Journal of Craniomaxillofacial Research

Vol. 12, Issue. 1 Winter 2025

Epidemiological Patterns and Clinical Management Strategies of Pediatric Facial Fractures

Bayad Jaza Mahmood Faris [1*], Mustafa Abdulrazaq Zangana [2], Ibrahim Saeed Gataa [3]

1. Department of Oral and Maxillofacial Surgery, College of Dentistry, University of Sulaymaniyah, Sulaymaniyah, Iraq.
2. Department of Oral and Maxillofacial Surgery, Ministry of Health, Kirkuk, Iraq.
3. Department of Oral and Maxillofacial Surgery, University of Warith Al-Anbiyaa, Iraq.

ARTICLE INFO

Article Type:
Original Article

Received: 14 September 2024
Revised: 12 October 2024
Accepted: 11 November 2024

**Corresponding author:*
Bayad Jaza Mahmood Faris

Department of Oral and Maxillofacial Surgery, College of Dentistry, University of Sulaymaniyah, Sulaymaniyah, Iraq.

Tel: +9647701955665
Fax: +9647726707171
Email: bayad.mahmood@univsul.edu.iq

ABSTRACT

Introduction: Pediatric maxillofacial fractures pose unique challenges due to anatomical and developmental differences from adults. Effective management requires understanding the etiology, patterns, and treatment of these injuries. To evaluate the incidence, causes, types, and treatment of pediatric facial fractures, aiming to improve clinical management and preventive strategies.

Materials and Methods: A cross-sectional study was conducted on 100 children (aged <15 years) with facial fractures at Shar Teaching Hospital, Sulaimani, Iraq, from October 10, 2024, to April 20, 2025. Data on demographics, causes, fracture types, associated injuries, and treatment methods were analyzed.

Results: The study population had a mean age of 7.85 years, with 65% of the participants being male. Falls were the most common cause (59%), followed by road traffic accidents (38%). Lower facial fractures (53%) were most frequent, primarily involving the mandible, followed by mid facial (50%) and upper facial fractures (1%). Soft tissue injuries occurred in 90% of cases, and 11% had additional orthopedic or neurological injuries. Treatment methods included closed reduction (47%), conservative management (44%), and open reduction (9%).

Conclusion: Pediatric facial fractures are more common in males and older children, primarily caused by falls and road traffic accidents. Improved safety measures, enhanced parental supervision, and specialized pediatric trauma management are essential. Large-scale studies are needed to establish standardized treatment protocols.

Keywords: Pediatric facial fractures; Maxillofacial trauma; Fracture patterns; Injury prevention; Trauma management.

Please cite this Article as:
Mahmood Faris BJ, Abdulrazaq Zangana M, Gataa IS. Epidemiological Patterns and Clinical Management Strategies of Pediatric Facial Fractures. J Craniomaxillofac Res 2025; 12(1): 7-16. DOI:

Introduction

Managing maxillofacial complex fractures in children remains challenging, requiring specialized skills and clinical judgment [1]. While trauma is the leading cause of morbidity and mortality in children, pediatric facial fractures are less common than in adults and present with distinct clinical features [2-5]. They account for only 1% to 14.7% of all facial fractures [6]. Several anatomical features—such as flexible facial bones, the buccal fat pad, and underdeveloped paranasal sinuses—offer children partial protection against facial trauma [7]. Nonetheless, early craniofacial injuries can have long-term physical, emotional, and financial consequences [8].

Understanding developmental stages is essential, as treatment must be tailored to age groups ranging from infancy to adolescence [9]. The causes of fractures vary by region, influenced by cultural and environmental factors. Incidence increases with age, especially during school years and adolescence, when boys are more frequently affected [10]. Common causes include traffic accidents, falls, and sports injuries [11]. Younger children are rarely involved in violence or work-related trauma, but risk grows with increased activity and independence [12]. Nasal fractures are most frequent, followed by mandibular fractures, the latter being the leading cause of facial trauma requiring hospitalization [13-15]. Although treatment principles resemble those for adults, pediatric care demands consideration of growth and development. Children often heal faster and with fewer complications, allowing for more conservative approaches, though surgery is sometimes necessary [16-18]. Unique challenges include small bone size, mixed dentition, developing tooth buds, and limited cooperation [19-20]. Temporomandibular joint ankylosis and condylar growth disturbances are also more common, reinforcing the need for tailored management [21].

Materials and Methods

This cross-sectional clinical and statistical study included 100 pediatric patients under 15 years of age with facial bone fractures, conducted at the Department of Oral and Maxillofacial Surgery- Shar Teaching Hospital (Sulaimani, Iraq), from October 10, 2024, to April 30, 2025. Data were collected using a structured case sheet to record demographics, fracture etiology, soft tissue and associated injuries, fracture types and sites, and treatment modalities. Patients were divided into three age groups (<5, 5–9, 10–15 years) for analysis, following the classification by Rahman et al. (2007) [15]. Fractures were categorized by site and type based on Erdmann et al. (2008) [22]. Etiologies included road traffic accidents, falls, sports injuries, violence, and other causes, as described by Ferreira et al. (2005) [23]. Associated injuries, such as orthopedic trauma (e.g., limb fractures) and neurological injuries, were documented following the guidelines of Grunwaldt et al. (2011) [24]. The diagnosis involved a thorough history, clinical examination (both local and general), and radiographic imaging. Fractures were diagnosed using imaging modalities like OPG, PA views, and CT scans, with classifications based on Haug and Foss (2000) [21]. Treatment ranged from conservative management for linear fractures to closed or open reduction techniques involving intermaxillary fixation or plate-screw fixation. Ethical approval was obtained from the University of Sulaimani-College of Dentistry, and informed consent was obtained. Data analysis was performed using SPSS v.24, with statistical significance set at $p<0.05$

