

Review

Rates, Patterns and Prevalence of Mandibular Fractures in Children

Ayman Bukhsh¹, Rahaf Bargat², Mohammed Alkuhl³, Sarah Alshudukhi⁴, Abdel Rahim Hamadah⁵, Nada Alzahrani⁶, Muhannad Zarbah⁷, Faisal AlOtaibi⁸, Norah Alghamdi⁹, Renad Attar¹⁰, Haifa Binthabit¹¹

¹ Department of Maxillofacial Surgery, King Abdul Aziz Specialist Hospital, Taif, Saudi Arabia

² College of Dentistry, Vision Colleges, Riyadh, Saudi Arabia

³ General Dentist, Ministry of Health, Hafer Albaten, Saudi Arabia

⁴ General Dentist, Hail Dental Center, Hail, Saudi Arabia

⁵ College of Dentistry, Vision Colleges, Jeddah, Saudi Arabia

⁶ College of Dentistry, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia

⁷ General Dentist, Maternity and Children Hospital, Abha, Saudi Arabia

⁸ College of Dentistry, Jazan University, Jazan, Saudi Arabia

⁹ General Dentist, Bella Clinic, Riyadh, Saudi Arabia

¹⁰ College of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

¹¹ College of Dentistry, King Khalid University, Abha, Saudi Arabia

Correspondence should be addressed to **Ayman Bukhsh**, Department of Maxillofacial Surgery, King Abdul Aziz Specialist Hospital, Taif, Saudi Arabia. Email: dr.Ayman_bukhsh@hotmail.com

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Abstract

Maxillofacial pediatric fractures are highly uncommon due to their unique characteristics of high elasticity, cartilaginous tissue, lack of pneumatization, evolutionary stages of dentition and other protective features. However, despite their rarity, pediatric facial fractures often seen by pediatric surgeons, plastic surgeons and in the emergency department. The mandible is the most commonly fractured pediatric facial bone. In this review, we will discuss the various patterns of mandibular fractures, their rates and prevalence in the pediatric population. An extensive search was conducted from various electronic databases such as PubMed, Medline Embase, Google Scholar and Cochrane Library to retrieve original researches and narrative reviews. The most common site to be fractured in the mandible is the condylar process, followed by the symphysis and the angle. Condylar process fractures are more common in younger children between the ages of 1 to 13 and angular fractures supersede during the teenage years. Mandibular fractures are also categorized based on the localization and number of fractures such as a single fracture, or multiple fracture both unilateral and bilateral. Further studies with larger sample sizes and specific age groups should be conducted to achieve more significant results.

Keywords: Mandible, Children, Pediatric, Patterns, Fractures

Introduction

Maxillofacial fractures are a rare occurrence in children, but can lead to severe, long-term consequences (1-4). Certain features of pediatric facial bones such as high elasticity and cartilaginous structures, a high ratio of cancellous to cortical bone, protection by adipose tissue, lack of pneumatization of paranasal sinuses, and anchoring of the maxilla and mandible due to unerupted teeth and mixed dentition in older children make the mandible highly elastic and stable (5, 6). Therefore, we can state that children are a very distinctive population in regards to maxillofacial fractures (6).

The mandible a membranous bone with cartilaginous tissue containing growth centres undergoing secondary calcification with strength reinforced by muscles of mastication (6). It is a complex musculoskeletal unit that is responsible for basic life functions such as speech and mastication (7). Despite the protective features of pediatric facial bones, the most commonly fractured facial bone in children is the mandible. Mandibular fractures occur in around half the pediatric population presenting to the department of accident and emergency (1). The incidence of mandibular fractures is 15% to 86.7% out of all pediatric maxillofacial fractures (8). They are more common in boys as compared to girls with a male: female ratio of 4:1 (1, 2). The age distribution for children with mandibular fractures is 1.6 to 16 years, with a mean age of 11.5 years (4, 9).

