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The epidemiology of edentulous atrophic mandibular fractures in Europe

Matteo Brucoli, MD DDS, Paolo Boffano, MD, Irene Romeo, MD, Chiara Corio, MD, Arnaldo Benech, MD DDS, Muhammad Ruslin, MD DDS PhD, Tymour Forouzanfar, MD DDS PhD, Tanía Rodríguez-Santamarta, MD DDS, Juan Carlos de Vicente, MD DDS PhD, Marko Tarle, MD, Emil Dediol, MD PhD, Petia Pechalova, MD DDS PhD, Nikolai Pavlov, MD DDS, Hristo Daskalov, MD DDS, Iva Doykova, MD DDS, Kadri Kelemith, DDS, Tiia Tamme, MD PhD, Andrey Kopchak, MD DDS PhD, Ievgen Shumynskyi, MD DDS, Pierre Corre, MD PhD, Helios Bertin, MD PhD, Maeva Bourry, MD, Pierre Guyonvarc'h, MD, Tadej Dovšak, MD PhD, David Vozlič, MD, Anže Birk, MD, Boban Aničić, MD DDS, Vitomir.S. Konstantinovic, DDS MD MSc PhD, Thomas Starch-Jensen, MD PhD

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AUTHORS: Matteo Brucoli MD DDS,[1] Paolo Boffano MD, [1] Irene Romeo MD, [1] Chiara Corio MD, [1] Arnaldo Benech MD DDS, [1] Muhammad Ruslin MD DDS PhD,[2] Tymour Forouzanfar MD DDS PhD,[3] Tanía Rodríguez-Santamarta MD DDS,[4] Juan Carlos de Vicente MD DDS PhD, [4] Marko Tarle MD,[5] Emil Dediol MD PhD,[5] Petia Pechalova MD DDS PhD,[6] Nikolai Pavlov MD DDS,[7] Hristo Daskalov MD DDS,[6] Iva Doykova MD DDS,[8] Kadri Kelemith DDS,[9] Tiia Tamme MD PhD,[10] Andrey Kopchak MD DDS PhD,[11] Ievgen Shumynskyi MD DDS,[12] Pierre Corre MD PhD,[13] Helios Bertin MD PhD,[13] Maeva Bourry MD,[13] Pierre Guyonvarc'h MD,[13] Tadej Dovšak MD PhD,[14] David Vozlič MD,[14] Anže Birk MD,[14] Boban Aničić MD DDS,[15] Vitomir S. Konstantinovic DDS MD MSc PhD,[15] Thomas Starch-Jensen MD PhD.[16]

[1] Division of Maxillofacial Surgery, University Hospital "Maggiore della Carità", University of Eastern Piedmont, Novara, Italy

[2] Department of Oral and Maxillofacial Surgery, Hasanuddin University, Makassar, Indonesia

[3] Department of Oral and Maxillofacial Surgery/Oral Pathology, VU University Medical Center, Amsterdam, The Netherlands

[4] Servicio de Cirugía Maxilofacial, Hospital Universitario Central de Asturias, Oviedo, Spain

[5] Department of Maxillofacial Surgery, University Hospital Dubrava, Zagreb, Croatia

[6] Department of Oral surgery, Faculty of Dental Medicine, Medical University, Plovdiv, Bulgaria

[7] Private practice of oral surgery, Plovdiv, Bulgaria

[8] Department of maxillofacial surgery, Faculty of Dental Medicine, Medical University, Plovdiv, Bulgaria

[9] Department of maxillo-facial surgery, North Estonia Medical Centre Foundation, Tallinn, Estonia.

[10] Faculty of Medicine, University of Tartu, Tartu, Estonia

[11] Bogomolets National Medical University, Stomatological medical center, Kyiv, Ukraine.

[12] Bogomolets National Medical University, Kyiv City Clinical Emergency Hospital, Kyiv, Ukraine

[13] Division of Maxillofacial Surgery, Chu de Nantes, Nantes, France

[14] Department of *Maxillofacial* and Oral Surgery of the University Medical Centre, Ljubljana, Slovenia

[15] Department of Maxillofacial surgery, School of Dental Medicine, University of Belgrade, Serbia

[16] Department of Oral and Maxillofacial Surgery, Aalborg University Hospital, Aalborg, Denmark

Address correspondence and reprint requests to Dr Paolo Boffano: Division of Maxillofacial Surgery, University Hospital “Maggiore della Carità”, University of Eastern Piedmont, Novara, Italy
E-mail address: paolo.boffano@gmail.com

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ABSTRACT

INTRODUCTION

The objective of the present study was to assess the demographic variables, causes, and patterns of edentulous atrophic fractures of the mandible managed at several European departments of oral and maxillofacial surgery. The results of this multicenter collaboration over a 10-year period are presented.

