

ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Clinical characteristics of mandibular fractures in patients over 50 years of age

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**SUMMARY**

Introduction/Objective The most commonly used methods of treatment of mandibular fracture are not always successful in older patients. This is due to decreased regenerative ability, impaired vascularization, osteoporosis, and atrophic changes. The corresponding changes are often found in patients over 50 years of age, especially accompanied with teeth loss.

The objective was to review the clinical characteristics of mandibular fractures in older patients based on a retrospective analysis of medical records.

Methods A group of patients over 50 years of age was selected and analyzed among patients with mandibular fractures who had been treated for 10 years.

Results A total of 642 patients over 50 years with 1,003 fracture lines were identified. This represents 8.53% of the total number of patients with mandibular fractures. Comorbidities were diagnosed in 67% of cases. Significant differences in the distribution of the frequency of fracture lines by localization were identified, depending on the presence or absence of occlusal contact. A high incidence rate of open fractures and bone fragment dislocation was observed both in individuals with or without occlusive contact.

Conclusion Patients over 50 years of age are a statistically important group in the general population of patients with mandibular fractures with a number of clinical features. To the author's knowledge, this study comprises the largest number of patients over the age of 50 with mandibular fractures, including those with edentulous mandible, which ensures the required level of representation, allowing reliable clinical characterization of this contingent of patients.

Keywords: mandibular atrophy; occlusion; edentulous; older patients

INTRODUCTION

At old age, any injury is a serious threat. This is due to the reduced regenerative ability caused by the depletion of the pool of mesenchymal stem cells, impaired vascularization as a result of systemic atherosclerosis, and osteoporosis resulting from changes in mineral metabolism. The course of a traumatic disease is significantly influenced by comorbidities, which are common in this age group.

Maxillofacial injuries are not an exception, as they frequently lead to disability, including from the social perspective. It is known that mandibular fractures are one of the most frequent types of facial bone injuries, which also holds true for the individuals of older age groups [1, 2]. However, as a result of the loss of teeth, atrophic changes of the alveolar area and body of the mandible, standard treatment methods are not always effective in these patients [3]. According to several authors, the rate of complications associated only with impaired consolidation reaches 25% [4, 5]. In the age population over 50 years old, people with the loss of a large number of teeth and the lack of occlusal relationships are often found. As a result, they develop atrophic changes in

the mandible of varying degrees of severity. Accordingly, its damage, in this case, will have a number of clinical features.

The objective of this paper is to review the clinical characteristics of mandibular fractures in older patients based on a retrospective analysis of medical records.

METHODS

Medical records of 7,532 patients with mandibular fractures undergoing treatment in the Maxillofacial Surgery Clinic of the N. I. The First Pirogov Municipal Clinical Hospital (the clinical base of the university department) within a period of 10 years was analyzed. We selected a group of patients over 50 years of age. As noted above, this age criterion was chosen based on the fact that mandibular atrophic changes related to the loss of teeth are common enough at this age thus inevitably influencing the clinical course of a traumatic disease.

At admission, all patients provided a written informed consent for the statistical processing of their data.

All procedures performed in this study were in accordance with the ethical standards of the

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institutional research and with the 1964 Helsinki declaration. Permission from the local Committee on Ethics has been obtained to conduct this research (protocol from May 30, 2019).

The distribution of patients by sex and age, as well as the presence or absence of comorbidities, was analyzed.

To characterize mandibular fractures, the Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF) classification was applied [6]. This is the most convenient classification for the statistical processing of data in large groups in research studies and it also allows the highest possible number of clinical features of practical surgical significance to be taken into consideration. According to the requirements of this classification, the following categories were evaluated: F (fracture), L (localization), S (soft tissue), O (occlusion) (Table 1).

