

# Patterns and characteristics of maxillofacial trauma among children and adolescents: A Bi-institutional retrospective study

## ABSTRACT

**Introduction:** Maxillofacial injuries in children and adolescents always present a challenge due to the peculiar facial anatomy in children. This study aimed to determine the characteristics and pattern of traumatic maxillofacial injuries in children and adolescents reported to outpatient departments of two tertiary care health centers.

**Materials and Methods:** Present study had a retrospective design, and the hospital records of all children and adolescent patients aged between 0 and 18 years, who had undergone maxillofacial fractures and were admitted for the same to two tertiary care health centers between January 2012 and May 2022 were reviewed.

**Results:** 77 patients suffered maxillofacial trauma with 115 fractures. The leading cause of maxillofacial trauma in the study was found to be road traffic accidents (RTA) followed by falls and sports-related injuries. Maxillofacial trauma was observed more in boys than girls, with an M:F ratio of 3.8:1. Out of 77 patients in the present study, more than half (51.9%) suffered maxillofacial trauma involving the lower one-third of the face, followed by the middle third (45.5%) and upper third (2.6%). A total of 11 patients (14.2%) were treated within 24 hr of sustaining injury. The majority of the patients, (n = 68; 88.3%) underwent open reduction and rigid internal fixation (ORIF), while 9 patients (11.7%) underwent closed reduction.

**Conclusions:** Pediatric maxillofacial trauma was mainly attributed to road traffic accidents. Lower one-third of faces were more commonly affected and an increasing trend of maxillofacial trauma was observed with age.

**Keywords:** Accidents, adolescents, children, fall, maxillofacial injuries

## INTRODUCTION

Maxillofacial trauma is less common in children and adolescents. As per the literature, maxillofacial traumatic injuries account for 1.5 to 8.0% of all injuries in children in the age group 12 years or younger, and less than 1% of injuries in children aged less than 5 years.<sup>[1,2]</sup> Distinct anatomical features like the presence of tooth buds, developing unerupted teeth, absence of pneumatization of the paranasal sinus, less mineralized bones, and eminence of the buccal fat pad that disseminate the impact over a larger region make children more prone to greenstick fractures when compared to adults.<sup>[3]</sup> A wide geographical disparity in the prevalence, etiology, gender predilection, and age of presentation of maxillofacial trauma has been observed which can be attributed to


differences in study designs, and sociodemographic, behavioral, cultural, and environmental factors.

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The novelty of the present study is that it is the first study that encompasses various epidemiological factors related to pediatric maxillofacial trauma in two tertiary care centers.

The present bi-center retrospective study aimed to determine the pattern and characteristics of traumatic maxillofacial injuries in children and adolescents reported to outpatient departments of two tertiary care health centers over a period of ten years.

## MATERIALS AND METHODS

The present study was designed to determine the pattern of traumatic maxillofacial injuries in children and adolescents reporting to the department of oral and maxillofacial surgery of two tertiary health centers after receiving ethical approval from the institutional ethics committee vide letter no. IEC/ Dental/20208/52 dated 04 Jul 2022. Guidelines of the Declaration of Helsinki were followed.

### Study design

Retrospective study.

### Study setting

Patients aged 0 to  $\leq 18$  years old reported with maxillofacial trauma/injuries, hospitalized between Jan 2012 and May 2022 in the respective oral and maxillofacial surgery departments of both the centers (Centre I and Centre II).

### Entry criteria

Patients aged 0 to  $\leq 18$  years, both genders included, who reported maxillofacial traumatic injuries and got their treatment done at these hospitals having a full set of hospital records, were included in this study.

### Exit criteria

The following patients were excluded from the study:

1. Incomplete history
2. Syndromic patients
3. Patients who received definitive treatment elsewhere
4. Patients diagnosed with pure soft tissue or pure traumatic dental injuries.

The following data were recorded and evaluated from hospital records: age, gender, cause of the trauma, site of maxillofacial injury, facial injury severity scale (FISS) score, any other concomitant injuries, the month when the child underwent maxillofacial injury/trauma, the time within which treatment was received, the form of treatment received and duration of hospital stay. For ease of statistical analysis, patients were divided into three groups: Pre School (0-6 yrs), School Children (7-12yrs), and Adolescents (13-18 yrs).

