

# Treatment of mandibular fractures – A 10-year retrospective study

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**Abstract.** Introduction: The mandible is the most fractured bone of the viscerocranium and the number of cases is continuously increasing. As the treatment of mandibular fractures is currently not standardized at international level, the choice of the ideal therapeutic approach is still a problem for every clinician. Materials and methods: A 10-year retrospective evaluation was performed, with the aim of assessing the treatment methods used in the case of mandibular fractures in our geographical area, as well as postoperative complications depending on each treatment method applied. Results: In a group of 709 patients with 1099 fracture lines, the most frequent type of treatment performed was orthopedic treatment 77.07%, followed by combined orthopedic-surgical treatment 12.19%, mandibular cerclage 6.82%, and surgical treatment 3.18%. 1200 stainless steel Erich splints, 700 titanium monocortical miniplates 2 mm thick, and 2500 titanium screws 2 mm in diameter and 7 mm in length were used. Conclusions: The most frequent type of treatment performed was orthopedic treatment but the most effective treatment, with the lowest rate of postoperative complications, is osteosynthesis surgery.

**Key Words:** mandible, treatment, trauma, fracture, injury, maxillofacial.

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## Introduction

With the increasing incidence of road traffic accidents, sports injuries and interpersonal violence worldwide, maxillofacial trauma has become a frequent and important pathology (Banks 2001, Natu et al 2012, Sakret al 2006). Traumas of the lower viscerocranium are extremely varied and constantly pose problems in the choice of the ideal treatment approach by the clinician (Freinberg et al 1997, Motamedi 2003). The mandible forms by itself the lower face skeleton, and through its prominent position is susceptible to trauma, being the most fractured bone of the viscerocranium (Ahmed et al 2004).

Anatomically, the mandible consists of a body and two vertical rami, which in turn present two processes: the coronoid apophysis and the condylar process (Bucur et al 2009, Brasileiro et al 2006). The most frequent topographic location of mandibular fractures differs considerably in the literature. Some authors support that the most frequent fracture is that of the mandibular angle (Naut et al 2012, Mock et al 2001), while others report condylar (Alkan et al 2007, De Matos et al 2010) and lateral fractures (Shah et al 2007, Ellis et al 1985) to be the most frequent. The biomechanics of mandibular fractures is influenced by the location of the fracture line, the muscle insertions in each fractured fragment, as well as by the degree of

bone involvement; secondary displacement of various degrees of the fractured fragments can occur (Nahum 1975).

The optimal type of treatment should be chosen by taking into consideration the anatomical and biomechanical characteristics of each fracture site (Kale et al 2013, Ramli et al 2011), which is required in order to ensure a favorable evolution and a reduction of postoperative complications (King et al 2004). Unfortunately, the authors' opinions in the literature diverge in this respect, and there is no standardized therapeutic approach to mandibular fractures at international level (Alkan et al 2007, Ellis et al 1999, Kruger 1990).

The aim of this study is to assess the treatment methods used for mandibular fractures in our geographical area, as well as postoperative complications depending on each treatment method applied.

## Materials and methods

For this study, patients admitted and treated in the Clinic of Oral and Maxillofacial Surgery I Cluj-Napoca in the period 1 January 2002 – 31 December 2011 were available. The protocol was approved by the Ethical Committee of University of Oradea, Romania and all the patients had signed the informed consent.

The inclusion criteria in the study were: the presence of at least one fracture line in the mandible, a history of an acute trauma episode, imaging investigations confirming the presence and characteristics of the fracture lines, treatment administered in the study's host clinic, complete documentation, a six-week postoperative follow-up of patients to assess healing and the development of potential complications.

Data were collected from the patients' observation charts, and the following variables were monitored: the therapeutic approach (orthopedic, surgical, orthopedic-surgical, and mandibular cerclage), postoperative evolution (favorable, unfavorable), the development and the type of postoperative complications. The exclusion criteria were: patient treated in other services, patient with associated diseases interfering with fracture healing (chemotherapy, bisphosphonate treatment, etc.), mandibular fracture of other etiology than trauma (pathological bone fracture), absence of postoperative follow-up.