Table 1. The Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF) classification of fractures of the mandible

Category	Fracture
F	F ₁ simple fracture
	F _{1s} oblique split fracture
	F ₂ double or multiple unilateral fractures
	F ₃ splintered fracture
	F ₄ fracture associated with the formation of a bone defect
L	L ₁ fracture located in the incisor region
	L ₂ fracture located in the canine region
	L ₃ fracture located in the lateral portions of the mandibular body, in the area from the first premolar to the second molar
	L ₄ fracture located in the mandibular angle region.
	L ₅ fracture located in the mandibular ramus region
	L ₆ fracture located in the condylar process region
	L ₇ fracture located in the coronoid process region
	L ₈ fracture of the alveolar portion of the mandible
S	S ₀ closed fracture
	S ₁ open fracture communicating with the oral cavity
	S ₂ open fracture accompanied by skin injuries
	S ₃ fracture which is open both intra- and extraorally
	S ₄ fracture associated with the formation of a soft tissue defect
O	O ₀ no malocclusions
	O ₁ disocclusion
	O ₂ no occlusal contact

RESULTS

In the retrospective study of the archival documents, medical records of 642 patients aged over 50 years were identified, which represents 8.53% of the total number of patients with mandibular fractures. The relative share of older patients in different years ranged 7–11.3%, i.e. this parameter remained rather stable. Cumulatively, 1,003 fracture lines were diagnosed in these patients.

A total of 90 patients were female, representing 14% of the total number of the studied group, while 552 patients, who constitute 86%, respectively, were male.

Comorbidities were identified in a total of 67% of patients. Among these, cardiovascular disorders were predominant (Table 2). They were also detected in patients with other types of diseases, as a concomitant condition.

Table 2. Comorbidity structure in patients over 50 years of age with mandibular fractures

Parameter	Male		Female		Total	
	n	%	n	%	n	%
Total number of patients	552	86	90	14	642	100
Patients with comorbidities	359	55.9	71	11	430	67
Cardiovascular disorders	290	45.1	51	7.9	341	53.1
Respiratory disorders	39	6	9	1.4	48	7.5
Gastrointestinal disorders	20	3.11	4	0.6	24	3.7
Urinary tract disorders	4	0.6	4	0.6	8	1.2
Diabetes mellitus	3	0.4	2	0.3	5	0.7
Other	3	0.4	1	0.2	4	0.6

Occlusal contact was present in 305 patients, while 337 had no occlusal contact (O₂ category). The number of fracture lines diagnosed was 477 in the first group and 525 in the second group, respectively. Table 3 shows the distribution of unilateral and bilateral fractures in these groups.

Table 3. Number of unilateral and bilateral mandibular fractures in patients over 50 years of age by the presence or absence of tooth rows

Fractures	Dentulous		Edentulous		Total
	n	%	n	%	
Bilateral fractures	158	51.8	201	59.6	359
Unilateral fractures	147	48.2	136	40.4	283
Total	305	100	337	100	642

In O category (occlusion), the distribution of fracture frequency in various regions of the mandible was completely different in patients with preserved dentition and patients with loss of occlusal contact. The corresponding data relative to the total number of fractures are presented in Table 4. The incidence rate of fracture lines in various regions of the mandible relative to the total number of patients with present and absent occlusal contacts is presented in Figure 1.

The distribution of bilateral mandibular fracture lines in patients over 50 years of age by their localization in both present and absent occlusal contacts are shown in Table 5.

Dislocated bone fragments were observed in 79.1% of patients without occlusal contacts and in 66.3% of patients with occlusal contacts. The frequency distribution of bone fragment displacement by localization of the fracture line is shown in Figure 2.

DISCUSSION

The incidence rate of mandibular fractures in individuals over 50 is significantly lower than in other age groups (the maximum rate is reported in individuals aged 20–29 years: 37.53%), however they still represent a statistically significant population with specific clinical manifestations. Specifically, they include an increasing number of patients

Table 4. The distribution of mandibular fracture lines by localization in patients over 50 years of age

Injury region	Dentulous* (n = 477, 100%)					
	S ₀		S ₁		S ₃	
	n	%	n	%	n	%
L ₁	5	1	46	9.7		
L ₂	4	0.8	20	4.2		
L ₃	26	5.5	75	15.8	2	0.4
L ₄	74	15.5	110	23.1	2	0.4
L ₅	11	2.3				
L ₆	102	21.4				
Total	222	46.5	251	52.6	4	0.8

Injury region	Edentulous (n = 525, 100%)					
	S ₀		S ₁		S ₃	
	n	%	n	%	n	%
L ₁	12	2.3	14	2.7		
L ₂	14	2.7	15	2.9	1	0.2
L ₃	89	16.9	101	19.2	2	0.4
L ₄	84	16	97	18.4	2	0.4
L ₅	14	2.7				
L ₆	80	15.2				
Total	293	55.8	227	43.2	5	1