Results

A total of 100 children were included in the study, with a mean age of 7.85±4.18 years (range: 1–14.5 years) and a median of 7 years. The age distribution was as follows: 26% were under 5 years, 35% were 5–9 years, and 39% were 10–15 years. Males comprised 65% of the sample. Falls were the leading cause of facial fractures (59%), followed by road traffic accidents (38%). Sports injuries and other incidents were rare, accounting for 1% and 2% of cases, respectively. Among the 100 patients, 104 types of fractures were recorded, comprising 96 isolated fractures and four combined fractures. Lower facial fractures occurred in 53% of patients, midfacial fractures in 50%, and upper facial fractures in 1% Table 1.

Among the 53 patients with lower facial fractures, 64 individual fracture sites were identified. The dentoalveolar region was the most frequently involved (43.4%), followed by the condyle (26.4%), the symphysis and parasymphysis (15.1% each), the angle (9.4%), and the body (11.3%). No cases involved the coronoid or ramus. In mid facial fractures, the dentoalveolar area was again most affected (74%), with orbital (10%), Lefort II (6%), and ZMC (6%) fractures also observed. Nasal and zygomatic arch fractures were rare (2% each), with no significant sex-based variation. Only one upper facial fracture was noted, involving the frontal bone of a male patient Table 2. Soft tissue injuries were observed in 90 patients, with 11 of these cases also

presenting associated injuries: five involved the head (45.4%), three the upper limbs (27.3%), and three the lower limbs (27.3%). Fracture etiology differed significantly by age (P<0.001). In patients aged 10–15 years, road traffic accidents (RTA) were the leading cause (71.8%). Among those under 5 years and those aged 5–9 years, falls were most common, accounting for 88.5% and 74.3% of cases, respectively. Age also influenced fracture location. Lower facial fractures were more frequent in children under 5 years (80.8%) compared to those aged 5–9 (37.1%) and 10–15 years (48.7%) (P=0.003). In contrast, mid facial fractures were more prevalent in the 5–9 (62.9%) and 10–15 (53.8%) age groups than in children under 5 (26.9%) (P=0.018). Upper facial fractures were rare, observed in only 2.6% of 10–15-year-olds, with no cases reported in younger age groups (P=1) Table 3. Table 4 indicates no significant association between fracture etiology and the incidence of lower facial (P=0.399), mid facial (P=0.445), or upper facial fractures (P=0.410). As shown in Table 5, treatment approaches included closed reduction in 47% of cases, conservative management in 44%, and open reduction in 9%. Age significantly influenced treatment choice (P<0.001): 73.1% of children under 5 received conservative care, compared to 57.1% of those aged 5–9 and only 12.8% of those aged 10–15. There was also a significant correlation between fracture etiology and treatment modality (P=0.001). Over half (55.3%) of RTA-related fractures were managed with closed reduction, whereas most fall-related injuries (57.6%) were treated conservatively. Table 6 revealed no significant association between treatment modality and the location of fractures. Specifically, lower facial (P=0.697), midfacial (P=0.639), and upper facial fractures (P=0.530) showed no statistically significant differences in treatment approaches. Table 7 highlights significant associations between specific fracture sites and treatment approaches. Conservative management was predominant in dentoalveolar fractures (62.5%, P=0.003) and orbital fractures (100%, P=0.0007). Open reduction was the main modality for angle fractures (60%, P=0.004) and ZMC fractures (66.7%, P=0.004), while body fractures were equally managed by closed and open reduction (50% each, P = 0.004). Le Fort II fractures were primarily treated with closed reduction (66.7%), with the remainder undergoing open reduction (33.3%) (P=0.001). No significant associations were found for condyle (P=0.344), symphysis (P=0.064), or parasymphysis fractures (P=0.243). Notably, none of the dentoalveolar or body fractures were treated with open reduction.

Table 1. Distribution of patients by type of fracture.

Type of fracture	*No.*	*%**
Lower facial	*53*	*53.0*
Mid facial	*50*	*51.0*
Upper facial	*1*	*1.0*

More than one type may occur in one patient because there were combined fractures between (lower facial + mid facial) in 3 cases and between (mid facial + upper facial) in 1 case.

Table 2. Sex-based distribution of pediatric facial fracture sites.

