

Complications in the treatment of mandibular fractures (Literature review)

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<https://doi.org/10.5281/zenodo.5774336>

Abstract: The presented literature review contains publications for the period from 2015-2021, which consider the complications that arise in the treatment of mandibular fractures and modern technologies for the restoration of injuries. Analysis of possible errors and the most typical complications in this type of injury will help to avoid them in the future.

Keywords: fracture of the lower jaw, complications of fractures, treatment.

Introduction Among the injuries of the facial skeleton, the most common are fractures of the lower jaw, which, according to domestic and foreign clinics, range from 70% to 85%. To solve this problem, a significant number of methods and tools are used, but the number of infectious and inflammatory processes in the post-traumatic period continues to be high, which significantly complicates the treatment of victims. (Nishimoto RN. Dodson TB; Dillon JK. 2021; Rozeboom AVJ, Dubois L. 2018; Artyushkevich A. S. 2017)

Scientists and practical dental surgeons are trying to significantly reduce the severity of the operation and the risk of complications in the treatment of patients with a mandibular fracture, using modern tools and methods for this purpose. The issues of developing and improving methods of early diagnosis, treatment and prevention of complications in patients with a mandibular fracture do not lose their relevance.

Traumatic injuries of the maxillofacial region can be accompanied by various complications at the time of the injury (immediate complications), during transportation and at the stages of first or specialized care (early complications), as well as during the treatment of the patient (late complications).

Saratov authors Lepilin A.V., Fishev S. B. idr (2017) consider the development of complications in mandibular fractures, which depend on many factors, including violations of local and general blood supply, neurotrophic disorders and the presence of inflammatory periodontal diseases. At the same time, fractures of the lower jaw and their complications predominate among the fractures of the facial bones, which was 59.5%. In the structure of mandibular fractures that were treated in hospital, bilateral and double fractures prevailed (on average, 28%). At the same time, 18.6% of patients were treated for complications of mandibular fractures, such as suppuration of soft tissues (6.5%), traumatic osteomyelitis and its exacerbation (6.4%), suppuration of a bone wound (4.2%), a false joint and an incorrectly fused fracture (1.5%). A large number of complications of mandibular fractures persisted, despite the young age of the patients (an average of 27 years) and the fact that about half of the patients were treated in the first three days after the injury. The fact that mandibular fractures are the most common pathology, as well as a large number of complications of jaw fractures (on average 18.6%), dictates the need to study the pathogenetic factors of the development of complications to find new methods of their early diagnosis and prevention.

According to many authors, the high number of complications is partly due to the widespread use of surgical methods of treatment in hospital settings, which are used on average in 67% of patients. As a rule, patients with fractures of the lower jaw with dislocation of fragments, requiring surgical treatment, as well as with multiple fractures are referred for inpatient treatment (Vasadze N. 2014; Lepilin A.V. 2017; Madadian MA, Simon S, Messiha A. 2020).

The development of complications in mandibular fractures depends on many factors, and of great importance are local and general blood supply disorders, neurotrophic disorders and the presence of inflammatory periodontal diseases. This requires a comprehensive examination of patients with mandibular fractures and pathogenetic treatment aimed at correcting the identified disorders.

The work of Indian scientists Ravikumar C, Bhoj M. (2019) examines the assessment of postoperative complications of open contraction and internal fixation in the treatment of mandibular fractures in 98 patients who occurred in the postoperative period after treatment with ORIF. Mandibular fractures play a significant role in traumatic brain injury and account for almost 50% of facial fractures. From each group, it was noted that the most common complication is an infection leading to the removal of the plates. Other complications that followed were dechisction wounds, occlusive disorders, and neurological disorders such as paresthesia and facial nerve paralysis. Lower alveolar nerve paresthesia in patients was detected within 3-6 months after surgery. Complications were observed in all age groups, including pediatric and adult patients, and were more common in men than in women. It was also noted that the condyl region had the highest incidence of postoperative complications compared to angular and parasymphysical patients.

