

Review Article

Fractures of the lower jaw in children (causes, types, diagnosis and treatment). Retrospective 5 year analysis

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ABSTRACT

Background/aim: Epidemiology of the lower jaw fractures varies between populations. This study explores the epidemiology of the lower jaw fractures at the Department of Surgical Dentistry and Maxillofacial Surgery of Childhood, Bogomolets National Medical University.

Methods: This is a retrospective analysis of 210 case histories of children with traumatic fractures of the lower jaw, from the age of 6 months–18 years old, carried out at the Department of Surgical Dentistry and Maxillofacial Surgery of Childhood, Bogomolets National Medical University, from January 2014 to December 2018.

Results: The most common cause of the mandibular fractures was falling 142 (67%). Mostly, qualified help was sought on the first day of injury (n = 103–49%). X-ray diagnostics was performed for all patients, but in different forms: orthopantomography was performed in 57 cases (27%), panoramic radiographs of the lower jaw in a direct projection - 17 (8%), and CT studies - in 136 (65%) children. The immobilization of fractured fragments of the lower jaw is mainly carried out using the double jaw splinting according to Tigerstedt 153 (73%), in combination with osteosynthesis - 29 (14%) cases.

Conclusion: Fractures of the lower jaw occurred more commonly between the ages of 7 and 17 years, the cause of which in most cases was a fall. The most common location of the mandibular fractures was the condylar process. The most common method of fixing fragments of the lower jaw was double jaw splinting.

1. Introduction

Fractures of the lower jaw are one of the most frequent and complex types of traumatic injuries of the maxillofacial region in childhood, ranging from 45% to 95% of all injuries of the bones of the facial skeleton.¹ Children's traumatic fractures have peculiarities in the clinical course, diagnosis and immobilization, which is due to both general and local factors, namely: the psycho-emotional state of the child and the incomplete morphological and functional tissue development, the presence of growth zones, tooth rudiments.² The differential diagnosis of the mandibular fractures in children hinges on the clinical signs and the results of the additional investigations, which need to be approached critically in terms of their reliability. When choosing the type of immobilization of fragments of the lower jaw, the main task is to use the most sparing type, taking into account the peculiarities of the structure of the jaw and the period of occlusion.³

2. Materials and methods

We conducted a retrospective analysis of 210 case histories of children with traumatic fractures of the lower jaw from the age of 6 months–18 years carried out who were treated at Department of Surgical Dentistry and Maxillofacial Surgery of Childhood, Bogomolets National Medical University from January 2014 to December 2018 year. Analysis of case histories was carried out according to the proposed survey map, which provided the information on the age, gender, etiology of the injury, seasonality, terms for seeking help, additional research methods, the type and location of fractures depending on age and gender, treatment and the length of hospital stay.

3. Results

Under our supervision, there were 210 patients in whom 261 fractures of the lower jaw were diagnosed, of which there were 2.3 times more boys than girls (Fig. 1). Fractures in 104 (49%) cases were observed in the age 13–17 years old, among them 90% of boys (n = 87).

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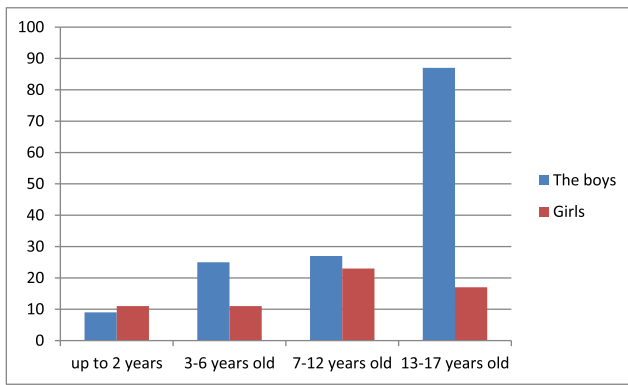


Fig. 1. Distribution of children with mandibular fractures by gender and age.

