bobamuratova D.T., 2019).

All patients were examined in the Department of Pediatric Oral and Maxillofacial Surgery of the TSCI clinic for negotiability. For the period from 2018 to 2020 92 children with mandibular fractures in the area of the body requiring inpatient treatment were examined, including 60 (65.3%) boys and 32 (34.7%) girls. All children were between the ages of 3 and 18.

All children on the day of admission for emergency indications were examined according to the developed scheme: when collecting an anamnesis, they

studied the etiology of the injury, the condition of the child in the next few hours after it was received, and the amount of care provided before hospitalization.

Depending on the method of immobilization of mandibular fragments, all sick children with PJ were divided into 4 groups.

Group 1 - 26 children who were immobilized with Tigerstedt double-jaw splints; group 2 - 24 children who were immobilized with double-jawed Tigerstedt splints using LISTERINE® "Children's" mouthwash and vitamin D;

Group 3 - 20 children who underwent immobilization with dental splints fixed with composite filling materials ("Immobilization method for fractures of the lower jaw in children" (Registration number of an application for a patent for an invention: IAP 2020 0316, Authors: Shomurodov K.E., Musaev Sh.Sh., 07/14/2020)).

group 4 - 22 children who underwent immobilization using orthodontic mini screws; As control values, the results of an extended dispensary examination of 16 children of practically healthy children aged 3-18 years without dental and somatic pathology were used. All examined sick and healthy children were included in the groups by randomization.

Immobilization using adhesive technology using composite filling materials.

To implement the method, the cervical part of the enamel of the teeth of the upper and lower jaws, as well as aluminum wire with a diameter of 1.4 mm. with hook loops (made according to the Tigerstedt method) are etched with a special dental etching gel (35% phosphoric acid) for 10 seconds. and completely washed, then isolate the teeth with a rubber dam or cotton rolls, carefully dry the enamel with an air gun and apply a thin layer of adhesive to the surface of the teeth where etching was performed. Polymerization is carried out for 15 seconds. polymerization lamp on each tooth. A thin layer of fluid composite filling material is applied to each tooth of the lower jaw in the area of the applied adhesive, an aluminum tire with hook loops is installed over the applied composite material and polymerized. A macro-filling composite filling material is applied over the aluminum bar on each tooth and evenly distributed so that the material envelops

the aluminum wire from all sides, then polymerizes. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole.

The mean age of the patients was 9.3 ± 1.6 years. For treatment, only fractures in the body region of the mandible (ICD-10: S02.61) without displacement and with displacement (up to 0.5 cm) were selected. Unilateral fractures were diagnosed in 64 patients (40 boys and 24 girls), bilateral and double fractures in 8 patients (7 boys and 1 girl).

In total, we studied 327 case histories of children aged 1 to 18 years who were treated for mandibular fractures.

The proportion of patients with mandibular fractures among the victims during the study period was 49.6%. The average length of stay of the victim in bed is 5.2 days. Among the injuries, fractures of the mandible predominate. Of all types of mandibular fractures, bilateral fractures were registered in 129 cases (39.5%). In 108 cases (33.0%) the fractures were left-sided, in 90 (27.5%) cases right-sided.

Upon admission to the Department of PCLF, children with MNP had no differences in the IGFV index in sick children with MNP of all groups and the values varied from 1.9 ± 0.09 to 2.2 ± 0.13 points ($p > 0.05$). Comparison of the values of this hygiene index obtained in the course of the study with the values of children in the control group showed that hygiene in sick children with MLF was significantly unsatisfactory ($p < 0.05$). This plays an important role in the treatment and largely determines how the healing will proceed and in what condition, as well as the quality of the consolidation of fragments in PJ. Since local inflammatory processes of periodontal tissues negatively affect the state of microcirculation and rheological properties of blood, in addition, they change the general biochemical parameters of blood. All this, in turn, affects the regeneration of bone tissue to one degree or another.

During the examination at the first stage, all sick children with MF revealed more pronounced inflammation of the gums than in children in the control group. There were no clear differences in PI scores between the groups. However, small differences were found compared to the control group.

When studying in the course of the IGFV study, statistically significant differences were revealed, indicating that in sick children with MFP of the 1st group, the index values are more unsatisfactory than in patients of the other three groups. Change in indicators in the first group from 2.2 ± 0.13 to 3.0 ± 0.18 points ($p < 0.01$), in the second group from 2.0 ± 0.08 to 2.3 ± 0.09 points ($p < 0.01$), in group 3 2.2 ± 0.05 to 2.6 ± 0.06 points ($p < 0.01$), in group 4 1.9 ± 0.08 to 2.4 ± 0.09 points ($p < 0.01$).

The severity of gingival inflammation during immobilization increased and reached its maximum in groups 1 and 3 at the last examination, and in group 4 at the second examination. At the same time, at the last examination in patients of the 2nd and 4th groups, the lowest PMA values were obtained compared to other groups of patients - 35.5 ± 1.55 and $36.1 \pm 1.38\%$, respectively ($p < 0.05$).