The ORIF procedure has gained universal acceptance in the treatment of vestibular fractures; however, it is not without complications. This depends on the clinical picture, surgical assessment of the fracture, etc. features in maxillofacial surgery. ORIF promotes primary bone healing without a long period of intermaxillation and immobilization. Despite a number of advantages associated with this method, patients face complications such as low occlusion, infection, impaired wound healing, paresthesia, FNP, and plate fracture. The most common fracture of the mandibular bone is the condylar fracture, which accounts for 17.5-52% of all mandibular fractures. An open approach to the treatment of condylar fractures is becoming more common, and some of the complications of ORIF in this region are paresthesia, infections, and facial paralysis. Some literature data suggest that infection of maxillofacial fractures is the most common postoperative complication of orifrimandibular fractures, which are associated with the highest risk of infections compared to other maxillofacial interventions.

Violations of regional blood flow lead to the development of complications of mandibular fractures. Thus, during the examination of 60 patients with mandibular fractures, without gross somatic pathology, with a trauma duration of 1-2 days (during the initial and most pronounced reaction of the autonomic nervous system), traumatic stress was detected, which was accompanied by appropriate hemodynamic parameters. The predominance of the influence of the sympathetic division of the autonomic nervous system in these patients was indicated by: systolic (ADp) (145.0 ± 1.5 mm Hg at a norm of 120-124 mm Hg. diastolic pressure (ADp) (86.0 ± 1.2 mm Hg at a rate of 76-80 mm Hg) and pulse pressure (59.0 ± 2.3 mm Hg at a rate of 44.0 ± 2.2 mm Hg). According to the Garkavi lymphocyte-neutrophil index (the average value was 0.28 ± 0.01), 48 of the 60 patients were in a state of stress. The development of stress in patients with mandibular fractures was indicated by the Kerdo vegetative index, calculated on the basis of ADp and heart rate ($+5.50 \pm 0.25$ with a norm of $+2.3 \pm 1.8$), an increase in the Hildebrant index, which was calculated by the ratio of the number of heartbeats. (Bakhteevag. R., Lepilina. V., Soykhern. G. 2012)

Korean scientists (SakongY; Kim YH., Chung KJ. 2021) analyzed the frequency of complications between the Champi technique and the rigid fixation used in the treatment of a mandibular angle fracture. The angle of the lower jaw withstands tension and compression during chewing, and proper internal fixation is essential when a fracture occurs. A retrospective study included patients with a mandibular angle fracture between January 2003 and December 2019. The patients were divided into 2 groups according to the angular fracture fixation method: the Champi method, which uses a single mini-plate, and the rigid fixation, which uses multiple mini-plates, a reconstructive plate, a compression plate, a lag screw, and a wire. Pearson's chi-square test was used to analyze the complication rate. A total of 64 patients met the inclusion criteria. Thirty-four patients had isolated angular fractures, and 30 patients had multiple mandibular fractures. In an isolated angular fracture, there were no significant differences in all complications between the Champi technique group and the rigid fixation group. In multiple mandibular fractures, there were no significant differences in all complications between the 2 groups. For isolated angular fractures, the Champi method is a reliable treatment method. In addition, in the case of multiple fractures of the lower jaw, the Champi method is an effective method of fixation for angular fractures, when appropriate rigid fixation is performed for concomitant fractures.

German scientists Smolka W; Liokatis P; Cornelius CP (2020) present the results of a study evaluating the different pattern of fractures in patients treated with trapezoidal plate fixation of the condylar base and neck fractures using the AOCMF classification system to determine the specific pattern of fractures associated with a violation of trapezoidal plate fixation. Ten patients with fractures of the base of the condyle of the lower jaw and neck underwent internal fixation using trapezoidal plates. Condylar process fractures were classified in according to the AOCMF classification system using computed tomography data. The fracture pattern was compared with complications due to equipment failure, such as loosening of the plate or screw and plate fracture. The weakening of the plates and screws of the trapezoidal plates for fixing the fractures of the base of the condyle and neck was associated with the localization of the fracture in the neck area and the displacement of the main fragment with the loss of contact between the proximal and distal fragments of the fracture. Further research, such as finite element analysis of various coating systems for fixing condyle neck fractures, is needed to establish the optimal technique for fixing condyle neck fractures.