At 3–6 years old (n = 36–18%) boys prevail (n = 25–69%), at 7–12 years old (n = 50–24%), the distribution of fractures by sex was almost the same, and up to 2- x years (n = 20–9%), fractures of the lower jaw are more common in girls - 55%.

The most common cause of mandibular fractures was falling 142 (67%), which occurred while running and walking 73 (34.5%), during the game on the playground - swings and slides - 29 (14%), riding a bicycle and scooter - 30 (14%), a fall from a height about 9 (4%) (and even one attempted suicide.).

As a result of the impact, the fractures of the lower jaw were observed in 68 (33%) children: 41 (20%) in a brawl, 20 (10%) sports injury, 7 (3%) in road accidents (Fig. 2).

When assessing the seasonality of the injury, it was found that fractures of the lower jaw in the summer (n = 68–32%) and autumn months (n = 57–27%) were more common. Children were less injured in spring (n = 47–23%) and in winter (n = 38–18%) (Fig. 3).

Mostly, qualified help was sought on the first day of injury (n = 103–49%), on the second day - 46 children (22%), on the third - 34 (16%), delayed treatment (after 4 days) amounted to 27 patients (13%) (Fig. 4). Diagnosis of fractures of the lower jaw included a clinical examination and x-ray studies.

The most common clinical symptoms were: pain, severe swelling of the soft tissues, the presence of wounds on the skin and mucous membrane, limitation of opening the mouth, mobility of bone fragments, malocclusion, displacement of the central line, tooth mobility.

X-ray diagnostics was performed for all patients, but in different forms: orthopantomography was performed in 57 cases (27%), panoramic radiographs of the lower jaw in a direct projection - 17 (8%), and CT studies - in 136 (65%) children.

A significant part of the fractures was localized in the region of the

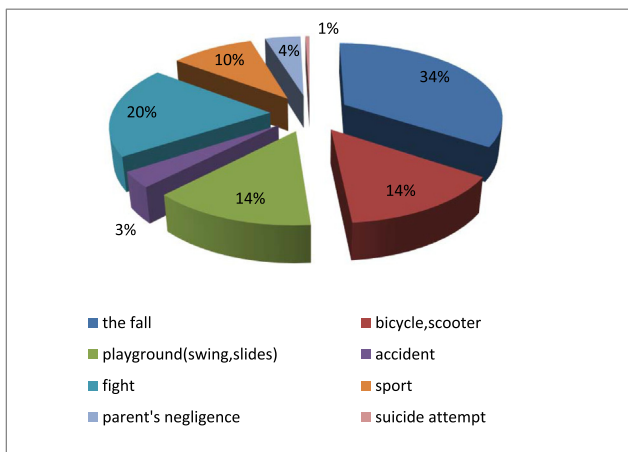


Fig. 2. Etiology of traumatic fractures in children.

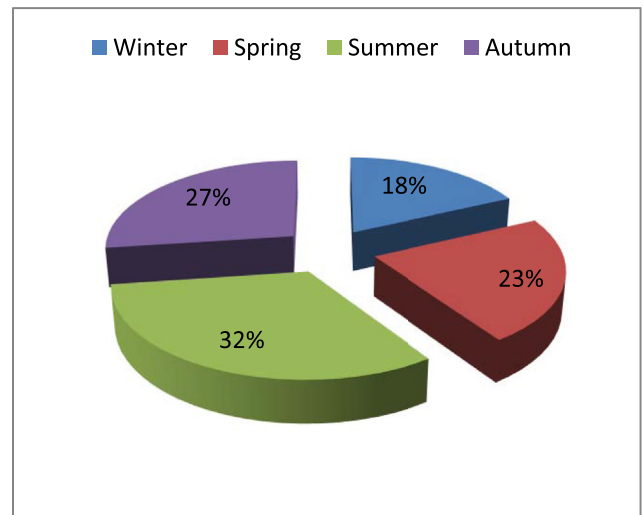


Fig. 3. Seasonality of traumatic fractures.