An analysis of the data obtained with the help of LDF studies in children of the control group showed the following: PM in the group of children aged 3-5

years was - 12.7 ± 1.16 c.u., in children 6-12 years old - 13.23 ± 1.13 c.u., and in children 13-18 years old - 11.84 ± 1.26 c.u. When comparing the PM tissues of the periodontal complex of sick children with PJ obtained before immobilization with the parameters obtained from the children of the control group, significant changes were revealed, indicating that in children with PJ the state of microcirculation of periodontal tissues in the fracture area is disturbed and in children with PJ in the age group of 3-5 years was 8.8 ± 1.12 , in the group of 6-12 years old - 9.7 ± 1.15 and in children aged 13-18 - 7.62 ± 1.11 c.u. The values obtained in the course of LDF studies indicate a more active microcirculation in periodontal tissues in children in the age group of 6-12 years compared with other age groups of healthy and sick children ($p < 0.05$). This can be explained by the fact that in children with MF of this age group, the physiological process of changing milk teeth to permanent teeth is continuously going on. In addition, there is a process of reformation of the tissues of the periodontal complex. In the course of the study, cases were recorded in which a deterioration in the efficiency of microcirculation in sick children with MF was revealed in comparison with healthy children in the control group by 1.2 times in all age groups.

The results of the standard deviation in children with a healthy intact periodontal complex, in the age group of 3-5 years it was - 1.06 ± 0.03 c.u., in children 6-12 years old - 0.94 ± 0.05 c.u., in children 13-18 years old - 1.04 ± 0.06 c.u. Results pindicator of the standard deviation in sick children with MF tended to decrease before the immobilization of fragments and showed the following values: in children aged 3-5 years, the standard deviation was - 0.98 ± 0.04 c.u., in children aged 6-12 years old - 0.78 ± 0.05 c.u., and in children in the age group of 13-18 years old - 0.89 ± 0.06 c.u. At the same time, in sick children with PLF, low values were statistically significant in children in the age groups of 6-12 and 13-18 years ($p < 0.05$). The root-mean-square deviation parameter characterizes a non-constant, variable blood circulation perfusion in the microvasculature of the periodontal complex tissues and, in particular, indicates a decrease in the values

in the LDF study of the average modulation in all frequency ranges of capillary blood flow.

It was found that the speed and time of passage of ultrasonic oscillations before the start of immobilization in all groups of examined sick children averaged 27.7 ± 0.5 m/sec. ($p < 0.05$). After removal of the fixing structure, the time of passage of ultrasound on the side of the injury in children who were immobilized by the traditional method (Group 1) was longer than in the other groups. In other groups, they were shorter, which indicates a denser bone tissue in the fracture zone in these children.

So, the greater the density of the medium, the faster the ultrasound passes and vice versa, the looser the medium, the slower the sound will pass. Thus, it can be concluded that when using immobilization methods that help maintain the anatomical and functional integrity of the tissues of the periodontal complex, the risk of inflammatory processes decreases, thereby improving the biochemical parameters of the blood, in particular the state of bone metabolism, which in turn affects the quality and the rate of consolidation of fragments in the treatment of PJ in children.

Determination of biochemical parameters of bone tissue metabolism was carried out simultaneously: before the start of treatment, on the 14th day of immobilization and after the removal of immobilizing structures. A total of 232 studies were conducted.

As a result of the study, it was found that in children aged 3-5 and 6-12 years with MF before immobilization, ALP (217.79 ± 1.73 and 234.22 ± 2.08 U/l) and the level of P (2.03 ± 0.02 and 1.58 ± 0.02 mmol/l) in serum blood counts were much higher than in healthy children of the control group ($p < 0.05$). The content of OK in children aged 3-5 and 6-12 years old with MF was significantly lower than in healthy children of the same age and amounted to 68.12 ± 1.16 and 83.44 ± 0.51 ng/ml. In general, in children with PLF, the level of OK in the blood serum was below normal. When studying the level of ionized Ca in children in the age groups of 3-5 and 6-12 years old with MF before immobilization (as well

as on the 14th day of immobilization and after the removal of immobilizing structures), no significant changes were observed compared with the values of children in the control group ($p < 0.05$).

In the course of the biochemical studies in the 1st group of sick children who underwent immobilization of bone fragments using the traditional method, the serum level of OC in the older age group was significantly higher than in children aged 3-5 years. The study of the concentration of inorganic phosphorus showed the opposite, in older age groups it showed lower values than in children 3-5 years old ($p < 0.05$). In the group of healthy children in the control group, the same situation was observed as in the groups of sick children with PLF.

A biochemical study of blood serum on the 14th day of immobilization in sick children with MF showed the following: in sick children with MF of the 1st group, who underwent immobilization of fragments by the traditional method in the age groups of 3-5 and 6-12 years, the content of OK in the blood serum showed statistically significant low values in comparison with the values in children of the other three groups of patients with MF ($p < 0.01$). In addition, the serum concentration of OK in the blood of sick children with MF of the first group, who underwent immobilization of fragments by the traditional method in children in the age group of 6-12 years and in children of groups 2, 3 and 4 in the age group of 3-5 years, decreased compared to with results before immobilization ($p < 0.05$). In the course of studying ALP in the blood serum of sick children with MF at this stage of immobilization by fragments remained elevated, while there was no difference in the values of ALP between groups of sick children with PLF. In addition, the ALP values were as high as at the stage before the immobilization of mandibular fragments.

The study of the level of ionized calcium in the blood serum of sick children with MF did not change and no statistically significant changes were obtained. However, in sick children with MF in the age group of 3-5 years of groups 2, 3 and 4, the concentration was lower than before the immobilization of fragments and vice versa, in children of this age in group 1, the concentration of ionized

calcium in the blood serum was high compared with the results before immobilization of fragments ($p<0.05$).

In the course of the study of the content of inorganic phosphorus in the blood serum of sick children with MFP of the 1st group in the age group of 3-5 years, high rates were obtained - 1.80 ± 0.05 mmol/l., however, in children of groups 2, 3 and 4, on the contrary, this indicator was lower compared to the results before the immobilization of fragments ($p<0.05$). In addition, in children of groups 2, 3 and 4 of the younger age group, this indicator was significantly lower than in group 1, 1.34 ± 0.02 mmol/l. ($p<0.01$). In children of the older age group, on the contrary, the indicators were significantly higher compared to the results of children who underwent immobilization by the traditional method.