METHODS

The data of all patients with fractures of the atrophic edentulous mandible from the involved maxillofacial surgical units across Europe between January 1, 2008, and December 31, 2017 were recorded: gender; age; voluptuary habits; comorbidities; etiology; fracture sites; synchronous body injuries; atrophy of the mandible according to Luhr classification; eventual type of treatment; timing of the eventual surgery; length of hospital stay.

RESULTS

A total of 197 patients (86 male and 111 female patients) with 285 mandibular fractures were included in the study. Mean age of the study population was 75 years. Statistically significant associations were found between Luhr classes I – II and condylar fractures on one hand ($p < .0005$), and between Luhr class III and body and parasymphyseal fractures on the other hand ($p < .05$). Finally, 135 patients underwent open reduction and internal fixation, 56 patients did not

undergo any intervention, and 6 patients underwent closed reduction. No statistically significant association was observed between treatment, timing of treatment, comorbidities, and concomitant injuries.

CONCLUSIONS

The management of edentulous atrophic mandibular fractures remains challenging. Treatment decisions should continue to be based on the clinician's previous experience and on the degree of bone resorption in edentulous mandible in relation to fracture subsites.

KEYWORDS: edentulous; mandibular fracture; mandible; atrophic; management.

INTRODUCTION

Fractures of the atrophic edentulous mandible represent a rare subset of facial fractures whose management is still challenging due to several factors, such as patient's age, significant operative risks, poor bone quality, decreased osteogenesis, and reduced contact area between the fracture fragments.[1-11]

In fact, when teeth are lost or removed, a series of biological effects occur that lead to loss of the alveolar process, thus causing a progressive atrophy of the mandible and its increase in vulnerability to fractures due to the decreased bone volume. [1-2]

The incidence of atrophic edentulous mandible fractures has been reported to be low compared with dentate mandibles, ranging from 1% to 5% of all mandibular fractures; nevertheless, the difficulties associated with surgical interventions for such fractures are responsible for noticeable complications rates that have been reported up to 20%, including malunion and nonunion.[1-4]

Articles regarding this specific group of facial fractures are often case reports or small population studies. However, the progressive ageing of population in developed countries suggests that these injuries will receive more and more attention. In fact, edentulous alveolar bone resorption is a chronic, progressive, and irreversible condition occurring in all subjects following the loss of the dentition. Therefore, as the geriatric population continues to increase, surgeons are more likely to see fractures of the atrophic edentulous mandible. [1-6] Several European centers that had already shown research experience in maxillofacial trauma decided to collaborate on a multicenter research project about the epidemiology of mandibular edentulous atrophic fractures.

The objective of the present study was to assess the demographic variables, causes, and patterns

of edentulous atrophic fractures of the mandible managed at several European departments of oral and maxillofacial surgery. The results of this multicenter collaboration over a 10-year period are presented.

METHODS

This study was conducted in 12 European departments of oral and maxillofacial surgery. All coauthors met the criteria that qualified a person for being an author, according to Elsevier Ethics in Research & Publication.

This study is based on a systematic computer-assisted database that allowed the recording of data of all patients with fractures of the atrophic edentulous mandible from the involved maxillofacial surgical units across Europe between January 1, 2008, and December 31, 2017. Only patients that were diagnosed with isolated atrophic edentulous mandibular fractures were included.

The following data were recorded for each patient: gender; age; voluptuary habits (drug-addiction, smoke or alcohol consumption); comorbidities; etiology; site of mandibular fractures; synchronous body injuries; degree of atrophy of the mandible according to Luhr classification;[5] eventual type of treatment (no treatment; closed treatment; open reduction and internal fixation); timing of the eventual surgery (within 24 hours, within 72 hours, beyond 72 hours); length of hospital stay.

The following categories of the cause of injury were considered: fall, motor vehicle accident, assault, sport injury, work injury, and other cause. Fractures of the mandible were subclassified in fractures of the parasymphysis, body, angle, ramus, coronoid, or condyle.

Patient characteristics were analyzed using descriptive statistics. Statistical analysis was used to search for associations among multiple variables. Statistical significance was determined using the X2 test or, if the sample sizes were too small, the Fisher exact test. Statistical significance was set at .05. We followed the Helsinki Declaration guidelines, according to local laws. The study was exempt from requiring institutional review board approval as a retrospective study, according to a local institution.