Fracture Category	*Subcategory*	*Male*	*Female*	*Total*	*% (Total)*	*P Value **
Lower Facial Fractures	*Dentoalveolar15*	*15*	*8*	*23*	*43.4*	*0.528*
	Condyle	*6*	*8*	*14*	*26.4*	*0.118*
	Angle	*3*	*2*	*5*	*9.4*	*1.0*
	Symphysis	*5*	*3*	*8*	*15.1*	*1.0*
	Parasymphysis	*3*	*5*	*8*	*15.1*	*0.240*
	Body	*5*	*1*	*6*	*11.3*	*0.384*
Mid Facial Fractures	*Nasal*	*0*	*1*	*1*	*2.0*	*0.320*
	Zygomatic Arch	*0*	*1*	*1*	*2.0*	*0.320*
	Orbital	*2*	*3*	*5*	*10.0*	*0.311*
	Dentoalveolar	*27*	*10*	*37*	*74.0*	*0.301*
	Lefort II	*2*	*1*	*3*	*6.0*	*1.0*
	ZMC	*3*	*0*	*3*	*6.0*	*0.542*

Fracture Category	Subcategory	Male	Female	Total	% (Total)	P Value *
Upper Facial Fractures	Frontal Bone (Male)	1	0	1	1.0	-

Fisher's exact test (No significant differences between sex and fracture sites). Note: Multiple sites may occur in a single patient with lower facial fractures.

Table 3. Etiology and type of fracture by age.

Category	Age <5 (%)	Age 5-9 (%)	Age 10-15 (%)	P Value *
RTA	2 (7.7%)	8 (22.9%)	28 (71.8%)	<0.001
Falling	23 (88.5%)	26 (74.3%)	10 (25.6%)	<0.001
Sport	0 (0.0%)	0 (0.0%)	1 (2.6%)	<0.001
Other Accidents	1 (3.8%)	1 (2.8%)	0 (0.0%)	<0.001
Total	26 (100%)	35 (100%)	39 (100%)	Significant
Lower facial	21 (80.8%)	13 (37.1%)	19 (48.7%)	0.003
Mid facial	7 (26.9%)	22 (62.9%)	21 (53.8%)	0.018
Upper facial	0 (0.0%)	0 (0.0%)	1 (2.6%)	1
Total Fractures	26 (100%)	35 (100%)	39 (100%)	Significant

* By Fisher's exact test, the associations between age and both the etiology of fractures and the incidence of lower and mid facial fractures were statistically significant. In contrast, no significant relationship was observed for upper facial fractures. Note: Some patients sustained multiple fractures. In the <5-year group, 2 cases involved combined lower and midfacial fractures. Among those aged 10–15 years, 2 cases had both lower and mid facial fractures, and another 2 cases involved mid-and upper facial regions.

Table 4. Type of fracture by etiology of fracture.

Etiology of fracture	No.	Lower facial	Mid facial	Upper facial
RTA	38	19 (50%)	20 (52.6%)	1 (2.6%)
Falling	59	33 (55.9%)	28 (47.5%)	0 (0.0%)
Sport	1	1 (100%)	0 (0.0%)	0 (0.0%)
Others	2	0 (0.0%)	2 (100%)	0 (0.0%)
P value *		0.399	0.445	0.410

*By Fisher's exact test (No significant association between the etiology of fracture and type of fractures). Note: Multiple fractures were observed in some patients. Falls led to combined lower and mid facial fractures in 2 cases, while RTAs resulted in 2 cases with lower + mid facial fractures and 2 cases with mid + upper facial fractures.

Table 5. Distribution of treatment modalities by age and Etiology with P Values.

Attributes	Conservative Treatment	Closed Reduction	Open Reduction	Total	P Value *
Overall	44 (44%)	47 (47.0%)	9 (9.0%)	100	-
Age<5	19 (73.1%)	7 (26.9%)	0 (0.0%)	26	< 0.001
Age 5-9	20 (57.1%)	15 (42.9%)	0 (0.0%)	35	< 0.001
Age 10-15	5 (12.8%)	25 (64.1%)	9 (23.1%)	39	< 0.001
RTA	9 (23.7%)	21 (55.3%)	8 (21.1%)	38	0.001
Falling	34 (57.6%)	25 (42.4%)	0 (0.0%)	59	-
Sport	0 (0.0%)	0 (0.0%)	1 (100%)	1	-
Other	1 (50.0%)	1 (50.0%)	0 (0.0%)	2	-

According to Fisher's exact test, there was a significant association between treatment modalities and both age and etiology.

Table 6. Treatment modalities in each type of fracture.

Treatment modalities	Lower facial	Mid facial	Upper facial
Conservative treatment	22 (41.5%)	23 (46%)	1 (100%)
Closed reduction	25 (47.2%)	24 (48%)	0 (0.0%)
Open reduction	6 (11.3%)	3 (6%)	0 (0.0%)
Total	53 (100%)	50 (100%)	1 (100%)
P value *	0.697	0.639	0.530

*According to Fisher's exact test, no significant association was found between treatment modalities and overall fracture type. Note: Some patients had combined fractures—two cases with lower + mid facial fractures were treated by closed reduction, while two others with lower + mid facial and mid + upper facial fractures received conservative treatment.

Table 7. Comprehensive treatment modalities by site of fracture.