The results of the analysis of biochemical studies of blood serum in children with CSF on the last day of immobilization of fragments after the removal of immobilizing structures showed that in sick children with CSF of the 1st group in which the immobilization of fragments was carried out by the traditional method of double-jaw splinting, the concentration of OK in the blood serum was still lower than in the children of the other three groups and was 61.71 ± 1.43 ng / ml at the age of 3-5 years, at the age of 6- 12 years old - 77.62 ± 0.78 ng / ml, and at the age of 13-18 years - 80.57 ± 0.83 ng / ml. ($p<0.01$) (Table 3.5.3). In addition, in children of group 1 who underwent immobilization of fragments by the traditional method of double-jaw splinting the concentration of OK in the blood serum decreased compared to the results before the immobilization of fragments. Analysis of the results of indicators of the concentration of OK in the blood serum in sick children with MNP of the other three groups showed the opposite and did not undergo pronounced deviations. However, in children in the age group of 6-12 years, it turned out to be lower than the value of the same indicator on the 14th day of immobilization of fragments ($p<0.05$).

A study on the study of ALP in the blood serum of sick children with MNP of all groups and regardless of the age group, the indicator tended to decrease

compared to the results obtained at previous stages of the survey, however, the ALP indicator still remained above normal values compared to the indicators of control children groups. The study of the content of ionized calcium in the blood serum of children with MF varied within the normal range by age, however, in sick children with MF in the age group of 3-5 years of groups 2, 3 and 4, the indicator was lower compared to the results obtained at the stage before immobilization mandibular fragments ($p < 0.05$).

The study of the content of inorganic phosphorus in the blood serum of sick children with MF in all groups showed that the values of inorganic P values are lower compared to the results obtained at the stage before immobilization and at the stage of 14 days of immobilization of fragments. However, the values remained above the norm compared with the indicators of children in the control group according to age criteria.

Immobilization using adhesive technology using composite filling materials.

To implement the method, the cervical part of the enamel of the teeth of the upper and lower jaws, as well as aluminum wire with a diameter of 1.4 mm. with hook loops (made according to the Tigerstedt method) are etched with a special dental etching gel (35% phosphoric acid) for 10 seconds. and completely washed, then isolate the teeth with a rubber dam or cotton rolls, carefully dry the enamel with an air gun and apply a thin layer of adhesive to the surface of the teeth where etching was performed. Polymerization is carried out for 15 seconds. polymerization lamp on each tooth. A thin layer of fluid composite filling material is applied to each tooth of the lower jaw in the area of the applied adhesive, an aluminum tire with hook loops is installed over the applied composite material and polymerized. A macro-filling composite filling material is applied over the aluminum bar on each tooth and evenly distributed so that the material envelops the aluminum wire from all sides, then polymerizes. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus,

the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole. The tire on the upper jaw is installed in exactly the same way. After fixing both tires, rubber rings are put on the hook loops, which are cut from an elastic rubber tube 1.5–2 mm thick. Thus, the composite filling material holds the aluminum splint like a collar and attaches it to the teeth without damaging, in particular, the gingival papilla and the circular ligaments of the teeth, and the periodontal complex as a whole.

The analysis of the obtained results allows us to recommend the use of the oral hygiene regimen with the use of LISTERINE® "Children's" mouthwash and vitamin D ("AquaDetrim") in patients with mandibular fractures. This scheme leads to improved hygiene and reduced inflammation in patients with mandibular fractures on the background of immobilization with Tigerstedt splints.

So, the greater the density of the medium, the faster the ultrasound passes and vice versa, the looser the medium, the slower the sound will pass. Thus, it can be concluded that when using immobilization methods that help maintain the anatomical and functional integrity of the tissues of the periodontal complex, the risk of inflammatory processes decreases, thereby improving the biochemical parameters of the blood, in particular the state of bone metabolism, which in turn affects the quality and the rate of consolidation of fragments in the treatment of PJ in children.

BIBLIOGRAPHY

1. Al-Fakih M. A. Historical aspects of the development of methods for the surgical treatment of mandibular fractures // Modern dentistry. – 2012. – T. 2. – C. 22-23.
2. Andreeva V. V., Lyapin V. P. The use of contractubex in the treatment of mandibular fractures in athletes and patients with high aesthetic requirements, taking into account individual anatomical variability. Morphological Almanac named after V.G. Kovesnikov. – 2018. – T. 16, No. 3. – P. 9-15.
3. Artyushkevich AS Dynamics of regional blood circulation and osteogenesis in the surgical treatment of mandibular fractures // Modern Dentistry. – 2015. No. 1 (60). – C. 69-75.
4. Artyushkevich AS Mistakes and complications in the treatment of mandibular fractures // Modern dentistry. – 2016. No. 4 (65). – C. 40-41.
5. Artyushkevich A. S., Al-Fakih M. A. Clinical and radiological assessment of the results of mandibular osteosynthesis using screws and mini-plates // Modern Dentistry. – 2014. No. 2 (59). – C. 69-70.
6. Artyushkevich A. S., Al-Fakih M. A., Tsedik L. V., Shelukhina A. I. Comparative assessment of the strength of the connection of screws with thrust and trapezoidal threads with bone tissue and polyurethane // Modern Dentistry. – 2014. No. 1. – C. 75-76.
7. Artyushkevich A. S., Sakharova E. M., Artyushkevich V. S. The state of the soft tissues of the face, the oral mucosa and the bones of the facial skeleton under various types of external influences // Modern Dentistry. – 2016. No. 1. – C. 22-26.
8. Bayrikov I. M., Fisher I. I., Shukhorova Yu. A., Ablekov A. A., Zhukova E. P. Improving the provision of medical care to patients with mandibular fractures at all stages of rehabilitation // Management of the quality of medical care –2017. No. 1-2. – C. 59-65.
9. Barannik N. G., Ryabokon E. N., Moseiko A. A., Mishchenko O. N., Manukhina L. N., Smirnova I. V. compression-distraction apparatus and

osteotropic preparations // Zaporozhye Medical Journal. – 2010. – T. 12, No. 3. – C. 5-8.