Aloua R. Slimani F; (2020) consider complications of post-traumatic sialocele. Salivary parotid cyst as a complication of the subangular approach of the mandible in a subdilar fracture of the mandible, Iatrogenic sialocele has been described as a complication of parotid surgery, but there are no specific data on cases of surgical damage to the sialocele and salivary ducts in the treatment of condylar fractures. A clinical case is being considered: a 36-year-old man was taken to the emergency department of the maxillofacial region with a fracture of the lower jaw and internal fixation of the fracture of the lower jaw was planned. After the operation, he was found to have a cyst of the salivary gland, which was treated conservatively. Iatrogenic damage to the salivary duct and the formation of sialocele was observed in the postoperative period of surgical treatment of a condyle fracture with subangulomandibular access. Maxillofacial surgeons should be aware of this complication and the importance of taking conservative treatment whenever possible. Botulinum toxin injections can be performed as a first-line treatment for these complications. Conservative treatment in this case was performed by pressing bandages and percutaneous aspiration of the tumor with a needle, which was useful for absorbing the cystic contents and promoting healing.

Numerous studies have established a correlative dependence of the frequency and nature of complications on the location of the fracture. By

it is shown that the most common inflammatory process develops in the fracture of the lower jaw in the area of its angle, which is due to the interposition of the masticatory muscles, which contributes to the gaping of the bone wound and its infection with the contents of the oral cavity (Smolka W; Liokatis P; 2020, Odom EB, Snyder-Warwick AK. 2016).

Complications in the treatment of mandibular condylar fractures: surgical and conservative treatment. The main complications that often affect patients with CT and ORIF were: asymmetry (10.2%/6.4%), residual pain (6.5%/5.6%), temporal and articular imbalances (15.9%/10.3%), and malocclusion (11.1%/4.0%), respectively. The authors found only significant differences between CTR and ORIF in the number of cases of visomandibular joint and joint imbalance and malocclusion. Facial nerve damage was found exclusively among ORIF patients (8.6%) of which 8.3% were temporary and 0.3% permanent. Complications associated with any technique are minimal and rare, resulting in successful outcomes with minimal morbidity. CTR is associated with complications resulting from delayed mobilization leading to functional restriction, while the main complication associated with ORIF treatment was facial nerve damage. Separately, the authors note that the lesions of the facial nerve are manifested in the form of paresis or paralysis of the facial muscles. In addition, there may be both sensitive and vegetative disorders on the face and neck, since the facial nerve is widely anastomosed not only with the trigeminal nerve, but also with the cervical plexus. Paresis of the facial nerve is usually treated conservatively. Recovery of facial muscle function usually occurs 4-6 months after the start of treatment. (García-Guerrero I, Ramírez JM, GómezdeDiego R. 2018)

Madadian MA, Simon S, Messiha A. (2020) the assessment and complications of mandibular condylar fractures treated both surgically and non-surgically are shown. A total of 358 patients were included in the study with an average age of 33 years (average 38), and a male: female ratio of 2.7:1. A total of 72 patients (20%) received conservative treatment, 177 (49%) were treated with a closed method, and 109 (31%) with ORIF. The ORIF group showed better results than the closed group in terms of reducing protrusive and late excessive movements, as well as temporal-mandibular joint pain (TMJ); and in terms of occlusive disorder compared to the conservative group. The ORIF group had poorer outcomes than the closed and conservative interms of maximum mouth opening groups, and temporary facial nerve injury occurred in 5/109 (5%) and condylar resorption in 2/109 (2%) patients in the ORIF group. ORIF treatment may be justified because it provides improved functional results in severe or displaced condylar fractures. However, this should be evaluated with the risk of potential surgical complications. Therefore, careful case selection is necessary to optimize the management of these injuries.