Data was compiled and entered into the digital spreadsheet. Descriptive and inferential analyses were performed using SPSS STATISTICS 21.0. Descriptive results were obtained as Mean  $\pm$  SD and frequency (percent). Pearson's Chi-square test, Kruskal Wallis test of significance, and logistic regression analysis were further used for the analysis of categorical and independent variables. Statistical significance was set at a  $P$  value  $< 0.05$ .

## RESULTS

Between January 2012 and May 2022, 77 children and adolescent patients aged between 0 to 18 years were hospitalized owing to maxillofacial injuries/trauma. Out of these, 34 children had multiple fractures (fracture at two sites-30; fracture at three sites-4). Hence, the total fracture sites were 115. For ease of statistical analysis, the subject with multiple fractures was considered in a single fracture site as per the severity of the fracture, thus generating a total of 77 subjects. The distribution of children as per etiology, site of maxillofacial injury, the time within which treatment was received, the form of treatment received, and the center of treatment is shown in Table 1. Patterns and characteristics of maxillofacial injuries amongst children and adolescents across both centers are summarised in Table 2 and Figure 1.

Of 77 patients, 61 were boys and 16 were girls (male: female ratio [M: F], 3.8:1) with a mean age of presentation

**Table 1: Frequency distribution of etiology, fracture site, time, type, and centre of treatment among the sample population**

Parameter	n	%
Age		
Preschool	10	12.97
School Going	19	24.70
Adolescents	48	62.33
Etiology		
Fall	20	25.98
RTA	45	58.44
Sports Associated	12	15.58
Fracture Site		
Upper One Third	2	2.6
Middle One Third	35	45.5
Lower One Third	40	51.9
Time of Treatment		
Within 24 hours	11	14.29
After 24 hours	66	85.71
Type of Treatment		
Closed Reduction	9	11.68
ORIF	68	88.32
Site Involved		
Right Side	27	35.06
Left Side	17	22.08
Multiple Sites	33	42.86
Treatment Centers		
Centre 1	35	45.45
Centre 2	42	54.55

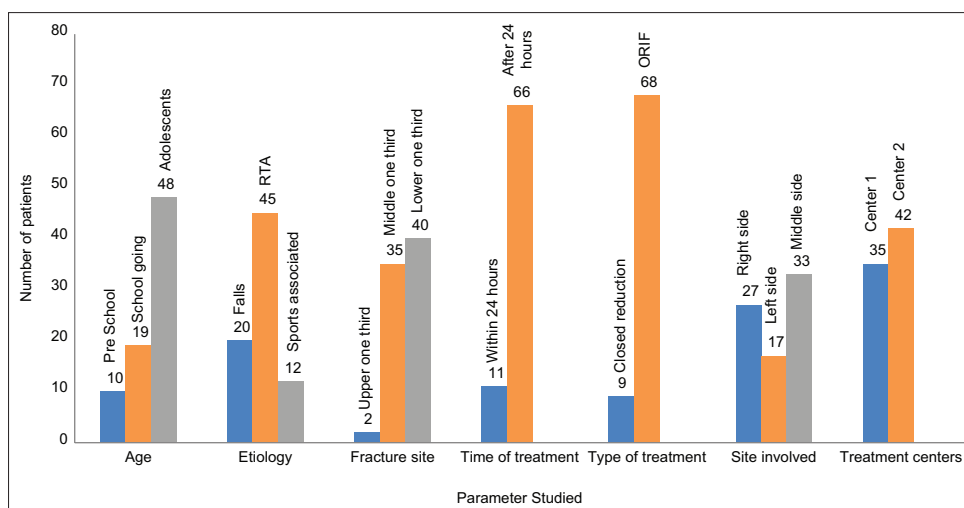


Figure 1: Distribution of various parameters studied

Table 2: Summary of maxillofacial fracture characteristics in children and adolescent populations across both the centres