10. Barilo A. S., Furman R. L., Kravchuk P. A. Magnetic laser therapy for injuries of the lower alveolar nerve caused by mandibular fractures. Bulletin of Dentistry. – 2014. No. 2 (87). - C. 32-37.

11. Barilo O. S., Kravchuk P. O., Furman R. L. Photoplethysmographic method for the analysis of microcirculatory disorders in the treatment and diagnostic complex for mandibular fractures // Modern Dentistry. – 2016. No. 5. – C. 31-35.

12. Barilo O. S., Kravchuk P. O., Furman R. L. Microbiological efficacy of using dental splints with antiseptic coating in the treatment of mandibular fractures // Modern Dentistry. – 2016. No. 3. – C. 77-81.

13. Baskakov A.P., Milenin S.V. Prevention of periodontal diseases in patients with jaw immobilization in mandibular fractures // Scientific community of students: Interdisciplinary research: Sat. Art. by mat. LIII Intern. stud. scientific-practical. conf. – 2018. No. 18(53). – C. 30-35.

14. Bakhteeva G. R., Lepilin A. V., Soikher M. G., Bulkin V. A., Mukhina N. M. The course and healing of mandibular fractures accompanied by damage to the branches of the trigeminal nerve // Saratov Journal of Medical Scientific Research . – 2012. – T. 8, No. 2. – C. 399-403.

15. Bezrukov S. G., Kaladze K. N. Clinical and immunological evaluation of the results of the use of bioresonance stimulation in the complex treatment of patients with mandibular fractures // Bulletin of Dentistry. – 2011. No. 3 (76). – C. 41-44.

16. Bezrukov S. G., Roganov G. G. Prevention of traumatic osteomyelitis of the mandible. Bulletin of Dentistry. – 2012. No. 4 (81). - C. 67-71.

17. Bezrukov S. G., Roganov G. G. To the question of the treatment of mandibular fracture // Tauride Medical and Biological Bulletin. – 2014. – T. 17, No. 3 (67). – C. 5-8.

18. Berezhnaya E. S., Latyushina L. S. Influence of local immunotherapy with recombinant IL-1 β on oral mucosal immunity in patients with complicated mandibular fractures // Modern problems of science and education. – 2015. – T.

6. – C. 58.

19. Bobylev N. G., Bobylev A. G., Bobylev D. A., Ladnyuk A. P., Abrosimov S. A., Zaritsky P. V., Berikashvili G. T. Surgical treatment of damage to the condylar process of the mandible and temporomandibular joint // Far Eastern Medical Journal. – 2010. No. 3. – C. 59-63.

20. Boymuradov Sh. A., Bobamuratova D. T. Care of patients with injuries of the maxillofacial region // Electronic innovation bulletin. – 2018. No. 4. – C. 51-58.

21. Bragina V. G., Gorbatoва L. N. Injury of the maxillofacial region in children // Human Ecology. – 2014. No. 2. – C. 20-24.

22. Bragina V. G., Gorbatoва L. N., Demichev A. N. Traumatic injuries of the maxillofacial region in children of the Arkhangelsk region // Pediatric Dentistry and Prevention. – 2011. – T. 10, No. 2 (37). - C. 34-38.

23. Brofman I., Tarchokova E. Influence of orthopedic constructions on the state of periodontal tissues in patients with mandibular fractures // Successes of modern science. – 2017. – T. 2, No. 2. – C. 198-200.

24. Vagapova V. Sh., Mukhametov U. F., Rybalko D. Yu. Comparative characteristics of the results of the use of implants from titanium alloys of various modifications in traumatology and orthopedics // Medical Bulletin of Bashkortostan. – 2012. – T. 7, No. 5. – C. 68-71.

25. Vorobyov A. A., Fomichev E. V., Mikhailchenko D. V., Sargsyan K. A., Dyachenko D. Yu., Gavrikova S. V. Modern methods of mandibular osteosynthesis (analytical review) // Vestnik Volgogradskogo state medical university. – 2017.10.19163/1994-9480-2017-2(62)-8-14 No. 2 (62). - C. 8-14.

26. Gandylyan S. M., Toloyan A. E., Eliseeva E. V. Modern materials for fixation of bone fragments of the facial skeleton // International Student Scientific Bulletin. – 2017. No. 5. – P. 26.

27. Grigorov S. N. Injuries of the facial skeleton: content analysis of treatment methods in the aspect of prevention of complicated course // Bulletin of Problems of Biology and Medicine. – 2010. No. 4. – C. 24-32.