Data were centralized in electronic format using Microsoft Excel software. Descriptive statistics of the assessed cases was performed with a two decimal accuracy.

For orthopedic treatment, the technique of intermaxillary immobilization with stainless steel vestibular Erich splints was used. These were fixed by 0.4 mm Wipla wire circumdental ligatures, and mandibulomaxillary fixation was performed using 0.6 mm Wipla wire. Surgical treatment involved osteosynthesis in the fracture focus with 2 mm thick titanium miniplates with 4 holes, 2 for each fracture line, and monocortical screws 2 mm in diameter and 7 mm in length. Mandibular cerclage was used in the case of edentulous patients or patients without osteosynthesis indications. This was carried out by fabricating bite blocks fixed at mandibular level with stainless steel circummandibular wire. Combined orthopedic-surgical treatment involved open fracture reduction and osteosynthesis immobilization of the fracture focus, requiring additional mandibulomaxillary immobilization for two weeks.

## Results

Orthopedic treatment by intermaxillary block was the most frequent treatment approach to mandibular fractures, followed by combined surgical-orthopedic treatment (Table 1).

Table 1. Distribution of fracture lines depending on the treatment used

Type of treatment	Total
orthopedic	847 (77.07%)
osteosynthesis plates	35 (3.18%)
cerclage	75 (6.82%)
compound	134 (12.19%)
other treatments	8 (0.73%)
<b>Total</b>	<b>1099</b>

The most frequently used materials for the treatment of mandibular fractures were vestibular Erich splints, followed by osteosynthesis plates (Table 2).

Postoperative evolution was favorable in 1053 (95.81%) fracture foci, while only 46 (4.19%) foci developed postoperative complications.

Table 2. Distribution of the type of materials used in the treatment of mandibular fractures

Type of materials used in the treatment	Erich archbars	Titanium plates	Acrylic trays	Total
orthopedic	1694 (68.69%)	0	0	1694
osteosynthesis plates	0	70 (2.83%)	0	70
cerclage	0	0	150 (6.08%)	150
compound	268 (10.86%)	268 (10.86%)	0	536
other treatments	16 (0.64%)	0	0	16
<b>Total</b>	<b>1978</b>	<b>338</b>	<b>150</b>	<b>2466</b>

Table 3. Distribution of patients depending on the presence of postoperative complications

Complications	
without complications	1054 (95.9%)
osteitis	28 (2.54%)
vicious consolidation	7 (0.63%)
other complications	10 (0.9%)
<b>Total</b>	<b>1099</b>

Table 4. Distribution of postoperative complications according to the chosen treatment

Treatment	Complications			Total
	Osteitis	Vicious consolidation	Delayed consolidation	
Orthopedic	7 (46.6%)	4 (26.6%)	4 (26.6%)	15
Surgical	3 (100%)	0	0	3
Cerclage	16 (64%)	6 (24%)	6 (24%)	25
Combined	2 (100%)	0	0	2

Osteitis in the fracture focus was the most frequent postoperative complication in the group of patients, followed by delayed consolidation and vicious consolidation (Table 3).

The correlation of the type of treatment applied and the materials used with the presence of postoperative complications showed that strictly orthopedic treatment and mandibular cerclage generated the most frequent postoperative complications (Table 4).

## Discussions

The aim of this study was reached: the most frequently used therapeutic methods for the treatment of mandibular fractures could be identified, and a correlation of their efficacy and the materials used for treatment with postoperative evolution could be established. The different results reported in the literature

regarding the etiopathogeny of mandibular fractures have prevented the development of standard treatment protocols for each affected topographic region of the mandible. In the absence of adequate treatment, mandibular fractures can evolve with severe complications that subsequently require complex surgery for the restoration of facial bones.