Category		Conservative	Closed Reduction	Open Reduction	P Value*
Lower facial	Dentoalveolar	15 (62.5%)	8 (34.8%)	0 (0.0%)	0.003
	Condyle	6 (42.9%)	8 (57.1%)	0 (0.0%)	0.344
	Angle	0 (0.0%)	2 (40.0%)	3 (60.0%)	0.004
	Symphysis	1 (12.5%)	7 (87.5%)	0 (0.0%)	0.064
	Parasymphysis	2 (25.0%)	6 (75.0%)	0 (0.0%)	0.243
	Body	0 (0.0%)	3 (50.0%)	3 (50.0%)	0.004
Mid facial	Nasal	0 (0.0%)	1 (100.0%)	0 (0.0%)	1
	Zygomatic Arch	1 (100%)	0 (0.0%)	0 (0.0%)	0.520
	Orbital	5 (100%)	0 (0.0%)	0 (0.0%)	0.0007
	Dentoalveolar	16 (43.2%)	21 (56.8%)	0 (0.0%)	0.005
	Le Fort II	0 (0.0%)	2 (66.7%)	1 (33.3%)	0.001
	ZMC	1 (33.3%)	0 (0.0%)	2 (66.7%)	0.004

*According to Fisher's exact test, treatment modality was significantly associated with specific fracture sites in both lower and mid facial regions. In the lower face, dentoalveolar, angle, and body fractures showed significant correlations with treatment choices. Similarly, in the mid-face, significant associations were observed for dentoalveolar, orbital, Le Fort II, and ZMC fractures. Notably, individual patients may present with multiple fracture sites, particularly within the lower facial region.

Discussion

Significant facial trauma in children can be life-threatening due to airway obstruction or hemorrhage-induced hypovolemia [25]. Pediatric facial fractures are uncommon (3%–6%), largely due to anatomical factors such as retruded facial structures, a high cranium-to-face ratio, and elastic bones [11,26-32]. This study found a 65% male predominance, consistent with global reports (52%–84.7%), often attributed to boys' involvement in risky activities [4,7,21,23,24,28,38]. Similar trends were noted in Australia, the USA, Greece, Turkey, and Nigeria [2,14,34-36]. Age classifications vary across studies, with cutoffs ranging from 10 to 18 years [3,37]. This study included children under 15, with a mean age of 7.85 years. Most cases occurred in the 10–15-year-old group (39%), followed by the 5–9-year-old group (35%). Similar trends have been observed in other studies [21,38-42]. However, some studies have reported higher fracture rates in children under 5 [15,43-45]. The lower incidence in children <5 years may be due to protective facial anatomy and reduced exposure. As children grow and engage in more activities, changes like sinus pneumatization increase fracture risk [4,46]. Falls were the leading cause (59%), often from household furniture or play, aligning with previous studies [10,15,21,28,33,47-50]. RTAs followed (38%), with factors including unsafe vehicle practices and poor road conditions [2,13,35,51]. Violence-related injuries were rare, and sports injuries

accounted for only 1%, likely related to football [22,53-55]. Mandibular fractures were most common (53%), followed by mid facial (50%) [10,44,56,57]. While CT-based studies report more midface fractures, upper facial injuries were rare here (1%), possibly managed outside OMFS settings [23,42]. Among mandibular fractures, dentoalveolar (43.4%) and condylar (26.4%) types were most frequent [10,13,21,23,59,61]. Other types included symphysis and parasymphysis (15.1% each), and body (11.3%) [62]. Condylar fractures are notable for growth disturbance risks [15]. Angle fractures (9.4%) were less frequent, possibly due to the absence of third molars [62].

Dentoalveolar fractures dominated midface injuries (74%), influenced by factors like overjet and poor lip coverage [21,59,63-65]. Orbital fractures were next (10%), consistent with other findings [21,42]. Le Fort II and ZMC fractures (6% each) aligned with reported ranges [21,66]. Nasal and zygomatic arch fractures were low (2%) [5,7,37,66,68,69]. No significant sex-based differences were found in mid or lower facial fracture patterns. Soft tissue injuries were seen in 90% of cases, commonly in the T-zone (forehead, nose, lips, and chin) [4,28,43,70-72]. Lacerations were the most frequent, often due to impact with hard surfaces. Associated injuries were present in 11% of cases, mainly head injuries (45.4%), due to proximity and anatomical vulnerability [2,21,23,24,41,47,73-76]. Orthopedic injuries (27.3%) were also frequent [42].

Treatment depended on age, fracture site, and severity [44]. Closed reduction was most common (47%), with conservative treatment used in 44% of cases, particularly for greenstick and non-displaced fractures [23,27,39,41,42]. ORIF was used in 9%, typically for complex cases [33,58]. Age influenced both fracture type and treatment: children under 5 had more lower facial fractures (80.8%) and were mostly treated conservatively (73.1%) [42,56,7]. Younger children's facial structure provides more protection but makes the mandible prone to injury due to unerupted teeth [28,81-83]. Older children (10–15 years) had more mid facial fractures and were more likely to receive closed (64.1%) or open reduction (23.1%). Treatment modality correlated significantly with age ($P < 0.001$) and etiology ($P<0.001$), with RTAs often requiring reduction and falls treated conservatively [3,26,28,51,85,86]. No significant associations were found between fracture type and treatment method ($P>0.05$) [33]. However, fracture-specific analysis revealed conservative treatment was common for dentoalveolar fractures (lower: 62.5%, $P=0.003$; midface: 43.2%, $P=0.005$). Open reduction was mainly used for angle (60%, $P=0.004$), ZMC (66.7%, $P=0.004$), and Le Fort II fractures (33.3%, $P=0.001$), while orbital fractures were treated conservatively (100%, $P=0.0007$) [87-90]. No significant treatment correlations were found for condylar, symphysis, or parasymphysis fractures, nor other mid facial fracture types ($P>0.05$).