28. Grigorov S. N. Injuries of the facial skull: the structure of injuries and analysis

- of the factors of the complicated course // World of Medicine and Biology. – 2010. – T. 6, No. 4. – C. 172-176.
29. Davydova N. V., Firsova I. V., Suetenkov D. E., Oleinikova N. M. Prevention of traumatic injuries of teeth, soft tissues, jaw bones in children and adolescents // Saratov Journal of Medical Science. – 2011. – T. 7, No. 1. – C. 199-202.
30. Dolgova I. V., Efimov Yu. V., Afanas'eva O. Yu., Malyukov A. V., Mukhin V. N. Innovative technologies in the rehabilitation of patients with mandibular fractures // Volgograd Medical Scientific Journal. – 2011. No. 1. – C. 46-48.
31. Dolgova I. V., Efimov Yu. V., Mukhaev Kh. Kh., Efimova E. Yu. Effectiveness of intraosseous drug infusions in the medical rehabilitation of patients with mandibular fractures // Volgograd Journal of Medical Scientific Research. – 2012. No. 4 (36). – C. 45-46.
32. Dolgova I. V., Efimov Yu. V., Mukhaev Kh. Kh., Efimova E. Yu., Kuvshinnikov A., Aleshanov K. A. Intraosseous drug infusions in the treatment of patients with mandibular fractures (state of the problem) // Dentistry. Medical alphabet. – 2013. – T. 1, No. 1. – C. 42-44.
33. Dolgova I. V., Efimov Yu. V., Mukhaev Kh. Kh., Efimova E. Yu., Kuvshinnikov A. V. The use of intraosseous infusions of 0.03% sodium hypochlorite solution as a pathogenetic means of preventing traumatic osteomyelitis of the lower jaw // Volgograd Medical Scientific Journal. – 2013. No. 1 (37). – C. 47-50.
34. Epifanov S. A., Skuredin V. D., Balin V. N. Endoscopic technologies in the surgical treatment of patients with fractures of the mandibular condyle. N.I. Pirogov. – 2015. – T. 10, No. 1. – C. 18-22.
35. Erokina N. L., Lepilin A. V., Zakharova N. B., Rogatina T. V., Lyapina Ya. A., Prokofieva O. V., Lukashov V. A. The use of cytological studies of periodontal pockets in patients with periodontitis in fractures of the lower jaw to choose the method of immobilization // Saratov Journal of Medical Scientific Research. – 2011. – T. 7, No. 4. – C. 905-909.
36. Erokina N. P., Lepilin A. V., Lyapina Ya. A., Fomin I. V., Rogatina T. V.

Rationale for the choice of immobilization method for mandibular fractures in patients with severe chronic generalized periodontitis // Saratov Scientific Research - medical journal. – 2013. – T. 9, No. 3. – C. 387-389.

37. Efimov Yu. V., Efimova E. Yu., Aleshanov K. A., Stomatov D. V., Telyanova Yu. alphabet. – 2015. – T. 4, No. 22. – C. 30-32.

38. Efimov Yu. V., Stomatov D. V., Efimova E. Yu., Dolgova I. V., Stomatova I. A. Treatment of patients with unilateral mandibular oblique fracture using an optimized wire suture method // Sciences of Europe . – 2018.10.4172/2168 No. 24-1 (24) –C. 38-42.

39. Eshiev A. M. The effectiveness of the treatment of mandibular fractures using the technique of osteosynthesis with bone wound dialysis // Science yesterday, today, tomorrow: Sat. Art. by mother. XXXII intl. scientific-practical. conf. – 2016. – T. No. 3(25). - C. 23-29.

40. Eshiev A. M., Myrzasheva N. M. Innovative methods and technologies for extraoral mandibular osteosynthesis using shape memory alloys and mini-plates // European research. – 2015. No. 9 (10). - C. 84-90.

41. Eshiev A. M., Myrzasheva N. M. Biocomposite preparations and electric vibration massage in the treatment of jaw fractures // Eurasian Union of Scientists. – 2015. No. 8-2 (17). - C. 19-22.

42. Eshiev A. M., Myrzasheva N. M., Eshiev D. A. The use of osteoplastic materials, photodynamic therapy and electrovibromassage in the treatment of fractures and defects of the alveolar processes of the jaws // International scientific review. – 2015. No. 6 (7). - C. 74-80.

43. Eshiev A. M., Egemkulov T. A. Orthopedic methods of treatment of patients with fractures of the mandibular condylar process without clinically detectable and functionally significant displacement. Fundamental research. – 2015. No. 1-6. – C. 1152-1155.

44. Zagorsky V. A., Zagorsky V. V. Biomechanics of splinted implants // Russian Dental Journal. – 2013. No. 2. – C. 4-5.

45. Ivanova M. S., Aleksandrova E. G. Mandibular fractures in children //

Problems of science and education. – 2018. No. 11 (23). - C. 90-92.

46. Iordanishvili A., Samsonov V., Guk V., Soldatova L., Zaborovsky K. The use of adaptive physical culture in the treatment and rehabilitation of patients of older age groups with mandibular fractures // Adaptive physical culture. – 2012. No. 1 (49). – C. 13-15.

47. Kazakova N. V., Averyanov A. A. Traumatic injuries of the maxillofacial region in children at a dental appointment // Collection of articles for a scientific and practical conference dedicated to the 45th anniversary of the clinic.

48. Kaladze KN Immunological evaluation of the results of the use of bioresonance stimulation and the drug Osteogenon in the complex treatment of patients with fractures of the lower jaw // Bulletin of Physiotherapy and Balneology quarterly medical scientific journal. – 2015. – T. 23, No. 3. – C. 52-55.

49. Kaladze K. N., Bezrukov S. G. Peculiarities of mandibular fracture consolidation under the influence of physiopharmatherapy // Bulletin of physiotherapy and balneology quarterly medical scientific journal. – 2015. – T. 23, No. 3. – C. 59-62.