Centre	No. of Patients	M: F ratio	Mean Age (SD)	Main Cause of Injury	Main Site of Fracture	Mean FISS (SD)	Mean Hospital Stay (SD)
Centre 1	35	4:1	13.9±4.8	RTA (22, 62.9%)	Middle 1/3 <sup>rd</sup> (17, 48.6%)	2.4±1.3	5.5±3.3
Centre 2	42	3.6:1	12.5±4.9	RTA (23, 54.8%)	Lower 1/3 <sup>rd</sup> (24, 57.1%)	2.6±1.5	5.04±2.03

of maxillofacial injury of  $13.2 \pm 4.9$  years with the youngest child being 1.3 years and the oldest being 18 years [Figure 2]. Boys were significantly older with a mean age of  $14.08 \pm 3.9$  years than girls with a mean age of  $9.8 \pm 6.7$  years and the difference between the two groups was statistically significant ( $P = 0.002$ ).

The main etiology of the maxillofacial injury/trauma was road traffic accidents (RTAs) [(58.4%); mean age,  $14.2 \pm 3.9$  years], with higher prevalence in Centre II- 51.1% [Figure 3], and the M: F ratio was 5.4:1 (38 Boys, 7 Girls). The second most frequent cause of maxillofacial trauma was fall [20 patients (26%); mean age,  $10.18 \pm 6.38$  years], with the M: F ratio of 1.85:1 (13 boys, 7 girls). In the entire study population, RTA was observed to be the main cause of injury amongst boys (62.3%) than in girls (43.8%), however, the results were not significant ( $P = 0.190$ ). The females were more affected (43.8%) by trauma due to falls as compared to males (21.3%). The reason for the falls included falling from a height, slipping, stumbling, and falling from stairs [Figure 4].

The third most frequent cause of maxillofacial injury/trauma was found to be sports-related injury [12 patients (15.6%); mean age  $14.5 \pm 3.4$  years]. The M: F ratio of these patients was 1:2. These injuries were observed more commonly amongst girls (66.7%) than in boys (33.3%), although the difference was not statistically significant ( $P = 0.629$ ). There were no reported cases of maxillofacial trauma due to interpersonal violence. The association between various age

groups and etiological factors was found to be statistically significant [Table 3].

Out of 77 patients in the present study, more than half (51.9%) suffered maxillofacial trauma involving the lower one-third of the face, followed by the middle one-third (45.5%) and upper one-third (2.6%). Table 4 elucidates various sites and subsites of fracture as per different age groups of the study population. The association between various age groups and sites of fractures was found to be statistically significant [Table 5]. The bilateral involvement of the face was more frequent (38 patients, 37.7%), followed by the right side (22 patients, 28.6%) and left side (17 patients, 22.1%) [Figure 5].

The mean Facial Injury Severity Scale (FISS) score was  $2.5 \pm 1.44$  with the lowest score of 1 and the highest score of 6. The difference in FISS scores between boys ( $2.49 \pm 1.37$ ) and girls ( $2.6 \pm 1.7$ ) was not statistically significant.

Concomitant head injuries were reported in 2 patients (28%), with a mean FISS score lower than the mean FISS score of the sample (2 vs 2.5). These were observed more commonly in patients having undergone trauma due to RTA.

The prevalence of facial trauma did not follow any specific trend per month when the trauma occurred, but the highest prevalence was observed in the month of May (19.4%).