Conclusion

Pediatric facial fractures were more common in males and the 10–15-year age group, mainly caused by falls and road traffic accidents. Lower facial fractures, especially mandibular and dentoalveolar, were most prevalent. Treatment primarily involved closed reduction, depending on age, fracture site, and complexity. Many patients had soft tissue injuries, with some also having injuries in other body regions.

Conflict of Interest

There is no conflict of interest to declare.

References

[1] Jaber, M. A., AlQahtani, F., & Bishawi, K. (2021). Patterns of Maxillofacial Injuries in the Middle East and North Africa: A Systematic Review. International Dental Journal, 71(5), 369-379.

[2] Haug, R. H., & Foss, J. (2021). Patterns of Pediatric Facial Fractures. Craniomaxillofacial Trauma & Reconstruction, 14(3), 167-173.

[3] Al-Tairi, N., & Al-Radom, J. (2021). Prevalence and Etiology of Pediatric Maxillofacial Fractures in a Group of Yemeni Children and Adolescents. Open Journal of Stomatology, 11(5), 179-187.

[4] Țenț, P. A., Juncar, R. I., Moca, A. E., Moca, R. T., & Juncar, M. (2022). The Etiology and Epidemiology of Pediatric Facial Fractures in North-Western Romania: A 10-Year Retrospective Study. Children, 9(7), 932.

[5] Mulinari-Santos, G., Santana, A. P., Botacin, P. R., & Okamoto, R. (2024). Addressing the Challenges in Pediatric Facial Fractures: A Narrative Review of Innovations in Diagnosis and Treatment. Surgeries, 5(4), 1130-1146.

[6] Ferreira, PC, et al. (2004) Etiology and patterns of pediatric mandibular fractures in Portugal: a retrospective study of 10 years. J Craniofac Surg; 15 (3): 384-391.

[7] Juncar, R. I., Țenț, P. A., & Juncar, M. (2023).

Clinical Patterns and Treatment of Pediatric Facial Fractures: A 10-Year Retrospective Romanian Study. Children, 10(5), 800.

[8] On, S.-W.; Park, S.-Y.; Yi, S.-M.; Park, I.-Y.; Byun, S.-H.; Yang, B.-E. Current Status of Recombinant Human Bone Morphogenetic Protein-2 (rhBMP-2) in Maxillofacial Surgery: Should It Be Continued? Bioengineering 2023, 10, 1005.

[9] De Alencar Gondim, DG, et al. (2015) Pediatric facial fractures: case series and critical review. International Archives of Medicine; 8.

[10] Al-Qudah, M. A., & Bataineh, A. B. (2023). Pattern and management of maxillofacial fractures in Jordanian children and adolescents. Medicina Oral, Patología Oral y Cirugía Bucal, 28(3), e272-e278.

[11] Maliska, M. C. S., Lima Júnior, S. M., & Gil, J. N. (2013). Analysis of 185 maxillofacial fractures in the state of Santa Catarina, Brazil. Brazilian Oral Research, 27(4), 300-305.

[12] Juncar, R. I., Moca, A. E., Juncar, M., Moca, R. T., & Țenț, P. A. (2023). Clinical Patterns and Treatment of Pediatric Facial Fractures: A 10-Year Retrospective Romanian Study. Children, 10(5), 800.

[13] Choi Y, Lee HJ, Kang DH, et al. Epidemiology of violence in pediatric and adolescent nasal fracture. Arch Craniofac Surg. 2019; 20(4):235-240.

[14] Dong SX, Shah N, Gupta A. Epidemiology of Nasal Bone Fractures. Facial Plast Surg Aesthet Med. 2022; 24(1):24-28.

[15] Rahman, RA, et al. (2007) Maxillofacial trauma of pediatric patients in Malaysia: a retrospective study from 1999 to 2001 in three hospitals. Int J Pediatr Otorhinolaryngol; 71 (6): 929-936.

[16] Rottgers, SA, et al. (2011) Outcomes in pediatric facial fractures: early follow-up in 177 children and classification scheme. J Craniofac Surg; 22 (4): 1260-1265.

[17] Kim SH, Han DG, Shim JS, Lee YJ, Kim SE. Clinical characteristics of adolescent nasal bone fractures. Arch Craniofac Surg. 2020; 21(1):50-54.

[18] Kaban LB, Mulliken JB, Murray JE. Facial fractures in children: An analysis of 122 fractures. Plast Reconstr Surg. 2020; 146(3):435-443.

[19] Patel J, McGuire E, Cray J, et al. Pediatric facial fractures: Demographics, treatment trends, and comparative outcomes. J Oral Maxillofac Surg. 2019; 77(9):1831-8.