50. Kaladze K. N., Bezrukov S. G., Poleshchuk O. Yu., Romanenko I. G. Immunological rationale for the use of bioresonance stimulation in the complex treatment of patients with mandibular fracture // Bulletin of the Medical Institute "Reaviz": rehabilitation, doctor and health. – 2017. No. 4 (28). – C. 84-89.

51. Karaseva V.V. Orthopedic rehabilitation for an improperly fused fracture of the lower jaw (on the example of a clinical case) // Problems of Dentistry. – 2012. – T. 4. – C. 54-56.

52. Karpov S. M., Christoforando D. Yu., Shevchenko P. P., Sharipov E. M., Abidokova F. A. Epidemiological aspects of maxillofacial trauma on the example of Stavropol // Russian Dental Journal. – 2012. No. 1. – C. 50-51.

53. Kaseinov I. M. Causes of development of traumatic osteomyelitis of the lower jaw // Bulletin of Surgery of Kazakhstan. – 2012. No. 4 (32). – C. 53.

54. Kozlov P. Yu., Brega IN, Chebanenko Yu. Yu. Experience in the treatment of

patients with fractures of the mandibular condylar process // Journal of Siberian Medical Sciences. – 2016. No. Special issue. – C. 10.

55. Korotkikh N. G., Bugrimov D. Yu. Rationale for the use of osteoplastic preparations "Bioplast-Dent" and "Klipdent" in the experiment // Scientific and Medical Bulletin of the Central Chernozem Region. – 2013. No. 52. – C. 200-202.

56. Korotkikh N. G., Bugrimov D. Yu., Larina O. E., Stepanov I. V., Stanislav I. N. The use of titanium structures with nanostructured biocoating in the complex treatment of mandibular fractures // Russian Dental Journal. – 2012. No. 3. – C. 16-18.

57. Korotkikh N. G., Stepanov I. V., Larina O. E., Stanislav I. N. The use of titanium miniplates coated with nanostructured hydroxyapatite in the complex treatment of mandibular fractures. Bulletin of New Medical Technologies. – 2011. – T. 18, No. 2. – C. 356-357.

58. Korotkikh N. G., Stepanov I. V., Stanislav I. N., Larina O. E. Optimization of surgical treatment of mandibular fractures due to computer 3D modeling and the use of nanostructured metal structures. Bulletin of new medical technologies. – 2010. – T. 17, No. 2. – C. 274-275.

59. Korotkikh N. G., Stepanov I. V., Stanislav I. N., Larina O. E. Application of modern computer technologies and materials in the treatment of mandibular fractures // Bulletin of the Smolensk State Medical Academy. – 2010. No. 2. – C. 76-78.

60. Kotov M. A. To the question of the treatment of fractures of the lower jaw // Innovative development of modern science: a collection of articles. – 2014. – C. 46-50.

61. Kulitskaya O. V. Development of a methodology for modeling standardized fractures of different parts of the lower jaw and the study of the features of bone regeneration. Bulletin of Dentistry. – 2015. No. 2 (91). – C. 25-29.

62. Latyushina L. S., Berezhnaya E. S., Dolgushin I. I., Finadeev A. P., Pavlienko Yu. V. Effect of immunotherapy with recombinant IL-1 β on clinical and immunological parameters of patients with complicated mandibular fractures //

Problems of dentistry. – 2017. – T. 13, No. 2. – C. 49-53.

63. Lepilin A. V., Bakhteeva G. R., Nozdrachev V. G., Shikhov M. Yu., Ramazanov A. Kh. Facial Surgery for 2008-2012 // Saratov Journal of Medical Scientific Research. – 2013. – T. 9, No. 3. – C. 425-428.

64. Lepilin A. V., Erokina N. L., Lyapina Ya. A., Prokofieva O. V. Cytomorphological changes in the contents of periodontal pockets in patients with chronic generalized periodontitis with mandibular fractures under the influence of double-jaw tooth splints // Volgograd Journal of Medical Scientific Research . – 2010. No. 3. – C. 36-41.

65. Lepilin A. V., Erokina N. L., Fishchev S. B., Bakhteeva G. R., Rogatina T. V. Analysis of the causes of complications of mandibular fractures // Periodontology. – 2017. No. 3 (84). – C. 60-63.

66. Lepilin A. V., Raigorodsky Yu. M., Bakhteeva G. R., Fedotenkova D. A., Ramazanov A. Kh. The use of electrical nerve stimulation and laser therapy in the treatment of patients with mandibular fractures // Physiotherapy, Balneology and Rehabilitation. – 2014. No. 2. – C. 22-25.

67. Loginov O. A., Savelyev A. L. Modeling of the stress-strain state of the lower jaw during osteosynthesis with extraosseous plates // Bulletin of the Samara State Technical University. Series Physical and Mathematical Sciences. – 2011. No. 4 (25). - C. 169-172.

68. Lyubetsky A. V., Petrovich N. I., Gorbacheva K. A. Multiple combined traumatic injuries of the maxillofacial region in children // Dental Journal. – 2010. No. 3. – C. 250-252.

69. Magomedov T. B., Dobrovolsky G. A., Muzurova L. V., Suetenkov D. E. Age-related variability of the morphometric parameters of the lower jaw in children and youths. Volga region. Medical Sciences. – 2012. No. 2 (22). – C. 3-10.

70. Magradze G. N., Iordanishvili A. K., Bagnenko A. S., Samsonov V. V. Fractures of the condylar process of the lower jaw, their characteristics and treatment // Institute of Dentistry. – 2013. No. 4 (61). - C. 46-49.