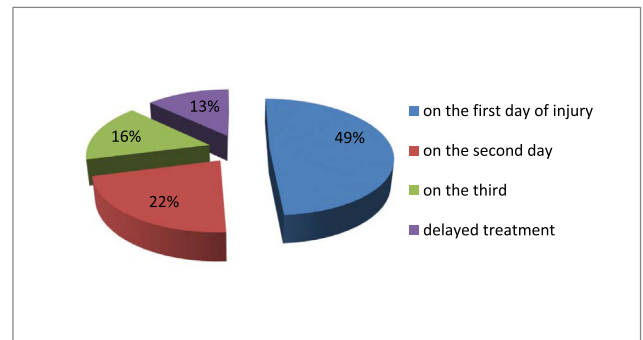


Fig. 4. Terms of applying for specialized help.

condylar processes 108 (43%) and the body of the mandible 44 (18%). The prevalence of fractures in the condylar processes in all age groups was established. An exception was the group of 13–17 years old, in which 1.3 more often had fractures with localization in the region of the angle of the lower jaw. Fractures in the mental region amounted to 40 (16%) cases, of which 82% (n = 33) of cases between the ages of 7 and 17 years. Fractures in the area of angles were observed in 37 (14%) patients and only at the age of 13–17 years. In the ramus region, fractures were observed in 7 (3%) patients in groups of 7–17 years old. Fractures of the anterior alveolar ridge were diagnosed in 5 (2%) children, of which aged 3–6 years in 60% (n = 3) cases, and in 13–17 years old - 40% (n = 2). Median fractures were 5% (n = 12) and 50% (n = 6) under the age of 2 years (Fig. 5).

In general, up to 2 years, mandibular fractures were diagnosed in 25 (9.5%) patients, among them 13 (52%) were fractures in the condylar process, median fractures - 6 (24%), in the angle and body region - 3 (12%).

Fractures without displacement were noted in 125 (60%) patients and prevailed over fractures with displacement - 85 (40%) cases. Moreover, with a bias were 58 (68%) in boys and 27 (32%) girls.

Fragment displacement was more often observed in the condylar processes 60 (60.6%) cases, then the body - 18 (18.2%), the angle - 8 (8.1%), the mental region - 7 (7.1%), the median - 3 (3%), ramus - 2 (2%), and also the alveolar ridge - 1 (1%).

The immobilization of fractured fragments of the lower jaw is mainly carried out using the double jaw splinting according to Tigerstedt 153 (73%), in combination with osteosynthesis - 29 (14%) cases (Table 1). In isolated form, Tigerstedt tires were used for fractures with different locations without displacement and with displacement in

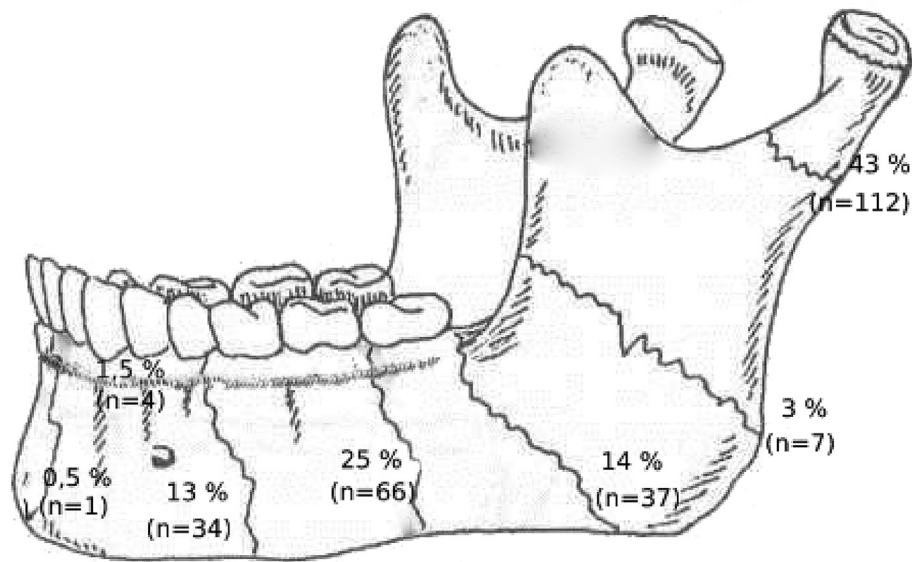


Fig. 5. Localization of fractures of the lower jaw.