*Category L8 cases (three cases) are not included in this table

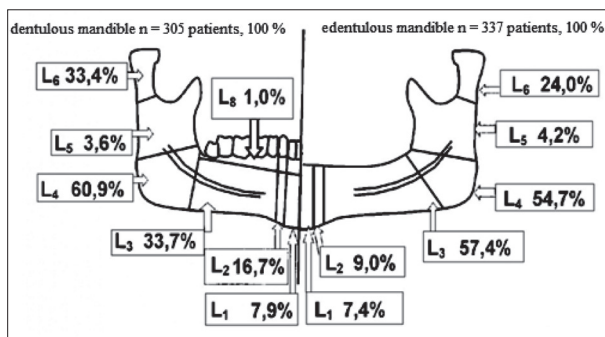


Figure 1. The frequency of mandibular fractures among the patients over 50 years of age (number of fracture lines to number of patients ratio)

with comorbidities, predominantly cardiovascular disorders. This implies the long-term use of various drugs influencing the function of different body systems (for example, anticoagulants), which should be taken into consideration when planning surgery.

The characteristics of the actual fractures fundamentally depend on the presence or absence of occlusal contacts; their loss leads to severe atrophic changes in the mandible. This affects the distribution of fracture lines by localization. In patients with occlusal contacts, the higher incidence rate of fracture lines is observed in the mandibular angle region, similarly to patients of other age groups. In patients with teeth loss, fracture lines are most prevalent in the lateral portions of the mandibular body, where the most pronounced atrophic changes occur. According to Newman [7], the incidence rate of fracture lines in this region is 57%, which is fully consistent with our results.

We noted that in a rather high proportion of cases (9%) in the O₂ category according to the AO/ASIF classification, bilateral symmetrical fracture lines located in the lateral

Table 5. The distribution of bilateral mandibular fracture lines in older patients by their localization

Fracture line localization pattern	Dentulous		Edentulous	
	n	%	n	%
L ₁ /L ₃	-	-	2	1
L ₁ /L ₄	14	8.9	5	2.4
L ₁ /L ₅	2	1.2	-	-
L ₁ /L ₆	14	8.9	18	9
L ₂ /L ₄	7	4.4	10	5
L ₂ /L ₅	2	1.3	-	-
L ₂ /L ₆	5	3.2	10	5
L ₃ /L ₃	1	0.6	18	9
L ₃ /L ₄	48	30.4	60	29.9
L ₃ /L ₅	7	4.4	5	2.4
L ₃ /L ₆	23	14.6	32	16
L ₄ /L ₄	21	13.2	21	10.4
L ₄ /L ₆	12	7.7	16	8
L ₅ /L ₅	-	-	2	1
L ₆ /L ₆	2	1.3	2	1
Total	158	100	201	100

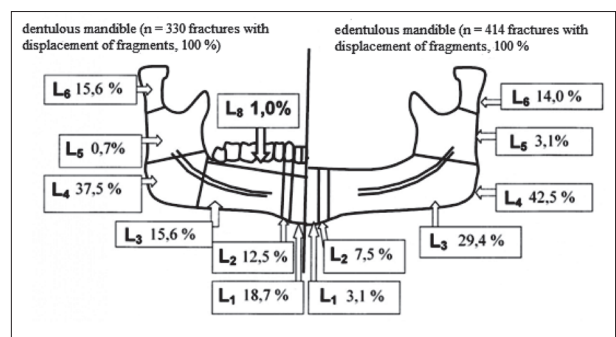


Figure 2. The frequency of dislocation of bone fragments in fractures of the mandible among the patients over 50 years of age

portions of the mandibular body are diagnosed. In the corresponding age group with occlusal contacts, a single such case was reported; moreover, this patient had bilateral free-end edentulous spaces from the first molars, while fracture lines were immediately behind them.

Luhr et al. [8] proposed a classification of atrophic jaw changes in patients with fractures, based on the vertical size of the bone. The mandibular height in the area of injury of 16 to 20 mm corresponds to class I atrophy, a height of 11 to 15 corresponds to class II, and a height below 10 mm corresponds to class III. Mugino et al. [9] also distinguished extremely severe atrophy with a mandibular height lower than 5 mm. Consequently, the recommendations on performing osteosynthesis of the atrophied mandible based on experimental data and clinical observations depend specifically on the assessment of the vertical size of the mandibular body [9–13].