Facial nerve palsy is a serious complication that has been associated with condylar surgery, but recent meta-analyses have shown that the incidence of postoperative temporary facial nerve-associated weakness is about 6%, with complete recovery within six months in most cases. The most common complication was temporal-mandibular joint pain, decreased opening of the mouth opening 16%, and occlusive disorders 32.9%. Other complications that were less frequently observed were mandalular deviation when opening the mouth 5%, reduction of protrusive movement (3%) and asymmetry (1%). Other rare complications were limited to ORIF-managed cases. These include plate fracture 4%, temporary weakness associated with the facial nerve 5%, and condylar resorption 2%.

Due to the wide variety of mandibular fractures, approaches, and surgical methods, it is difficult to objectively compare surgical methods for jaw fractures and their complications. Based on the literature, the authors of Rozeboom AVJ, Dubois L (2018) propose a treatment protocol for open treatment approaches. As for the skin incision, no real preference exists, although submandibular and periangular skin incisions have shown the best results. Subcutaneously, the transparotide approach is recommended, as it is simple, with direct visibility of the fracture and the shortest distance between the skin and the condyle of the lower jaw, and therefore leads to less stretching of the facial nerve. After open reduction and fixation, the parotid capsule is carefully sutured. When the surgeon has a high level of experience, you can use MIS. On the other hand, especially for surgeons with limited experience, it is reasonable to avoid a fracture with a small incision and forced opening of the dissected tissues. In addition, it is recommended to use a neurostimulator during surgery (Nishimoto RN. Dodson TB; Dillon JK. 2021).

Among the possible causes of complications, a number of authors believe that at the first stage of primary medical care, the most common mistakes are the lack of examination of patients with injuries, the lack of a full-fledged X-ray examination. Radiography in different projections allows you to diagnose oblique, transverse, complete, incomplete fractures of different localization, including those localized in the area of the base of the articular process. The conducted X-ray examination in two projections, lateral and frontal, allows not only to establish the fact of a fracture, but also to determine the nature and degree of displacement of bone fragments, the topography of the fracture gap in relation to the teeth, the presence of bone chips, fragments of broken tooth roots, the presence of periapical foci, chronic infections, etc. Radiography in different projections is the most informative, as it allows you to determine the true displacement of fragments in the frontal, sagittal and horizontal planes. The lack of a clear understanding of the position of bone fragments is the most common mistake in choosing a method of fracture treatment, when instead of osteosynthesis, which allows you to openly repose bone fragments under visual control, conventional bimaxillary lamination is used, which does not allow you to accurately compare the fragments when they are displaced. To determine the tactics of surgical treatment, an important step is to perform the correct diagnosis of mandibular fractures, which have their own characteristics depending on the localization, multiplicity, as well as the presence of concomitant injuries. Therefore, at the present stage of development of maxillofacial surgery in the diagnostic algorithm,

such radiation research methods as spiral computed tomography and cone-beam computed tomography have become integral components (Flyer G. M. et al., 2017; Zhang Sh. 2017)

It is also a common mistake to underestimate the importance of temporary transport immobilization of the lower jaw. The practice of many years of treating patients shows that almost all of them are not provided with the proper type of care when they are admitted to the hospital from a polyclinic or district hospital. Temporary immobilization of the jaw at the prehospital stage allows you to immobilize bone fragments, partially reduce pain, reduce the risk of bleeding, reduce infection of the fracture gap and the development of inflammatory complications in the form of suppuration of the bone wound, the development of traumatic osteomyelitis. Errors in the treatment of this category of patients are also found in the provision of specialized care, starting from the wrong choice of treatment method and ending with postoperative treatment. Most often, errors in choosing a treatment method are associated with an underestimation of the state of the dentition, individual teeth, the state of the marginal and apical periodontium, as well as the degree of displacement of bone fragments. An incomplete dentition (there are no teeth on one fragment or there is one tooth) requires osteosynthesis. A severe form of generalized periodontitis also narrows the indications for splinting. Most often, osteosynthesis is performed with a significant displacement of bone fragments. A serious mistake in the orthopedic treatment of symphyseal and parasymphyseal fractures is the use of a smooth splint-brace. Based on the biomechanics of fractures, a smooth splint-brace can only be used for incomplete, functionally stable fractures. This type of splinting does not provide rigid fixation of fragments in functionally unstable fractures. The splint-brace is not able to neutralize the variable compression and tension deformities, as well as the twisting moment of forces in fractures in the chin. This leads to the mobility of fragments and the development of complications in the form of traumatic osteomyelitis and impaired consolidation. When choosing a monoshine in this case, the preference should be given to the lingual or vestibular-lingual tire. An alternative choice is the usual bimxillary lamination (in the presence of full-fledged dentition) (Lepilin A.V. 2017).