RESULTS

A total of 197 patients (86 male and 111 female patients) met the inclusion criteria and were included in the study. Figure 1 shows the distribution of patients from the different involved maxillofacial surgery units. Of the patients, 44% were male patients and 56% were female patients, with a male-to-female ratio of 0.77:1.

In the different centers and countries, the male to female ratio varied widely, with the highest value encountered in the Kyiv centre (Ukraine) study population and the lowest value observed in Nantes (France). Figure 2 shows the different male and female distribution among centers.

The mean age of the study population was 75 years (median, 77 years; standard deviation, 11.4 years; range, 41 to 98 years). The highest mean age was observed in the Oviedo center (82 years), whereas the lowest was encountered in Kyiv (66 years) (Figure 3).

Thirty-eight patients (19,3%) of 197 reported one or more voluptuary habits, with 16 patients reporting smoking, 14 alcohol drinking, and 7 smoking and alcohol drinking. Only 1 patient reported smoking and drug abuse.

On the whole, 127 patients (65%) reported one or more comorbidities, the most frequent being hypertension (78), followed by dementia (24), heart rhythm disease (24), and diabetes (21) (Figure 4).

As for aetiology, the most frequent cause of injury was fall with 137 patients (69%), followed by assaults (29 patients, 15%), and other causes (17 patients, 9%) (Figure 5). Figure 6 shows the etiology distribution across the different maxillofacial surgery units.

The study population of 197 patients reported 285 mandibular fractures. Body fractures and condylar fractures were the most frequently observed mandibular injuries, with 114 and 105 fractures, respectively (Figure 7). Out of 197 patients, 111 reported a single mandibular fracture, whereas the most commonly encountered associations of fractures were body and condylar fracture (23 patients), and angle and body fracture (16 patients).

On the whole, 71 patients' mandibles were classified as class I according to Luhr, 88 class II, and 38 class III (Figure 8). Table 1 presents mandibular fracture types according to Luhr classes. Statistically significant associations were found between Luhr classes I – II and condylar fractures on one hand ($p < .0005$), and between Luhr class III and body and parasymphiseal fractures on the other hand ($p < .05$).

Concomitant injuries were observed in 31 out of 197 patients. Most frequently observed concomitant injuries were orthopedic injuries (21 patients), followed by encephalic (6), ocular (4), thoracic (3), spine (1), and abdominal injuries (1). Finally, 135 patients underwent open reduction and internal fixation (ORIF), 56 patients did not undergo any intervention, and 6 patients underwent closed reduction. ORIF was performed within 24 hours in 53 cases, within 72 hours in 33 cases, and beyond 72 hours in 49 patients. No statistically significant association was

observed between treatment, timing of treatment, comorbidities, and concomitant injuries. Mean length of stay was 3.2 days in conservatively managed patients and 6.7 days in ORIF patients.

DISCUSSION

Few wide studies are available in the literature regarding the incidence and epidemiology of fractures of the atrophic and edentulous mandible.[6] Our multicenter study included 197 patients, with a slight predominance of women. A quite uniform gender distribution was observed across the different centers. Mean age was 75 years, ranging between 66 years and 82 years across the different centers. As expected, considering the mean old age of patients with edentulous atrophic mandibles, a high percentage of subjects (65%) reported one or more comorbidities.

As for aetiology, the most frequent cause of injury was fall in 69% of patients. It is interesting to note that etiological factor distribution was quite similar among the involved centers. The main exceptions were represented by the Kyiv and Tallinn centers (followed by Plovdiv and Zagreb) with a relatively high percentages of assaults. Therefore, this result confirms that nowadays falls are an important etiological factor for maxillofacial trauma, because of the progressive ageing of the population. Of course, the peculiar characteristics of edentulous atrophic mandibular fractures again stress this feature.

On the whole, 285 mandibular fractures were diagnosed. Body fractures and condylar fractures were the most frequently observed mandibular injuries. Together, they represent the 76.8% of all fractures in the edentulous mandible. In our opinion, this is an interesting finding that could focus the attention of surgeons on the appropriate management of these two subtypes of

mandibular fractures in edentulous patients.