Table 1
Types of immobilization in fractures of the lower jaw.

Treatment method	Number of cases	%
Tigerstedt tires	153	73
osteosynthesis	14	7
osteosynthesis + intraos. screw	3	1,5
intraos. screw	1	0,5
Osteosynthesis + splints	29	14
osteosynthesis + orthodontic buttons	1	0,5
orthodontic buttons	3	1,5
Refusal of treatment	1	0,5
No treatment required	3	1,5

cases where it was possible to carry out a closed reposition and achieve stable fixation of fragments. For fractures of the condylar processes, Tigerstedt tires were used either as part of surgical treatment with further osteosynthesis, or independently. Tigerstedt tires were used for fractures up to 8 years old regardless of displacement (n = 36), to older children for displacements up to 30° (n = 45). Osteosynthesis without additional fixation with tires was used in 14 (7%) patients during the temporary bite, with median fractures (n = 8–57%) and in the mental region (n = 6–43%). Intraosal screws in combination with osteosynthesis were used in 3 (1.5%) cases, and in isolated form in one (0.5%). This type of fixation was used with localization in the region of the condylar processes and the body of the lower jaw, both with or without displacement, during the period of constant occlusion. Fragments were fixed using the orthodontic bracket system with an inactive arch to 3 (1.5%) children, in combination with osteosynthesis - 1 (0.5%) cases, was performed during fractures in the condylar processes and lower jaw body with a slight displacement.

The length of hospital stay of such children was: up to 5 days in 69 patients (33%); 6–10 days in 115 (55%); and over 10 days in 26 children (12%) (Fig. 6). On average, the child was hospitalized for 6–10 days, which was determined by the type of fracture and its somatic condition.

4. Discussion

Fractures of the lower jaw in children are distinguished by a variety of clinical pictures, which is associated with the anatomical and physiological characteristics of the maxillofacial lesions in different age

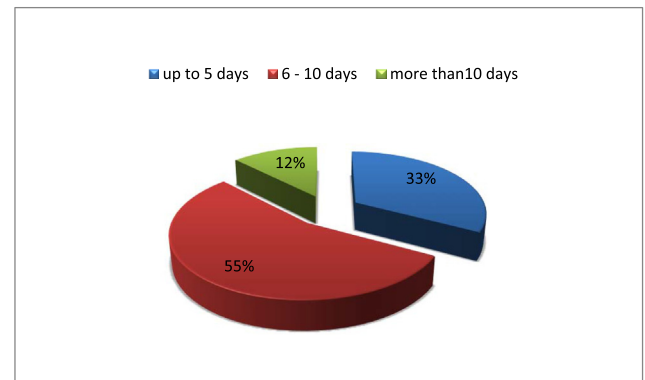


Fig. 6. Duration of stay of children with fractures mandible in the hospital.

periods. So, a large amount of fatty tissue, high permeability of blood and lymph vessels, causes pronounced edema of the soft tissues, the formation of hematomas and the leveling of pathognomonic symptoms. The structural features of the lower jaw and its relationship with surrounding tissues and anatomical structures affects the type of fracture and the course of the postoperative period.

The difficulties of assessing the clinical status of a child with traumatic damage to the lower jaw are also associated with the peculiarities of the child's psycho-emotional reaction to the injury. First of all, children show a violent reaction to trauma, they are sensitive to the appearance of even minor pain. Therefore, tension can occur in most of the muscles of the maxillofacial region, and sometimes the muscles of the whole body (the so-called retraction of fear). This makes it difficult to inspect the local status.⁴⁻⁶

Analyzing the age aspect, it should be noted that almost half of the fractures were noted in the age group from 13 to 17 years. This is due to increased physical activity during classes in sports sections, an increase in social activity, a search for oneself, manifestations of extreme behavior - the maximalism of youth.^{7,8}

In the group of children from 7 to 12 years old, which is in second place in the frequency of injuries of the lower jaw, fractures are promoted not only by physical activity, but also by local factors: interchangeable bite, with the presence of temporary teeth that are at the stage of root resorption, eruption and the formation of permanent, growth zones and buttresses.