Based on the Helkimo dysfunction indices (Di) used to assess clinical findings and the Helkimo Anamnestic indices (Ai) used to assess subjective symptoms can be used to identify signs and symptoms of a mandibular fracture in children. The Ai can be divided into 3 grades based on symptomatology, *Ai 0*, which is asymptomatic, *Ai I*, mild symptoms with either one or more of the following symptoms such as joint noise, muscle fatigue, and/or stiffness in the morning and during the exercise and *Ai II*, severe symptoms with either one or more of the following symptoms which include imitation of mouth opening, joint locking, dislocation, motion induced mandibular pain, and/or pain in the temporomandibular joint or masticatory muscles (10). The Di for clinical findings evaluated 5 signs of movement were assessed including movement under the edge of the lower jaw, joint dysfunction, tenderness of joint and muscle, pain in the jaw. Each sign was evaluated separately and assigned a score ranging from 0 to 5. The scores for all 5 signs are summed and graded as Di 0 indicating normal function and Di III as worsening function (10). In addition to the above signs

and symptoms, pain and swelling over the site of the fracture, gingival lacerations, a buccal and sub-lingual hematoma, a prickling or tingling sensation in the lower lip and chin which overlying the distribution of the inferior alveolar nerve, dental problems and trauma such as a malocclusion, mobile dental and osseous segments wide displacement between teeth and even bleeding from a laceration from the anterior wall of the external auditory canal due to a condylar fracture have also been reported (11).

Some of the most common causes of mandibular fractures among children varies according to their age group (6). In children between the ages of 1.5 to 12 years falls from bicycles, heights, or swings, assault by family members, road traffic accidents when children are passengers can lead to mandibular fractures, whereas children 13 years and older suffer from mandibular fractures most commonly due to road traffic or motor vehicle accidents when children are passengers or pedestrians, and sports injuries. (5, 6). In this review we will discuss the prevalence of mandibular fractures and different patterns of fractures among children.

Methodology

A thorough search was conducted from electronic databases such as PubMed, Medline Embase, Google Scholar and Cochrane Library. To avoid missing potential studies, a further manual search for papers was done through Google Scholar. Only literature published within the last 15 years and papers in the English language were included. All studies discussing mandibular fractures in adults were excluded from our review.

Discussion

The mandible is a U-shaped bone identified by its anatomical landmarks or subsites which are the condylar process or the condyle, the ramus, the body, the angle and the symphysis or parasymphysis (4, 7). Fracture patterns in children differ based on their stages of dentition, as the weak points of the pediatric mandible vary with age. Furthermore, the daily routine and activity levels, and the nature of children are different as compared to adults.

The most common site of fracture in a mandible is the condyle (4, 9). According to various studies reported in literature, the condylar region consisting of the condylar neck and condylar head is the most frequently fractured structure accounting for up to 56% of all mandibular fractures in children and adolescents. (7, 10). A study by

Glazer et al. conducted on 61 children between the ages of 1.5 years to 16 years treated for mandibular fractures over a period of 17 years from 1993 to 2010. The children were divided into three groups with *Group A*: 18 months–5 years, *Group B*: 6–11 years, and *Group C*: 12–16 years. The study revealed that the most common site in all age groups was the condyle in 38 out of 85 fractures accounting for 45% of all fractures, either solitary or in combination with other fractures. The condylar fracture in isolation occurred in 27 (44%) of the patients accounting for 44%. The incidence of a condylar fracture was significantly different than the other sites ($p < 0.05$) (9). Similarly, a retrospective chart review study by Shi et al. was conducted in Shanghai, China on children from the ages of 0 until 16 years of age who were treated for mandibular fractures from 2005 to 2012. Out of 104 children and adolescents, 55.7% of fractures were of the condylar process (10). A retrospective study was conducted by Cleveland et al. on the Healthcare Cost and Utilization Project from the 2016 Kids' Inpatient Database on children aged 18 years and less. Condylar fractures were found to be more commonly in younger children. Children younger than 1 year of age had the highest incidence of condylar fractures with 16.9% from 2056 children suffering from maxillofacial traumas. In children aged 13–18 years, condylar fracture of the mandible constituted between 5.2% and 7.8% of the mandibular fractures, whereas in children less than 13 years old these fractures accounted for between 6.2% and 16.9% of mandible fractures (12).