As expected, the first two classes according to Luhr classification were more frequently diagnosed, in comparison with class III. Moreover, one of the most interesting findings regarded the relationship between edentulous mandibular fracture types and Luhr classes. In fact, Luhr classes I and II were associated with condylar fractures, whereas mandibles rated as Luhr class III were associated with body and parasymphiseal fractures. Therefore, it could be speculated that injuries to relatively "thicker" edentulous mandibles more easily determine condylar fractures, as in dentate patients: in classes I and II, a sufficient bone volume could probably maintain biomechanical stress fracture lines as in "normal" dentate mandibles. Instead, on the other hand, in Luhr class III mandibles (where bone thickness is lower than 10 mm), the prominence of the chin together with the dramatically thinner body and parasymphyseal regions determine a change in biomechanics of mandibular fractures: in this case, body and parasymphysis become the more frequent sites of fractures. As for concomitant injuries, few patients (31 out of 197) presented synchronous lesions, such as orthopedic injuries.

As for treatment, it may be difficult, if not impossible, to standardize the clinical surgical or conservative decision in this kind of trauma: there are too many variables to be considered, such as the age of patients, the degree of dislocation of fractures, concomitant injuries, the combination of fractures, and last but not least the consent or refusal to surgery by patients. All these variables should warn us on one hand about the importance of an individualized clinical decision on a case by case basis, but on the other hand they confirm the exceptional challenge the surgeons have to face for the most appropriate management of these patients. In the literature, treatment modalities for atrophic edentulous mandibular fractures include observation, closed reduction, Gunning splits, external pix fixation, and ORIF with titanium mesh, locking miniplate,

or 2.4-reconstruction plate, with or without simultaneous bone grafting. [1-6] Nowadays, controversy remains regarding the choice of the most appropriate treatment, such as the use of miniplates or reconstruction plates, intraoral versus extraoral approaches, and simultaneous bone graft. [1-8] A 2007 Cochrane review on this topic concluded that treatment decisions should be based on the training and experience of the clinician as no single approach could be demonstrated to be superior to others.[7] In our multicenter study population, the noticeably high percentage (68%, 135 patients) of subjects undergoing ORIF highlights the importance of surgery for the management of edentulous atrophic mandibular fractures. In our opinion, a clear understanding of the advantages and disadvantages of each treatment technique is crucial in order to choose the most appropriate management option for each single patient and to finally achieve the best functional result (or at least the best possible compromise). In agreement with Ellis and Price,[2] we highlight the importance of treating not only the fractured edentulous mandible, but the patient himself. In front of this type of fracture, individualization of treatment is crucial and treatment options in often debilitated patients must be weighed carefully. For example, in fragile patients that are not likely to survive general anesthesia, observation without any treatment may be considered too. In other words, the aim of the treatment of edentulous atrophic mandibular fracture should be to facilitate a reasonable lifestyle together with the minimal risk for the patient, although ORIF still probably represents the most valuable approach.

Finally, the timing of treatment cannot be standardized. In our study sample, ORIF was performed within 24 hours in 53 cases, within 72 hours in 33 cases, and beyond 72 hours in 49 patients. No statistically significant association was observed between treatment, timing of treatment, comorbidities, and concomitant injuries. However, despite the fact tht there is no need for urgent treatment of facial fractures, in some centers that were dedicated to maxillofacial

trauma a fast preoperative general and anesthesiologic assessment was performed. It could be debatable whether an early treatment or delayed treatment could be better in this situation. However, economic issues and health systems directives may have a great influence on this issue.

CONCLUSIONS

The management of fractures of the edentulous mandible is challenging, and the literature supports the concept that treatment decisions should continue to be based on the clinician's previous experience. Our results highlight the importance of the degree of bone resorption in edentulous mandible in relation to fracture subsites.

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LEGENDS:

Figure 1: Distribution of patients from the different involved maxillofacial surgery units.

Figure 2: Male and female distribution among centers.

Figure 3: Distribution of mean age in the different involved maxillofacial surgery units.

Figure 4: Comorbidities within the study population.

Figure 5: Etiological factors of mandibular fractures within the study population.

Figure 6: Etiology distribution across the different maxillofacial surgery units.

Figure 7: Subsites of mandibular fractures in the study population.

Figure 8: Luhr classes within the study population.

Table 1: Mandibular fracture types according to Luhr classes.

	Luhr I	Luhr II	Luhr III	
Body	42	39	33	p< .05
Condyle	38	56	11	p< .0005
Parasymphysis	7	7	10	p< .05
Angle	7	10	6	NS
Ramus	6	5	2	NS
Coronoid	4	2	0	NS
Total	104	119	62	285