The smallest number of fractures of the lower jaw was noted at the

age of 1–6 years. This fact is explained by the elasticity of bone tissue due to the increased content of organic components and pronounced periosteum, which protects the bone from mechanical stress and is at the same time a source of bone formation. Children of this age are more often under the supervision of parents. In addition, at the age of 1–3 years, the center of gravity is shifted anteriorly in children, and therefore the fall occurs more often on the chin and as a result reflected fractures of the condylar processes, which accounted for half of all fractures in this group.^{9–11} Analyzing the seasonality of fractures, it was found that they occurred mainly in the summer months, which is associated with a significant time spent outdoors: visiting playgrounds, riding a bicycle and scooter, playing sports. The greatest number of cases with injuries of the lower jaw was observed in June and September, on average, 32 cases, and in other months - from 10 to 22.

Falls of various nature are the most common cause of fractures of the lower jaw (67%) were the result of a fall while running, riding a bicycle, scooter.^{9,10,12} Such fall can be preceded by a “given acceleration” (push or blow), which increases the speed of impact and the amount of damage, especially in the head area. Abrasions, bruising, and bruised wounds can occur at the site of the collision, which was also noted in our patients. When falling backwards, depending on the position of the head at the moment of impact, the cracks extend mainly to the arch (head tilted anteriorly) or the base of the skull (head tilted backward). The impact with respect to the brain extends mainly in the horizontal direction, causing concussion and bruises both in the collision zone and on the diametrically opposite side (“shock” zone). In our patients, the closed-head injury was diagnosed in 15% of patients.^{13,14} Damage due to free fall from a height, both direct and step-wise, depends on the height, weight, surface of the fall and its density, as well as with the acceleration previously imparted onto the body (shock or shock preceding the fall).

When falling from a moving object, a number of physical factors are added, such as speed, height, position of the child, and forces of inertia. These factors affect the location of the fracture, the degree of displacement of the fragments. In older age groups, a high percentage is made up of fractures received in a fight (20% of cases), the nature of the damage of which depends on the place of application and the magnitude of the traumatic force. It should be noted that the number of injuries received in road accidents, accompanied by combined fractures of other bones, is increasing.

Considering the characteristic of fractures by localization, it was found that half of all fractures were in the condylar process, and the second was the body of the lower jaw.^{9–11,15,16} This can be explained by the prevalence of household injuries at present, in which the blow falls mainly in the area of the chin and corners of the lower jaw, i.e., in the anteroposterior and lateral directions. Mandibular fractures in the ramus region occur on the side of the application of force. They are often comminuted and this, correlates with the data from our clinic. Such fractures were only rarely associated with the displacement of fragments, or the malocclusion.

Fractures of the anterior alveolar process of the lower jaw, which were noted more often in children 8–11 years old, are accompanied by ruptures of the mucous membrane and underlying soft tissues, as well as dislocation or fracture of the teeth. The anatomical position of the alveolar bone, defective dentition in children of this age often contributes to open damage.

2/3 of the patients examined were hospitalized in the acute period - on the day of the injury and the next. The remaining 1/3 of the of patients presented after 4 days; this was due to the parents' ignorance of the presence of a fracture, (especially in children under 7 years old), as well as the diagnostic and clinical management errors, particularly at the non-specialized medical institutions.