71. Magradze G. N., Iordanishvili A. K., Bagnenko A. S., Samsonov V. V. The concept of treatment of patients with fractures of the mandibular condylar process and the algorithm for its practical implementation using modern equipment, instruments and materials // *Khirurgiya* . – 2013. – T. 14. – C. 507-522.
72. Abotaleb BM, Al-Moraissi E., Zhiqiang W., Ping C., Yongjie K., Alkebsi K., Lan Y. A detailed analysis of mandibular fractures epidemiology, treatment and outcomes: A 5-year retrospective study, Gansu Province-China // *Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology*. – 2018. – T. 30, No. 3. – C. 197-205.
73. Adesina O., James O., Olasoji H. UNUSUAL CAUSE OF MANDIBULAR FRACTURE IN A NIGERIAN GIRL // *Pakistan Oral & Dental Journal*. – 2011. – T. 31, No. 2.
74. Afrooz PN, Bykowski MR, James IB, Daniali LN, Clavijo-Alvarez JA The Epidemiology of Mandibular Fractures in the United States, Part 1: A Review of 13,142 Cases from the US National Trauma Data Bank // *J Oral Maxillofac Surg*. – 2015. – T. 73, No. 12. – C. 2361-6.
75. Al Shetawi AH, Lim CA, Singh YK, Portnof JE, Blumberg SM Pediatric Maxillofacial Trauma: A Review of 156 Patients // *J Oral Maxillofac Surg*. – 2016. – T. 74, No. 7. – C. 1420 e1-4.
76. Ali AA, Kabbash MM, Said S., Shoeib MA, Osman MH Use of biodegradable plates and screws in the treatment of pediatric facial bone fractures // *Egyptian Journal of Oral & Maxillofacial Surgery*. – 2016. – T. 7, No. 3. – P. 86-93.
77. Almahdi HM, Higzi MA Maxillofacial fractures among Sudanese children at Khartoum Dental Teaching Hospital // *BMC Res Notes*. – 2016. – T. 9. – C. 120.
78. Al-Moraissi EA, Ellis E. Surgical management of anterior mandibular fractures: a systematic review and meta-analysis // *J Oral Maxillofac Surg*. – 2014. – T. 72, No. 12. – C. 2507 e1-11.
79. Altuntas ZK What are the Differences in Pediatric Mandible Fractures? // *Journal of Aesthetic & Reconstructive Surgery*. – 2017. – T. 03, No. 02.
80. An J., Jia P., Zhang Y., Gong X., Han X., He Y. Application of biodegradable

plates for treating pediatric mandibular fractures // J Craniomaxillofac Surg. – 2015. – T. 43, No. 4. – C. 515-20.

81. Andrade NN, Choradia S., Sriram SG An institutional experience in the management of pediatric mandibular fractures: A study of 74 cases // J Craniomaxillofac Surg. – 2015. – T. 43, No. 7. – C. 995-9.

82. Anita H., Arun K. Management of mandible fractures in pediatric patients // Acta Biomedica Scientia. – 2015. No. 2(4). - C. 173-176.

83. Ansari K., Hamlar D., Ho V., Hilger P., Aziz T. A comparison of anterior vs posterior isolated mandible fractures treated with intermaxillary fixation screws. Archives of facial plastic surgery. – 2011. – T. 13, No. 4. – C. 266-270.

84. Anyanechi CE, Saheeb BD Complications of mandibular fracture: study of the treatment methods in calabar, Nigeria // West Indian Med J. – 2014. – vol. 63, no. 4. – pp. 349-53.

85. Armond ACV, Martins CC, Gloria JCR, Galvao EL, Dos Santos CRR, Falci SGM Influence of third molars in mandibular fractures. Part 2: mandibular condyle-a meta-analysis // Int J Oral Maxillofac Surg. – 2017. – T. 46, No. 6. – C. 730-739.

86. Arvind RJ, Narendar R., Kumar PD, Venkataraman S., Gokulanathan S. Maxillofacial trauma in Tamil Nadu children and adolescents: A retrospective study // Journal of pharmacy & bioallied sciences. – 2013. – V. 5, No. Suppl 1. – C. S33-S35.

87. Atik F., Atac MS, Ozkan A., Kilinc Y., Arslan M. Biomechanical analysis of titanium fixation plates and screws in mandibular angle fractures // Niger J Clin Pract. – 2016. – T. 19, No. 3. – C. 386-90.

88. Balakrishnan R., Ebenezer V. Management of Mandibular Body Fractures in Pediatric Patients // Biomedical and Pharmacology Journal. – 2015. – T. 8, No. october Spl Edition. - C. 369-373.

89. Bede SY, Ismael WK, Al-Assaf D. Patterns of Pediatric Maxillofacial Injuries // J Craniofac Surg. – 2016. – T. 27, no. 3. – C. e271-5.

90. Bhagol A., Singh V., Singhal R. Management of Mandibular Fractures // A

Textbook of Advanced Oral and Maxillofacial Surgery, 2013.