However, atrophy of the edentulous mandible body progresses unevenly. The increase in the incidence rate of fracture lines in the L₃ region that we observed in

association with the loss of occlusal contacts suggests that atrophic changes in the bone tissue develops predominantly in the lateral portions of the mandibular body, while being less pronounced in the angle and frontal regions. These changes are related precisely with the atrophy of the mandibular body in cross-section, rather than with the loss of its height [14]. These fractures should be characterized as extremely unfavorable because of the abovementioned processes, contact surface between bone splinters is reduced, which negatively influences bone wound healing and can lead to impaired consolidation. According to Bruce and Ellis [5], in 20% of cases healing in this region occurs by syndesmosis, without callus formation. Consequently, it seems reasonable to perform computed tomography scanning when planning treatment if the fracture line is located in the lateral portions of the atrophied mandibular body.

Another factor considerably complicating bone wound healing in cases of severely atrophied mandibular body is luminal narrowing of the inferior alveolar artery; thus, bone tissue blood supply is provided predominantly by periosteal vessels [15], which are severely damaged following injury or surgery.

Spießl [16] described a non-union type of fracture typical for atrophied edentulous mandible, which is referred to as “elephant’s-foot-like” in literature, due to hypertrophy of the bone fragment ends. In this study, in the patients admitted to the clinic we observed non-union atrophic fractures accompanied by necrosis in the area of bone wound margins leading to the formation of secondary sequestra and, respectively, marginal bone defects after their removal (Figure 3).

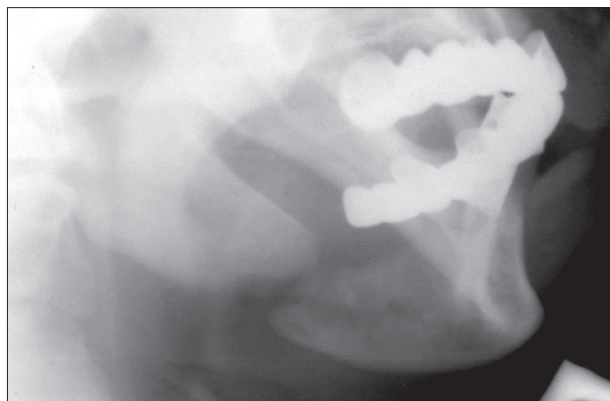


Figure 3. Pseudarthrosis of the atrophic type in the angle of the mandible

According to de Amaratugna [14], fractures in the angle of an edentulous mandible are rare. The author observed only three types of distribution of bilateral fractures by their localization with injury in the condylar process region in all cases. However, in our study, fractures in the mandibular angle area had the second highest prevalence in the O_2 category. We observed 13 different variants of fracture line localization in bilateral fractures. These differences could be related to the higher number of observations included in this study (337 versus 67).

Moreover, fractures in the condylar process region were slightly less frequent than in patients with occlusal contacts. Obviously, changes in the anthropometric parameters in the area of condylar processes in cases of mandibular atrophy do not essentially influence their resistance to injury.

In the current study, we determined that the incidence rate of fractures in the frontal portion of the edentulous mandible is $1.5 \times$ lower than in dentulous subjects.

The structure of etiological factors of mandibular fractures differs by country and region; however, the fact that in the absence of occlusal contacts fractures commonly occurred following an insignificant impact confirms the view of Barber [17] of decreased resistance of atrophied mandibles to damaging impact. Nevertheless, the frequency of bilateral fractures was only slightly higher compared to the group of patients with occlusal contacts. No significant differences were found between the two groups by the F category.

There is a widespread opinion expressed long ago by Rowe and Killey [18] that in older patients the risk of mandibular fracture infections is low, since in edentulous mandibles the injury leads to the detachment of mucosa and periosteum, whereas the fractures remain closed. On the contrary, our data showed that open fractures were diagnosed rather frequently not only in patients with occlusal contacts, but in edentulous patients as well (Table 2). This could be related to the decreased thickness of the mucosa covering the alveolar region of the mandible, which is observed in older patients [19]. Thus, the fracture area communicates with the oral cavity, which can lead to its infection.

The high frequency of bone fragment dislocation observed in the patients included in this study correlates with data reported by other authors [5, 7]. Obviously, the loss of teeth is a significant risk factor contributing to the displacement of splinters.