Treatment of complications arising from fractures of the lower jaw within the dentition, and the determination of the clinical and immunological effect of the use of recombinant IL-1P in patients with complicated fractures of the lower jaw is considered in the article of the authors (Latyushina L. S., Berezhnaya E. S., Dolgushin I. I. 2017) The use of the immunomodulator "Betaleikin" for the prevention of the transformation of the complicated course of fractures into traumatic osteomyelitis. In patients who were treated with the use of "Betaleukin", regardless of the method of its administration, soft tissue edema was stopped at an earlier time. The overall clinical score in the patients of the comparison group depended on the method of fixation of the fragments and in the group of operated patients was statistically higher than in the orthopedic group. In both main groups, this indicator indicated a more favorable healing of the bone wound. The patients showed an increase in the functional reserve of neutrophils. The study revealed the clinical and immunological effectiveness of local and parenteral use of Betaleukin in patients with complicated mandibular fractures. Recombinant IL-ip in patients of this category contributes to the prevention of the development of traumatic osteomyelitis.

Complications of the use of locking and non-locking plate systems in mandibular fractures are discussed in an article by authors from Mongolia Batbayar EO; Dijkstra PU; Bos RRM; vanMinnen B. (2019) a total of 33 studies (20 randomized studies and 13 non-randomized studies) were included, and 16 of them were included in the meta-analysis. Most of the randomized trials included had an unclear risk of bias (Cochrane Collaboration); the quality of non-randomized studies ranged from 6 to 17 (the methodological index for non-randomized studies is minors). Based on the results of the meta-analysis, the authors concluded that the fixing plates are superior only in terms of the need to fix the lower jaw (MMF) in the early postoperative period.

International research, including countries: Italy, France, Serbia, Estonia, etc. the analysis of complications and outcomes of surgical treatment of angular fractures managed in the departments of maxillofacial surgery in a number of European countries is shown. The study included patients hospitalized with unilateral isolated angular fractures between 2013 and 2017. The following data

were recorded: gender and age of patients, etiology of fractures, presence of the third molar, maxillofacial fixation, osteosynthesis technique and complications. A total of 489 patients were included in the study. It was found that the Champi method is the most frequently chosen method of osteosynthesis. Sixty complications were observed, which was 12.3%. Complications were associated with the absence of third molars ($P < 0.05$). Instead, the Champi technique was associated with fewer complications ($P < 0.05$) compared to other accepted methods. The treatment of angular fractures is still a complex task with a significant level of complications. The Champi technique still seems to be an appropriate option for treating such injuries. (Brucoli M; Boffano P. Pezzana A; et al, 2019)

Mandibular fractures are common facial injuries, and treatment can be complicated by a postoperative infection. The risk of infection as a result of infection with oral flora is well established, but there is no consensus on antibiotic prophylaxis.

Authors Domingo F; Dale E. Gao C. Groves C. (2016) studies assess risk factors and the effect of perioperative antibiotics on the incidence of infection of the surgical site (SSI) after mandibular fracture surgery. A retrospective review of medical records showed patients with injuries of any age who received surgical treatment for mandibular fractures at a Level I Trauma Center from September 2006 to June 2012. An outcome analysis was performed to determine the frequency of SSI associated with perioperative antibiotic use and other risk factors that may contribute to SSI.