The most frequent type of treatment used was orthopedic treatment, similarly to other literature studies (Anyanechi et al 2011, Motamedi 2003, Ramli et al 2011). Contrary to our results, there are authors who exclusively choose osteosynthesis surgery with titanium plates and screws for the treatment of mandibular fractures (Alkan et al 2007, De Matos et al 2010, Ellis et al 1985, Ellis et al 1999). This discrepancy may have multiple causes. On the one hand, it can be due to differences between the standard methods used by each medical school. On the other hand, it should be mentioned that osteosynthesis treatment requires materials and an additional number of hospitalization days, which leads to an increase of operative costs that could probably not be covered by all patients in the period concerned. These statements are purely speculative, as the retrospective nature of this study does not allow to draw a definite conclusion in this respect. Van Den Bergh (Van Den Bergh et al 2012) and Gandhi S (Gandhi et al 2011) treat mandibular fractures by combined orthopedic-surgical treatment. Combined treatment was the second therapeutic option in the current study, being only used in case of failure of orthopedic or surgical treatment, which was quite rarely found in the cases included in the study.

For orthopedic treatment, 1200 stainless steel vestibular Erich splints were used, while for surgical treatment, 700 titanium monocortical miniplates 2 mm thick and 2500 titanium screws 2 mm in diameter and 7 mm in length were employed. Similar results were provided by the studies of Vajgel A. (Vajgel et al 2013) and Van Den Bergh (Van Den Bergh et al 2012), who used 442 monocortical miniplates 2.0 mm thick and 1965 titanium screws over a 10-year period.

The majority of the patients had a favorable postoperative evolution. Most postoperative complications occurred in the case of mandibular cerclage. This is also evidenced by the results of the study carried out by Van Den Bergh (Van Den Bergh et al 2012) and can be due on the one hand to septic contamination of the fracture focus from the oral environment, and on the other hand to the patient's terrain, as it is known that this type of treatment is used for elderly persons with associated diseases that can interfere with healing and make them susceptible to infections. This is in contradiction with the result obtained by Kale TP. (Kale et al 2013), who reports that most complications occurred following orthopedic treatment. Osteosynthesis surgery and combined orthopedic-surgical treatment were followed by the smallest number of complications, a result similar to those reported by other authors (Alkan et al 2007, De Matos et al 2010, Ellis et al 1985, Ellis 1999, Gandhi et al 2011, Van Den Bergh et al 2012, Vajgel et al 2013, Yamamoto et al 2013). This is due to open reduction under direct visualization of the fracture focus and to perfect rigid immobilization with miniplates and screws. Regarding the type of complications developed, the most frequent complication was osteitis in the fracture focus, followed by delayed consolidation and vicious consolidation, similarly to the majority of the literature studies (Alkan et al 2007, De Matos et al 2010, Ellis et al 1985, Ellis

1999, Gandhi et al 2011, Van Den Bergh et al 2012, Vajgel et al 2013). This can be explained by the septicity of the oral cavity, multiple fracture foci being open intraorally. At the same time, the approach of choice to osteosynthesis surgery is intraoral, which automatically leads to the contamination of the fracture focus by the septic environment of the oral cavity. Contrary to the results presented above are the results of Yamamoto K. (Yamamoto et al 2013), who finds the highest rate of complications secondarily to orthopedic treatment.

It should be noted that like the other authors who treated the majority of cases by osteosynthesis, we obtained in our study, where orthopedic treatment was predominant, a high rate of favorable evolution, 95.91%. This emphasizes the fact that correct fracture reduction in anatomical position and faultless immobilization ensure optimal healing and decrease the rate of complications even in the case of orthopedic treatment.

Like any retrospective study, the current study has its limitations; the accuracy of data collected from the clinical observation charts cannot be completely guaranteed. Also, observation charts with incomplete data regarding the evolution of cases were excluded from the study, which is why a considerable amount of data was lost.

## Conclusions

The most frequent type of treatment performed was orthopedic treatment but the most effective treatment of mandibular fractures, with the lowest rate of postoperative complications, is osteosynthesis surgery. However, considering its high frequency of use, orthopedic treatment also yielded satisfactory results.

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