No unified clear algorithm for managing older patients with mandibular fractures has been developed yet. In practice, considering the presence of comorbidities and atrophic changes in the injured area, there is a tendency to extend the indications for conservative treatment. However, the results of this study show that such an approach is not justified, considering the high incidence rate of open fractures and bone fragment dislocation, which will negatively influence the probability of complications and the subsequent quality of life of older subjects. By contrast, stable fixation of bone fragments contributes to the immediate recovery of the normal mandibular function [20]. Nonetheless, the application of bone plates and screws causes an additional and rather significant injury, which is associated with the risk of subsequent impairment of blood supply to the mandible, including in the area of injury itself [21]. In older patients, a shorter duration of surgery should be attempted; however, the correct plate placement requires a considerable amount of time due to atrophic changes in the mandible [20]. In this regard, pre-operative computer planning technologies are currently being developed [22].

To solve this issue, opposite surgical concepts are sometimes proposed. Some authors postulate the principle that “The smaller the bone, the larger the plate” [13, 23], while others insist on a minimally invasive approach [9, 24]. It was experimentally shown that although the bone mass is decreased, the minimal acceptable thickness of the bone plate for an atrophied mandible should be at least 2 mm [25], since without occlusal contacts the distribution of load and the force generated by the multidirectional action of the masticatory muscles are transmitted directly to the injured area [13, 21]. Whether the use of bone transplants or tricalcium phosphate with rhBMP-2, fixed by an encircling suture or a locking plate [7, 13, 22, 26, 27], is appropriate or whether the plate should be placed over the periosteum, over the mucosa or directly on the bone remains controversial [13, 21, 23, 28]. Overall, as shown by the results of the most complete Cochrane Review by Nasser et al. [29], there is no consensus on this issue, which could be explained by the fact that most studies included comparatively small numbers of observations due to the relatively low incidence of such cases in clinical practice.

To date, there are no reliable randomized clinical trials based on sufficient statistically significant material that allows substantial advantages of a particular method of treatment of older patients with mandibular fractures at

the evidence level, which requires the continuation of the relevant multicenter clinical studies [30].

CONCLUSION

Patients over 50 years of age represent a rather consistent and statistically important subset of the general population of individuals with mandibular fractures. At the same time, a number of clinical features determined by a background of comorbidities and atrophic mandibular changes distinguish them from other age groups.

This study is the largest in literature by the included number of people over 50 years of age with mandibular fractures, including those with edentulous mandible, which ensures the required level of representation, allowing reliable clinical characterization of this contingent of patients. The presented material could be used for the development of a complex treatment algorithm for elderly patients with mandibular fractures, which would take into consideration both general and local status. This task can be accomplished with a wide approach to the problem overall rather than by separating different clinical aspects.

Conflict of interest: None declared.

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Клиничке карактеристике прелома доње вилице код болесника старијих од 50 година

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САЖЕТАК

Увод/Циљ Најчешће коришћене методе лечења прелома доње вилице нису увек успешне код старијих болесника, због смањења регенеративне способности, поремећаја васкуларизације, остеопорозе, атрофичних промена. Одговарајуће промене су честе код болесника старијих од 50 година, нарочито у позадини губитка великог броја зуба.

Циљ студије је преглед клиничких карактеристика прелома доње вилице код старијих болесника на основу ретроспективне анализе медицинске документације.

Метод Међу болесницима са преломима доње вилице који су били на лечењу 10 година изабрана је и анализирана група болесника старијих од 50 година.

Резултати Студија је открила 642 болесника старија од 50 година са 1003 линије прелома, што представља 8,53% укупног броја болесника са преломима доње вилице. Коморби-

дитет је дијагностикован у 67% случајева. Идентификоване су значајне разлике у расподели учесталости линија прелома локализацијом у зависности од присуства или одсуства оклузивног контакта. Висока учесталост отворених прелома и дислокација костних фрагмената примећена је и код особа са оклузивним контактом и без њега.

Закључак Болесници старији од 50 година су статистички значајна група у општој популацији болесника са преломима доње вилице са низом клиничких карактеристика. Колико нам је познато, ова студија је највећа по укљученом броју старијих особа са преломима доње вилице, укључујући и беззубу доњу вилицу, која обезбеђује потребан ниво репрезентативности, омогућавајући поуздану клиничку карактеризацију овог контингента болесника.

Кључне речи: атрофија доње вилице; оклузија; адентија; старији болесници