91. Bhardwaj Y., Kumar D. Pediatric Maxillofacial Trauma Outcomes Based on a Survey of 65 Patients: A Prospective Study of Etiology, Incidence and Methods of Treatment // J Maxillofac Oral Surg. – 2015. – T. 14, No. 3. – C. 687-92.
92. Bhola N., Jadhav A., Borle R., Khemka G., Adwani N., Bhattad M. Lateral compression open cap splint with circummandibular wiring for management of pediatric mandibular fractures: a retrospective audit of 10 cases // Oral Maxillofac Surg. – 2014. – T. 18, No. 1. – C. 65-8.
93. Boffano P., Kommers SC, Karagozoglu KH, Gallesio C., Forouzanfar T. Mandibular trauma: a two-centre study // Int J Oral Maxillofac Surg. – 2015. – T. 44, No. 8. – C. 998-1004.
94. Bonfield CM, Naran S., Adetayo OA, Pollack IF, Losee JE Pediatric skull fractures: the need for surgical intervention, characteristics, complications, and outcomes // J Neurosurg Pediatr. – 2014. – T. 14, No. 2. – C. 205-11.
95. Braun TL, Xue AS, Maricevich RS Differences in the Management of Pediatric Facial Trauma // Semin Plast Surg. – 2017. – T. 31, No. 2. – C. 118-122.
96. Bregagnolo LA, Bregagnolo JC, Silveira F. d., Bergamo AL, Santi LN d., Watanabe MG d. C. Oral and maxillofacial trauma in Brazilian children and adolescents // Brazilian dental journal. – 2013. – T. 24, No. 4. – C. 397-401.
97. Butler JS, Dolan RT, Burbridge M., Hurson CJ, O'Byrne JM, McCormack D., Synnott K., Poynton AR The long-term functional outcome of type II odontoid fractures managed non-operatively // Eur Spine J – 2010. – T. 19, No. 10. – C. 1635-42.
98. Chandan S., Halli R., Joshi S., Chhabaria G., Setiya S. Transosseous fixation of pediatric displaced mandibular fractures with polyglactin resorbable suture—a simplified technique // Journal of Craniofacial Surgery. – 2013. – T. 24, No. 6. – C. 2050-2052.
99. Choi KY, Yang JD, Chung HY, Cho BC Current concepts in the mandibular condyle fracture management part I: overview of condylar fracture // Arch Plast Surg. – 2012. – T. 39, No. 4. – C. 291-300.

100. Chrcanovic BR, Abreu MH, Freire-Maia B., Souza LN 1,454 mandibular fractures: a 3-year study in a hospital in Belo Horizonte, Brazil // J Craniomaxillofac Surg. – 2012. – T. 40, No. 2. – C. 116-23.
101. Claudia L., Matilde L., Lucinéia B., Rodolfo O., Roberto P. Infant multiple mandibular fracture: case report // Int. J. Med. Surg. sci. – 2016. – T. 3, No. 2. – C. 823-827.
102. de Alencar Gondim DG, Bessa-Nogueira RV, do Egito Vasconcelos BC, do Amaral MF, Melo AR, Pita-Neto IC, Montagner AM Pediatric facial fractures: case series and critical review // International Archives of Medicine. – 2015. – T. 8, No. 196. – C. 1-6.
103. de Matos FP, Arnez MF, Sverzut CE, Trivellato AE A retrospective study of mandibular fracture in a 40-month period // Int J Oral Maxillofac Surg. – 2010. – T. 39, No. 1. – C. 10-5.
104. Demir E., Erdur O., Kibar E., Elsurur C., Bozkurt MK, Ozturk K., Colpan B. Pediatric mandibular fractures: A retrospective study of 15 patients // British Journal of Oral and Maxillofacial Surgery. – 2016. – T. 54, No. 10. – C. e113-e114.
105. Demirkol M., Demirkol N., Abdo OH, Aras MH A Simplified Way for the Stabilization of Pediatric Mandibular Fracture With an Occlusal Splint // J Craniofac Surg. – 2016. – T. 27, no. 4. – C. e363-4.
106. Desai B. Pediatric Maxillofacial Injuries: Etiology, Diagnosis and Management // Cosmetol & Oro Facial Surg. – 2017. – T. 3, No. 2. – C. e104.
107. Dhiravia E., Ramkumar S., Abraham D. Thermoformed splints in the management of pediatric mandibular fracture-A case report // SRM University Journal of Dental Sciences. – 2010. – T. 1, No. 3. – C. 240-2.
108. Dolas A., Shigli A., Ninawe N., Kalaskar R. Management of Mandibular Fracture in Pediatric Patient Using Vacuum-Formed Splint: A Case Report // Dental Journal of Advance Studies. – 2017. – T. 5, No. 03. – C. 112-115.
109. Dreizin D., Nam AJ, Tirada N., Levin MD, Stein DM, Bodanapally UK, Mirvis SE, Munera F. Multidetector CT of mandibular fractures, reductions, and

- complications: a clinically relevant primer for the radiologist // Radiographics. – 2016. – T. 36, No. 5. – C. 1539-1564.
110. Efimov Y., Stomatov D., Efimova E., Stomatov A., Borodin V. Perspectives of the use of commissure in patients with oblique fractures of the lower jaw // ScienceRise. – 2016. – T. 2, No. 3 (19).
111. El-Anwar M., Salah M., Abdulmonaem G. C-arm-assisted internal fixation of pediatric mandibular fracture // The Egyptian Journal of Otolaryngology. – 2018. – T. 34, No. 2.
112. Elarbi M. Pattern of Mandibular Fracture in West of Libyan Ali Omar Askar Neuro and Spine University Center during Years of 2010-2012: A Retrospective Study // EC Dental Science. – 2017. – T. 7.6. – C. 235-242.
113. El-Saadany WH, Sadakah AA, Hussein MM, Saad KA Evaluation of using ultrasound welding process of biodegradable plates for fixation of pediatric mandibular fractures // Tanta Dental Journal. – 2015. – T. 12. – C. S22-S29.
114. Glazer M., Joshua BZ, Woldenberg Y., Bodner L. Mandibular fractures in children: analysis of 61 cases and review of the literature // Int J Pediatr Otorhinolaryngol. – 2011. – T. 75, No. 1. – C. 62-4.