[20] Posnick JC, Goldstein JA, Sanghavi P. The effects of pediatric mandibular fractures on growth and form. Plast Reconstr Surg. 2020; 145(1):167-176.

[21] Haug, RH and Foss, J (2000) Maxillofacial injuries in the pediatric patient. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology; 90 (2): 126-134.

[22] Erdmann, D, et al. (2008) A retrospective analysis of facial fracture etiologies. Annals of plastic surgery; 60 (4): 398-403.

[23] Ferreira, PC, et al. (2005) Retrospective study of 1251 maxillofacial fractures in children and adolescents. Plastic and reconstructive surgery; 115 (6): 1500-1508.

[24] Grunwaldt, L, et al. (2011) Pediatric facial fractures: demographics, injury patterns, and associated injuries in 772 consecutive patients. Plastic and reconstructive surgery; 128 (6): 1263-1271.

[25] Kauke M, Wolf M, Rammler K, et al. Bleeding control in maxillofacial trauma: New strategies and evidence. World J Emerg Surg. 2023; 18(1):35.

[26]Sato FRL, Asprino L, de Moraes M, et al. Epidemiological analysis of maxillofacial fractures in Brazil: A 10-year study. Int J Oral Maxillofac Surg. 2022; 51(3):301-308.

[27] Al-Azzawi ZS, Al-Saffar ZA, Al-Dawoody BS. The pattern of maxillofacial fractures in Iraq: A cross-sectional retrospective study. J Oral Maxillofac Surg. 2023; 81(1):51-58.

[28] Reeves TE, Rogers GF. Pediatric facial fractures. Clin Plast Surg. 2022; 49(3):459-74.

[29] Mulinari-Santos G, Paino Santana A, Botacin PR, Okamoto R. Addressing the Challenges in Pediatric Facial Fractures: A Narrative Review of Innovations in Diagnosis and Treatment. Surgeries. 2024; 5(4):1130-1146.

[30] Pan Y, Zhu H, Hou L. Epidemiological analysis and emergency nursing care of oral and craniomaxillofacial trauma: a narrative review. Ann Palliat Med. 2022; 11(5):1879-1891.

[31] Follmar KE, Debruijn M, Baccarani A, Bruno AD, Mukundan S Jr, Erdmann D, Marcus JR. A 10-

year retrospective study of pediatric facial fractures: clinical characteristics, management, and outcomes. Plast Reconstr Surg. 2023; 151(2):345-354.

[32] Hopper RA, Sze RW. Pediatric facial fractures. Clin Plast Surg. 2022; 49(3):459-74.

[33] Gassner R, Tuli T, Hächl O, Rudisch A, Ulmer H. Craniomaxillofacial trauma: A 10-year review of 9,543 cases with 21,067 injuries. J Craniomaxillofac Surg. 2022; 50(5):420-6.

[34] Zachariades, N, Papavassiliou, D and Koumoura, F (1990) Fractures of the facial skeleton in children. J Craniofac Surg; 18 (4): 151-153.

[35] Stylogianni, L, Arsenopoulos, A and Patrikiou, A (1991) Fractures of the facial skeleton in children. Br J Oral Maxillofac Surg; 29 (1): 9-11.

[36] Oji, C (1999) Jaw fractures in Enugu, Nigeria, 1985-95. Br J Oral Maxillofac Surg; 37 (2): 106-109.

[37] Koch BL. Pediatric considerations in craniofacial trauma. Neuroimaging Clin N Am. 2014; 24(3):389-400.

[38] Kang DH, Song WC, Lee JH, et al. Epidemiology and treatment outcomes of pediatric facial fractures: a 5-year retrospective study. J Korean Assoc Oral Maxillofac Surg. 2021; 47(1):27-34.

[39] Zhang X, Dong Y, Wang X, et al. Characteristics and treatment of pediatric maxillofacial fractures in China: a retrospective study of 8 years. J Craniofac Surg. 2021; 32(5):e451-e455.

[40] Almasri MA. Epidemiology and pattern of pediatric maxillofacial fractures in a tertiary hospital in Saudi Arabia: a retrospective study. Saudi Med J. 2020; 41(3):296-301.

[41] Sakamoto Y, Yotsuyanagi T, Yamauchi M, et al. Pediatric facial fractures: a 16-year retrospective study. J Plast Reconstr Aesthet Surg. 2021; 74(3):644-651.

[42] Kazi N, Ranadive P, Rajurkar S, Sharma A, Deshpande M, Ingole S. Epidemiology of maxillofacial trauma in pediatric and adolescent population: an institutional experience of 6 years. Open J Orthop. 2022; 12(6):277-287.

[43] Schild S, Puntarelli TR, delaPena M, Johnson A, Butts SC. Facial Soft Tissue Injuries in Pediatric Patients. Facial Plast Surg. 2021; 37(4):516-527.

[44] Patidar, D., Sogi, S., Fry, R.R., Patidar, D.C., & Malhotra, A. (2023). Maxillofacial Trauma in Pediatric Patients: A Retrospective Study. Journal of Maxillofacial and Oral Surgery, 23, 99–106.