The second most frequently fractured anatomical subunit of the mandible is the parasymphysis accounting for 20%–32% of mandibular fractures (7). In a study by Eskitascioglu et al., 235 cases ages 16 and under with mandibular fractures were studied retrospectively in the department of Plastic, Reconstructive, Esthetics Surgery in Turkey. The total number of cases has 333 fractures, and the most common fracture location of the mandible was the parasymphysis region (34%), however not many studies have reported this region to be commonly fractured. The mandibular angle is not fractured as commonly in children (10). The percentage of angle fractures ranges accounts for 4.4% to 45% of mandibular fractures. The increased incidence occurs with the development of the third molar tooth, during the teenage years of children (7). Due to its anatomic location in a high stress region with the attachment of many muscles, fractures of the angle are not observed. In the study by Shi et al. out of 104 children and adolescents, only 3.5% children suffered from fractures at the mandibular angle (10). However, in a retrospective study conducted as part

of the Healthcare Cost and Utilization Project's National Emergency Department Sample in 2012. The survey sample of 1984 records consisted of a cumulative of 8848 cases of pediatric mandibular fractures. The results revealed that the second most common site for mandibular fractures was the mandibular angle, in 1252 patients. Furthermore, in the age group of children between the ages of 13 and 18 years, the most frequent site of fracture was the mandibular angle in 1157 patients (17.6%), followed by other sites such as the condyle and ramus. In males, the fractures at the angle accounted for 15.0% ($n = 1053$) of all mandible fractures, whereas in females the fractures at the angle accounted for 10.9% ($n = 199$) (2). This is reiterated by the retrospective study by Cleveland et al. which reports that condylar fractures are more common in teenagers. In teenagers older than the age of 14 years fractures of the angle account for between 12.2% and 14.2% of mandible fractures, whereas fractures of this anatomical landmark in children younger than the age of 14 accounted for between 0% and 7.5% of mandible fractures. Children younger than 2 years of age did not suffer from angular fractures (12). Other less commonly reported fracture sites of the mandible among children are the body, and ramus, however not many studies have reported significant results with these sites of mandibular fracture.

Mandibular fractures can also be categorized as localization and number of fractures such as single, multiple unilateral, multiple bilateral. In the study by Eskitascioglu et al., out of 235 cases, 145 cases had a single fracture (62%), 40 cases had unilateral multiple fractures (bipartite tripartite) whereas 50 cases had bilateral fractures; 38% of all the cases constituted multiple fracture line rates (8). In the study by Glazer, 46% patients had multiple fractures of the mandible, with a mean of 1.39 fractures per patient. Multiple fractures were more common in *Group C* of children 12 to 16 years of age with 62%, as compared to *Group A* of children of 18 month to 5 years with 35% and *group B* of children from 6 to 11 years of age with 25% with a significant statistical difference ($p < 0.05$). Multiple fractures usually occur on the condyle of one side and the body/angle of the contralateral side of the mandible (9). Another type of classification of mandibular fractures has been discussed by Loukota et al. based on intracapsular fractures of the mandible by Neff et al. They are categorized into Types A, B, and M according to the location of the fracture line: *A type*, which is a fracture line through the medial condyle with the height of the ramus unchanged; *B type*, condylar fracture line through the lateral condyle with the height of the ramus

reduced significantly; and *M type*, where the condylar head showed a fracture (10). However, there are very limited studies that extensively discuss these types of mandibular classifications in the pediatric population.

Conclusion

Maxillofacial fractures although a rare occurrence in children due to the anatomy and features of the pediatric facial bones can lead to severe long-term consequences and disability in form and function in the event of fractures. The most common bone to be fractured in pediatric maxillofacial trauma is the mandible due to its various stages of dentition in the growing child and its vulnerable anatomical sites. The most common site to be fractured in the mandible is the condylar process, followed by the symphysis and the angle. Mandibular fractures are also categorized based on the localization and number of fractures such as a single fracture, or multiple fracture both unilateral and bilateral. Further studies with larger sample sizes and specific age groups should be conducted to achieve more significant results.

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Authors' contribution:

All authors contributed equally to the drafting, writing, sourcing, article screening and final proofreading of the manuscript.

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