A total of 359 patients met the criteria for inclusion in the analysis. 76% were men. The median age was 30.5 years. Thirty-eight patients developed infectious complications (10.6%). The complication rate was lower in closed and open surgeries (3.2% vs. 16.3%, $p=0.0001$) and in closed and open fractures (1% vs. 14%, $p=0.0005$). The frequency of SSI increased in patients with tobacco, alcohol, and drug use (14.6%, 13.2%, 53.6%, $p<0.0001$), traumatic dental injuries (19.6%, $p=0.0110$), and patients in road accidents (12.2%, $p=0.0062$). SSI scores stratified by injury severity score (ISS) less than or equal to 16 (23/255 [9%]) compared to ISS greater than 16 (15/104 [14%]) tended to be more severe injuries in patients with SSI development, $p=0.1347$. The frequency of SSI was similar in patients who received and did not receive postoperative antibiotics (14.7% vs. 9.6%, $p=0.2556$). The type of antibiotic, the duration of postoperative antibiotic administration, and the duration between injury and surgery did not affect the frequency of SSI. The findings suggest that after surgical treatment of mandibular fractures, open surgery, open fractures, and risk factors, including substance abuse, traumatic dental injury, and the mechanism of injury, significantly increase the incidence of infectious complications, while postoperative antibiotics do not appear to provide additional benefits compared to preoperative antibiotics alone.

Thus, incorrectly selected indications for conservative or surgical treatment of a fracture, as well as errors made during treatment, can lead to serious complications. The authors of the studies note that the complications of fractures are associated with various factors and, in particular, the type, severity of the fracture, the duration of assistance to the victims, the quality of treatment, etc. Often, complications arise as a result of medical errors made at the stages of providing assistance to victims. Analysis of possible errors and the most typical complications in this type of injury will help to avoid them in the future. So, the cause of malocclusion is most often an incorrectly chosen method of fracture treatment - orthopedic instead of surgical. Poorly performed reposition and insufficiently reliable fixation of fragments lead to the development of inflammatory complications in the form of traumatic osteomyelitis. Another reason for the development of this complication may be a periodontal tooth in the fracture gap. Insufficient immobilization of the fragments can lead to delayed consolidation, the formation of a false joint. Taking this into account, you can avoid complications by choosing an appropriate treatment method for a specific clinical situation, following all the rules of splinting or performing osteosynthesis.

List of used literature

1. Artyushkevich Alexander Sergeevich Mistakes and complications in the treatment of fractures of the lower jaw // Modern dentistry. 2016. No. 4 (65) – - p. 40-41