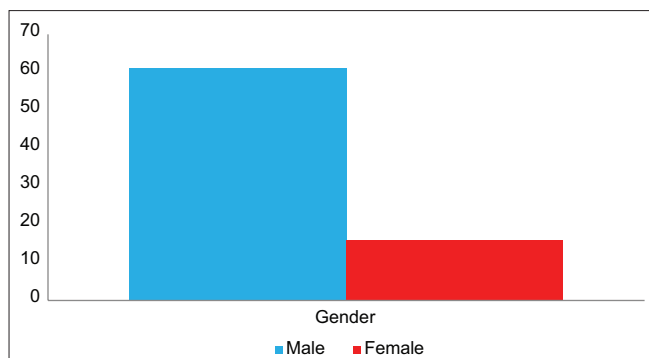


Figure 2: Gender wise Distribution of Maxillofacial Trauma

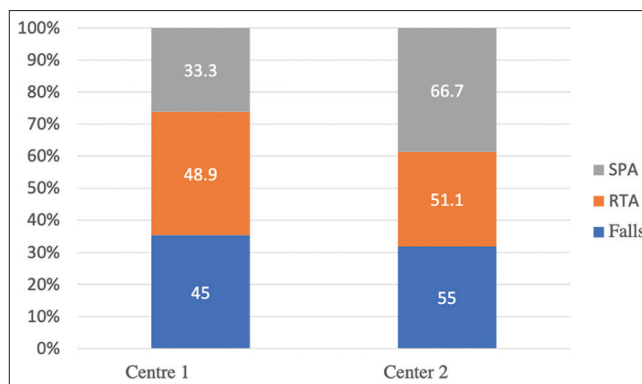


Figure 3: Distribution of etiological factors among two centres

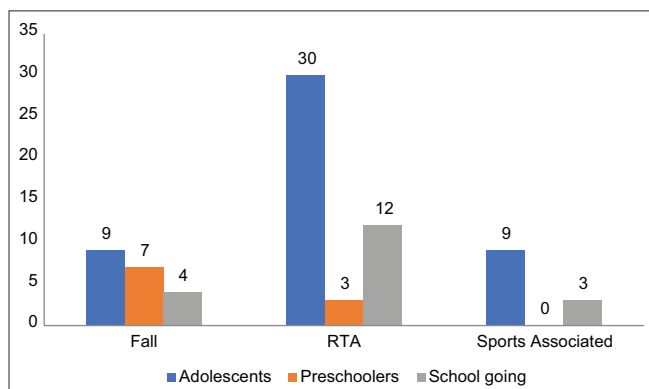


Figure 4: Distribution of etiological factors as per various age groups

Table 3: Association of age with etiological factors

Age	Fall	RTA	Sports Associated	P
Adolescents	9 (45%)	30 (66.7%)	9 (75%)	P=0.017*
Preschoolers	7 (35%)	3 (6.7%)	0	
School Going	4 (20%)	12 (26.7%)	3 (25%)	

Table 4: Distribution of the sites and subsites of the fractures by age group

Fracture Site	Adolescents	Preschoolers	School Going	Total
Upper One Third				
Anterior Wall	1	0	0	1
Middle One Third				
Le Fort I	1	0	0	1
Le Fort II	4	0	0	4
ZMC	20	0	1	21
Nose	2	0	1	3
Orbital floor	2	0	3	5
Orbital medial wall	1	0	6	7
Orbital roof	0	0	5	5
Lower One Third				
Angle	10	4	4	18
Body	4	0	1	5
Condyle	8	2	3	13
Coronoid	1	0	0	1
Parasymphysis	3	1	0	4
Symphysis	13	5	0	26
Total	70	15	30	115

Note- 38 subjects had fractures at multiple sites

Eleven patients (14.2%) received treatment within 24 hr of sustaining injury. Of all patients, 68 (88.3%) had undergone

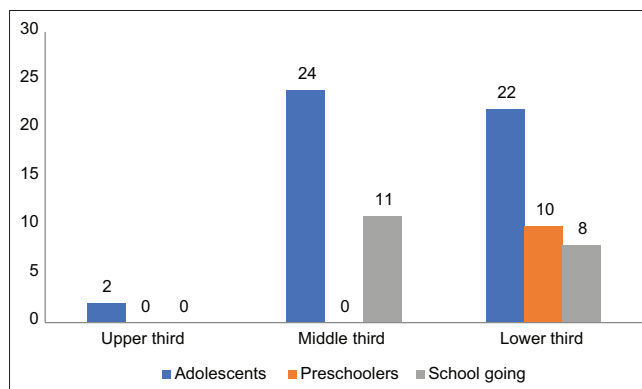


Figure 5: Distribution of site of fractures as per different age groups

open reduction and rigid internal fixation (ORIF) while 9 patients (11.7%) underwent closed reduction. Association between various age groups and the type of treatment received was found to be statistically significant [Table 6, Figure 6]. The mean hospitalization was  $5.4 \pm 2.65$  days, the minimum stay was 2 days and the maximum stay reported was 15 days. A weak negative correlation was found between the FISS score and duration of hospital stay (Spearman Correlation,  $r = -0.18$ ) which was not statistically significant. Also, a negligible negative correlation was observed between age and FISS Score, which was not statistically significant (Spearman correlation,  $r = -0.053$ ).