X-ray diagnostics is the main research tool for making diagnosis. Survey images were taken only at the place of residence - before admission to the hospital (at the prehospital stage). Survey radiographs in a direct projection in the nasal-frontal or nasal-chin placement allow us

to evaluate the consistency of the lower jaw along its lower edge, as well as the degree of displacement of fragments during fractures in the ramus area, generally without displacement details. In this case, the standing and position of the teeth on x-rays in a direct projection cannot be analyzed relative to the planes. X-rays are only useful in order to answer simply whether there is a fracture or not.

Orthopantomography for the diagnosis of variously localized mandibular fractures was performed in a third of cases. It makes it possible to assess the condition of the ramus and body of the lower jaw, but the image of the temporomandibular joint is formed in an oblique projection (not lateral) that is disadvantageous for it, which makes it possible to detect a violation of the integrity of bone tissue only with loss of height and significant displacement of fragments. On the orthopantomogram, it is impossible to visualize the “greenstick” fracture line - without displacing fragments, with a preserved periosteum, especially in the chin projection. Also, diagnostic errors can lead to the development of deformations of the dentition, post-traumatic osteomyelitis, and the formation of a false joint.

Another disadvantage of this radiological modality is the technical difficulty, namely: the need to control the position in the mouth of the x-ray tube applicator, which is especially difficult when carrying it out for children. There are age restrictions for performing this type of x-ray examination (best avoided in the children under 6 years old).

The most informative modality to date is the CT, which was conducted in 65% of patients. It depicts fully the fracture in its structure, the character of the integrity loss, the relation of the fracture line to the forming intra-mandibular permanent teeth. or the primordia, the degree of the fragment displacement. It also allows to appropriately choose and plan the immobilization method. However, in children of a younger age group, its conduct requires general anesthetic.

The choice of X-ray examination method depends on the type of fracture and the planned surgical intervention, taking into account the age of the child. Fragments immobilization during the healing period is the mainstay of treatment. Naturally, the correct choice of the fixation method determines its success in many respects, which depends on the location of the fracture, the degree of displacement of the fragments, the presence of teeth or primordia in the fracture line, and the period of occlusion.

The most common fixation method is double jaw splinting in an isolated form, or in combination with the lower jaw osteosynthesis. They were used in 73% and 14% respectively. However, the chronic trauma to the periodontal tissues should be noted, while difficulties in maintaining oral hygiene, splinting difficulties during a removable bite (the presence of mobile teeth due to physiological resorption and the presence of unformed roots), as well as the need for general anesthesia during splinting and their removal in many age groups.^{17,18}

When using osteosynthesis, the fixation and stability of the plate at a young age can be reduced due to low bone mineralization and the presence of primordia in the jaw, and therefore the fixing elements should be located on the lower edge of the mandible.

When using the titanium miniplates, a second operation is required - to remove them. In this regard, the use of resorbable plates is preferable. Intraosseal screws for the purpose of immobilization avoids the use of Tigerstedt tires with its negative consequences, however, it has limited indications in the form of fracture localization and the possibility of using it during a period of only permanent occlusion - there is a risk of injury to the buds and roots of the margin during insertion. Fixation of the mandibular fragments using the orthodontic bracket system with an inactive arch and in combination with osteosynthesis requires a sufficient number of stable teeth with a pronounced clinical crown, and the displacement of the fragments should be minimal. The discussed immobilization methods are the methods of choice and require discernment in their application in regards to the fracture type, the presence of displacement of fragments, the degree of occlusion and child's age.^{18,19}

5. Conclusions

Fractures of the lower jaw occurred more commonly between the ages of 7 and 17 years, the cause of which in most cases was a fall.

The most common location of the mandibular fractures was the condylar process. This was typically associated with the displacement, and prevailed in all age groups.

CT scan is the most informative method to establish the nature of the fracture and to determine the type of immobilization of the mandibular fragments. The immobilization method was determined by the type and location of the fracture, the presence of displacement of the fragments, and the degree of occlusion in the child.

The most common method of fixing fragments of the lower jaw was double jaw splinting, which was used both in an isolated form and in combination with others. However, it exerts a negative effect on the periodontal tissues in childhood.

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Declaration of competing interest

None.

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