2. Bakhteeva G. R., Lepilin A.V., Soyher M. G., Bulkin V. A., Mukhina N. M. The course and healing of fractures of the lower jaw, accompanied by damage to the branches of the trigeminal nerve. 2012. No. 2. pp. 399-403
3. Vasadze N. Bone potentiometric indicators in patients with uncomplicated and complicated forms of mandibular fractures in conservative treatment // Modern dentistry. 2014. No. 1 (70). p. 84
4. Gulyuk A. G., Tashchyan A. E., Gulyuk L. N. Prevention of consolidation complications in mandibular fractures in patients with structural and metabolic changes in bone tissue // Bulletin of Dentistry. 2012. №2 (79).
5. Latyushina L. S., Berezhnaya E. S., Dolgushin I. I., Influence of immunotherapy with recombinant IL-1B on clinical and immunological parameters of patients with complicated fractures of the lower jaw. 2017. No. 2. - p. 49-52
6. Lepilin A.V., Erokina N. L., Prokofieva O. V., Bakhteeva G. R., Rohatina T. V., Lyapina Ya. A. Vegetative reactions in patients with mandibular fractures in the dynamics of traditional treatment // Dental forum. 2011. No. 5. pp. 69-71.
7. Lepilin A.V. Analysis of the causes of complications of mandibular fractures// Periodontology.- 2017. - No. 3. - p. 60-65
8. Lepilin A.V. Clinical and statistical aspects of diagnosis and treatment of patients with lower jaw fractures and their complications. 2014. No. 4. pp. 67-69
9. Timofeev A. A. Prevention of purulent-inflammatory complications in patients with lower jaw fractures //Scientific view of the future, - 2016. - Vol. 7. - № 1 (1). - P. 72-77
10. Uvarova A. G. Immune-oriented therapy for lower jaw fractures in patients with high risk of inflammatory complications // Kuban Scientific medical Bulletin. 2015. No. 1 (150). pp. 119-124
11. Flyer Grigory Mikhailovich Features of the clinical picture of mandibular fractures // A symbol of science. 2016. No. 2-3.
12. Zhang Sh., Petruk Pavel Sergeevich, Medvedev Yu. A. Fractures of the lower jaw in the body and angle: structure, epidemiology, principles of diagnosis. Part I // Russian Journal of Pathology. 2017. No. 2. - p. 100-103
13. Aloua R Slimani F; Salivary parotid cyst as a complication of the subangulomandibular approach of subdilar mandibular fracture: case report. // Ann Med Surg (Lond)] 2020 Dec 01; Vol. 60, pp. 673-674.
14. Batbayar EO; Dijkstra PU; Bos RRM; van Minnen b. Complications of fixing and non-locking plate systems in mandibular fractures // International Journal of Maxillofacial Surgery .- 2019 September; Volume 48 (9), pp. 1213-1226;
15. Brucoli M; Boffano P. Pezzana A; et al., Research project "European angle of the lower jaw": analysis of complications after unilateral angular fractures. // Oral Surg Oral Med Oral Pathol Oral Radiol.- 2019 July; Volume 128 (1), pp. 14-17.
16. Domingo F; Dale E. Gao C. Groves C. Stanley D Single-center retrospective review of postoperative infectious complications in the surgical treatment of mandibular fractures: postoperative antibiotics do not benefit. // J Trauma Acute Care Surg] 2016 Dec; Vol. 81 (6), - pp. 1109-1114
17. Garcia-Guerrero I, Ramirez JM, Gomez de Diego R, Martinez-Gonzalez JM, Poblador MS, Lancho JL. Complications in the treatment of mandibular condyle fractures: surgical and conservative treatment. //Ann Anat. 2018 Mar;216:60-68
18. Madadian M. A., Simon S., Messikha A. Changing trends in the treatment of condyle fractures. // Br J Maxillofacial surgery. 2020 Nov.; 58(9):1145-1150.
19. Munante-Cardenas JL; FacchinaNunes PH; Passeri LA Etiology, treatment and complications of mandibular fractures. // Journal of Craniofacial Surgery. -2015 May; Volume 26 (3), - pp. 611-5
20. Nishimoto R.N. Dodson TB; Dillon JK; Is the distance between home and place of treatment a risk factor for complications after treatment of lower jaw fractures? // Journal of

Maxillofacial Surgery: Official Journal of the American Association of Maxillofacial Surgeons [J Oral Maxillofac Surg] 2021 February 26. Electronic publication date: February 26, 2021.

21. Odom EB, Snyder-Warwick AK. Complications of mandibular fracture and infection: The influence of demographic and modifiable factors. // Plast Reconstr Surg. 2016 Aug;138(2):282e-289e

22. Rozeboom AVJ, Dubois L, Bos RRM, Spijker R, de Lange J. Open treatment of condylar fractures using extraoral approaches: a review of complications.// J Craniomaxillofac Surg. 2018 Aug;46(8):1232-1240

23. Sakong Y; Kim YH., Chung KJ Analysis of complications in mandibular angle fracture: Champi technique versus rigid fixation. // Journal of Craniofacial Surgery [J Craniofac Surg] 2021 Apr 15. Korea

24. Smolka B; Liokatis P; Cornelius S. P. Evaluation of complications After open reduction and internal fixation of the base of the mandibular condyle and neck fractures Using trapezoidal plates. // Journal of Craniofacial Surgery. -2020