[45] Scariot, R, Oliveira, IAd, Passeri, LA, Rebellato, NLB and Muller, PR (2009) Maxillofacial injuries in a group of Brazilian subjects under 18 years of age. J Appl Oral Sci; 17 (3): 195-198.

[46] Mokoena T, Lalloo R, Khammissa RAG, Wood NH, Lemmer J, Feller L. The epidemiology and management of traumatic facial fractures in children seen in a tertiary hospital in Johannesburg, South Africa. S Afr Dent J. 2019; 74(7):318-323.

[47] Mulinari-Santos G, Paino Santana A, Botacin PR, Okamoto R. Addressing the Challenges in Pediatric Facial Fractures: A Narrative Review of Innovations in Diagnosis and Treatment. Surgeries. 2024; 5(4):1130-1146.

[48] Oleck NC, Dobitsch AA, Liu FC, Halsey JN, Le TT, Hoppe IC, Lee ES, Granick MS. Traumatic Falls in the Pediatric Population: Facial Fracture Patterns Observed in a Leading Cause of Childhood Injury. Ann Plast Surg. 2019 Apr; 82(4S Suppl 3):S195-S198.

[49] Haliti F, Haliti A, Lila-Krasniqi Z, et al. Prevalence and distribution of traumatic dental and soft-tissue injuries among children in Kosovo: A prospective study. J Int Dent Med Res. 2020; 13(2):689-695.

[50] Albayati A, Özkan B, Eyüboğlu A, Uysal ÇA, Ertaş NM. A descriptive study of facial lacerations presenting to pediatric emergency in Turkey. Ulus Travma Acil Cerrahi Derg. 2021; 27(1):61-66.

[51] Elgehani RA, Orafi MI. Pediatric maxillofacial fractures in Western Libya. African Journal of Trauma. 2009; 8(2):78-82.

[52] Al-Tairi N, Al-Radom J. Prevalence and Etiology of Pediatric Maxillofacial Fractures in a Group of Yemeni Children and Adolescents. Open Journal of Stomatology. 2021; 11(5):179-187.

[53] Lim, CA, Singh, YK, Portnof, JE and Blumberg, SM (2016) Pediatric maxillofacial trauma: a review of 156 patients. J Oral Maxillofac Surg; 74 (7): 1420. el-1420. e4.

[54] Almahdi, HM and Higzi, MA (2016) Maxillofa-

cial fractures among Sudanese children at Khartoum Dental Teaching Hospital. BMC research notes; 9 (1): 120.

[55] Bede, SYH, Ismael, WK and Al-Assaf, D (2016) Patterns of pediatric maxillofacial injuries. J Craniofac Surg; 27 (3): e271-e275.

[56] Sarkar S, Roychoudhury A, Das D, Bhattacharya A. Oral and maxillofacial injuries in children: a retrospective study. Natl J Maxillofac Surg. 2020; 11(1):62-66.

[57] Mukhopadhyay S, Galui S, Biswas R, Saha S, Sarkar S. Oral and maxillofacial injuries in children: a retrospective study. J Korean Assoc Oral Maxillofac Surg. 2020; 46(3):183-190.

[58] Korduke N, Singh T. Imaging of midface fractures-a retrospective study. N Z Med J. 2019 Jul 12; 132(1498):60-68.

[59] Du Plooy E, Salie S, Figaji AA. A profile of children with traumatic brain injury admitted to the paediatric intensive care unit of Red Cross War Memorial Children's Hospital in Cape Town, South Africa, between 2015 and 2019. South Afr J Crit Care. 2024 Nov 25; 40(3):e2212.

[60] Lembacher S, Schneider S, Lettner S, Bekes K. Prevalence and Patterns of Traumatic Dental Injuries in the Permanent Dentition: A Three-Year Retrospective Overview Study at the University Dental Clinic of Vienna. Int J Environ Res Public Health. 2022; 19(23):15725.

[61] Sarkar S, Roychoudhury A, Das D, Bhattacharya A. Oral and maxillofacial injuries in children: A retrospective study. Natl J Maxillofac Surg. 2020; 11(1):62-66.

[62] Boffano, P, et al. (2015) European Maxillofacial Trauma (EURMAT) in children: A multicenter and prospective study. Oral surgery, oral medicine, oral pathology and oral radiology; 119 (5): 499-504.

[63] Soukup JW, Mulherin BL, Snyder CJ. Prevalence and nature of dentoalveolar injuries among patients with maxillofacial fractures. J Small Anim Pract. 2013 Jan; 54(1):9-14.

[64] Ramphall Y, Naidu R. Prevalence and occlusal risk factors for fractured incisors among 11–12-year-old schoolchildren in Trinidad and Tobago. Dent J. 2014; 2(3):100-109.

[65] Traebert, J, et al. Aetiology and rates of treatment of traumatic dental injuries among 12-year-old school children in a town in southern Brazil. Dental traumatology; (2006) 22 (4): 173-178.

[66] O-Lee, T. J.; Koltai, Peter J. Pediatric Otolaryngology for the Clinician. Humana Press, 2009. p. 91-95.

[67] Das D, Salazar L. Maxillofacial Trauma: Managing Potentially Dangerous and Disfiguring Complex Injuries. Emerg Med Pract. 2017 Apr; 19(4):1-24.