As per age, the adolescent group consisted of 48 patients (62.3%), comprising 42 boys (87.5%) and 6 girls (12.5%) (M: F, 7:1). The main cause of maxillofacial trauma in adolescents was RTAs (30 patients, 62.5%) followed by falls (9 patients, 18.8%) and sports-related injuries (9 patients, 18.8%). In the adolescent group, only 1 subject underwent closed reduction and the rest (47 patients, 97.9%) underwent ORIF.

The school-age group consisted of 19 patients (24.7%), comprising 15 boys and 4 girls (M: F, 3.75:1), with maxillofacial injury/trauma caused mainly by RTAs (12 patients, 63.2%) followed by Falls (4 patients, 21.1%). The middle one-third

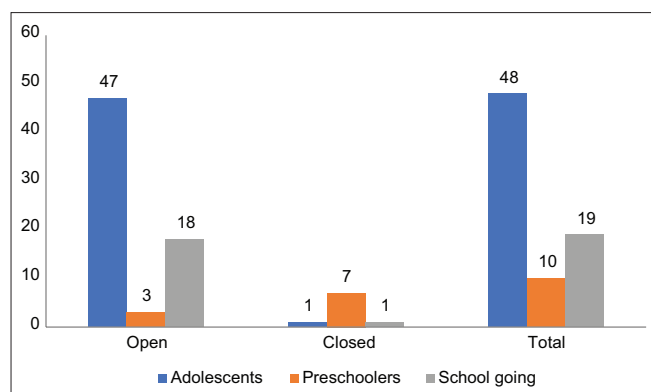


Figure 6: Distribution of treatment received as per various age groups

Table 5: Association of age with the site of fracture

Age	Upper Third	Middle Third	Lower Third	P
Adolescents	2 (100%)	24 (68.6%)	22 (55%)	P=0.019*
Preschoolers	0	0	10 (25%)	
School Going	0	11 (31.4%)	8 (20%)	

Table 6: Comparison of age groups with the type of treatment

Age	Open	Closed	Total	P
Adolescents	47 (97.9%)	1 (2.1%)	48 (100%)	Chi-Square value- 12.06 P<0.001*
Pre Schoolers	3 (30%)	7 (70%)	10 (100%)	
School Going	18 (94.7%)	1 (5.3%)	19 (100%)	

of the face was affected more followed by the lower one-third [Table 5]. The mean FISS score was  $2.4 \pm 1.6$  points. Two patients were treated within 24 hrs (10.6%). In this group, only 1 patient underwent closed reduction (5.3%) and the rest were treated by ORIF (18 patients, 94.7%) [Table 6]. The mean hospital stay of this group was  $5.5 \pm 2.5$  days.

Among the preschool group, 10 patients (12%), comprising 4 boys (40%) and 6 girls (60%) (M: F ratio, 1:1.5), suffered facial trauma due to falls (7 patients, 70%) and RTAs (3 patients, 30%) respectively. The lower one-third of the face was the exclusively affected area with a mean FISS score of  $2.8 \pm 0.91$  points. Five patients (50%) received treatment within 24 hours of injury/trauma. Seven patients (70%) underwent closed reduction, and three patients (30%) were managed with ORIF. The mean hospital stay was  $4.3 \pm 2.13$  days.

Overall, the proportion of open reduction was significantly higher in the adolescent and school groups ( $P < 0.001$ ). No significant difference as per FISS score was observed amongst various age groups. The hospital stay did not show any significant difference among various age groups ( $P > 0.05$ ).

## DISCUSSION

Maxillofacial injury/trauma encompasses both facial fractures as well as soft tissue injuries. Maxillofacial trauma

has a significant impact on the quality of life of children and adolescents, as the involvement of the face in such injuries has functional, mental, aesthetic, and psychological consequences.<sup>[1-6]</sup> As per epidemiological studies, these injuries are less prevalent in children and adolescents.<sup>[7]</sup> The present study comprised 77 patients who sustained 115 fractures and were hospitalized and treated for maxillofacial injuries at two different tertiary care dental centers. The prevalence of maxillofacial trauma was lesser compared to the prevalence obtained in studies of similar nature.<sup>[8-10]</sup> This could be due to exclusion of dentoalveolar trauma and soft tissue injury from the present study.

The mean age of presentation of maxillofacial trauma in the present study was higher than the mean age derived from other studies of similar nature. This could be attributed to different ranges of age considered for estimating maxillofacial trauma.<sup>[8,10,11]</sup>

Results of the present study revealed that the prevalence of maxillofacial injuries was more in boys than in girls. This was in concurrence with results obtained from other studies that had shown a similar trend of maxillofacial trauma as far as gender was concerned.<sup>[8-11]</sup> Male predominance was observed in adolescent and school-going children while almost similar involvement of both genders in preschool children was observed. This could be attributed to age-related childhood activities.<sup>[12]</sup> Male: female ratio as per literature ranges between 1.6:1 to 3.3:1.<sup>[13-15]</sup> A similar overall ratio was obtained from the present study. Greater male predominance could be attributed to the fact that males are more often exposed to risk factors like outdoor activities, driving vehicles, sports, and violence.

Road traffic accidents were the leading cause of maxillofacial trauma in adolescent and school-going children as per results obtained from the present study. The results obtained from our study were in concurrence with results obtained from a study conducted by Al Ali *et al.* in Kuwait.<sup>[10]</sup> It was observed that RTAs were seen more in adolescents than in children, because of growing age children and adolescents become more independent, and get access to motor vehicles, and hence their vulnerability to injuries related to high-velocity events increases. This predisposition to RTAs could be due to non-adherence to traffic rules like over-speeding, not wearing helmets, etc., and poor conditions of the roads. In preschool children, fall was the main cause of maxillofacial injuries/trauma. This could be due to uncertainty of motion and lack of fine coordination of motion in the first few years of life.<sup>[7]</sup> Moreover, the low center of gravity in school-aged children, contributes to a lack of coordination in them, thereby predisposing them to injuries.<sup>[16]</sup>



The lower one-third of the face was the most commonly involved in maxillofacial trauma. Adolescent and school-going children suffered trauma to the middle one-third of the face whereas an exclusively lower one-third of the face was involved in preschool children. Zygomatic maxillary complex (ZMC) and symphysis were the most commonly affected fracture sites, showing an increasing trend with age. Midface trauma is relatively uncommon in children and is usually the result of high-impact trauma like RTAs, which were found to be the main causes of maxillofacial trauma in our study. The symphysis was the most common fracture site in preschool children, showing an increasing trend with age. Similar results were obtained from a study conducted by Arvind *et al.* in Chennai and Al Ali *et al.* in Kuwait.<sup>[10,17,18]</sup> Concomitant head injuries were observed in 2.5% of the children affected by maxillofacial trauma in the present study. This could be attributed to the mechanism of trauma.

A conservative approach is used to avoid interference with the growth and development of the facial skeleton, as well as with normal dental development for the management of maxillofacial fractures, in preschool and school-age children. With increasing age and maturation of the craniofacial skeleton, the preferred treatment modality becomes ORIF. This was re-established in the present study, as only 30% of preschool children underwent ORIF, but 97.9% in the adolescent group, showing a statistically significant association with age.

## CONCLUSION

As per results obtained from the study, it can be concluded that pediatric maxillofacial trauma was observed in 77 patients who sustained 115 fractures mainly attributed to road traffic accidents with boys being more susceptible than girls. ZMC and symphysis fractures were the most commonly observed fractures and an increasing trend of maxillofacial trauma was observed with age. More than half of the study population suffered a fracture at more than one site. Falls and sports-related injuries were also seen as predominantly causes of maxillofacial injuries in girls. This gender predominance was more pronounced in the school-going and adolescent groups. Concomitant injuries were seen in two patients both suffered head injuries. The majority of the children were treated by open reduction and internal fixation.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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