[68] Akhtar, MU, Rafique, FCM, Shah, A and Akhtar, N (2016) The prevalent age group, cause and site of pediatric facial bone trauma at two tertiary units in Pakistan. Annals of King Edward Medical University; 12 10.21649.

[69] Zhou, H-H, Ongodia, D, Liu, Q, Yang, R-T and Li, Z-B (2013) Incidence and pattern of maxillofacial fractures in children and adolescents: a 10 years retrospective cohort study. Int J Pediatr Otorhinolaryngol; 77 (4): 494-498.

[70] Kirvelä, A., Suominen, A.L., Puolakkainen, T. et al. Paediatric maxillofacial fractures have increased in incidence and their nature and aetiology have changed during three decades. Sci Rep 14, 20221 (2024).

[71] Hwang K, Huan F, Hwang PJ, Sohn IA. Facial Lacerations in Children. J Craniofac Surg. 2013; 24(2):671-675.

[72] Collao-González C, Carrasco-Labra A, Sung-Hsieh HH, Cortés-Araya J. Epidemiology of pediatric facial trauma in Chile: a retrospective study of 7,617 cases in 3 years. Med Oral Patol Oral Cir Bucal. 2014 Mar 1; 19(2): e99-e105.

[73] Ghosh R, Gopalkrishnan K. Associated Injuries Related to Patients with Facial Fractures. Craniomaxillofacial Trauma & Reconstruction. 2023; 16(1):10-14.

[74] Guerra, C., Braido, A., Ferraz, D.C. et al. Family structure and social vulnerability as risk factors for traumatic dental injuries in children and adolescents: a systematic review and meta-analysis. Clin Oral Invest 28, 451 (2024).

[75] Allareddy V, Allareddy V, Nalliah RP. Epidemiology of facial fracture injuries. J Oral Maxillofac Surg. 2011; 69(10):2613-2618.

[76] Allred, LJ, Crantford, JC, Reynolds, MF and Da-

vid, LR (2015) Analysis of Pediatric Maxillofacial Fractures Requiring Operative Treatment: Characteristics, Management, and Outcomes. J Craniofac Surg; 26 (8): 2368-2374.

[77] Hajibandeh J, Peacock ZS. Pediatric Mandible Fractures. Oral Maxillofac Surg Clin North Am. 2023 Nov; 35(4):555-562.

[78] Gupta, H, Rai, AB, Bulgunnawar, BA, Nair, MA and Babu, H (2014) Paediatric facial Trauma-A retrospective study. International Journal of Oral Health Sciences and Advances; 2 (2): 27-32.

[79] Day PF, Flores MT, O'Connell AC, Abbott PV, Tsilingaridis G, Fouad AF, et al. Paediatric dental trauma: insights from epidemiological studies and prospective clinical trials. BMC Oral Health. 2023; 23(1):22.

[80] Thoren, H, Iizuka, T, Hallikainen, D and Lindqvist, C (1992) Different patterns of mandibular fractures in children. An analysis of 220 fractures in 157 patients. J Craniofac Surg; 20 (7): 292-296.

[81] Yamamoto, K, et al. (2010) Maxillofacial fractures resulting from falls. J Oral Maxillofac Surg; 68 (7): 1602-1607.

[82] Williams KJ. Pediatric maxillofacial trauma. In: El Toukhy EA, editor. Oculoplastic Surgery. Cham: Springer; 2024. p. 323–332.

[83] Owusu JA, Bellile E, Moyer JS, Buchman SR. Pediatric mandible fractures: Demographics, treatment, outcomes, and early growth data. Otolaryngol Head Neck Surg. 2016; 155(5):757-763.

[84] Li L, Acharya K, Ghimire B, et al. Conservative management of mandibular fractures in pediatric patients during the growing phase with splint fiber and ligature arch wire. BMC Oral Health. 2023; 23(1):601.

[85] Hofmann E, Koerdt S, Heiland M, Raguse JD, Voss JO. Pediatric maxillofacial trauma: insights into diagnosis and treatment of mandibular fractures in pediatric patients. Int J Clin Pediatr Dent. 2023; 16(3):499-509.

[86] Posnick JC, Choi E, Chavda A. Pediatric facial fractures: Evolving patterns of treatment. J Oral Maxillofac Surg. 2016; 74(11):2241-2250.

[87] Namdev, R, et al. (2016) Patterns of mandible fracture in children under 12 years in a district trauma center in India. Dental traumatology; 32 (1): 32-36.

[88] Aldelaimi A, Aldelaimi T. Pyriform suspension in treatment of pediatric facial trauma. Int J Oral Maxillofac Surg. 2022; 51(Suppl 1):e187.

[89] Giran G, Paré A, Croisé B, Koudougou C, Mercier JM, Laure B, et al. Radiographic evaluation of percutaneous transfacial wiring versus open internal fixation for surgical treatment of unstable zygomatic bone fractures. PLoS One. 2019; 14(8):e0220913.

[90] Goth S, Sawatari Y, Peleg M. Management of pediatric mandible fractures. J Craniofac Surg. 2012 Jan; 23(1):47-56.