Research Square

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Reporting Pediatric Maxillofacial Trauma from Sindh's Largest Public Sector Surgical Unit of a Tertiary Care Institute in Pakistan

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Research Article

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Abstract

Background

Pediatric Maxillofacial trauma is comparatively common among small and growing children in our country, as they are actively exploring the world, get exposed to social factors, sustain facial trauma due to; sports, motor vehicles, fall and other reasons. We share our original and the largest clinical experience of Pediatric trauma population from Pakistan.

Methods

A retrospective study of 215 pediatric trauma patients, both genders, sustaining maxillofacial trauma performed at the department of oral & maxillofacial surgery of a leading public sector medical university and hospital of Karachi performed. Study period ranged from August 2023 to August 2024. Data was collected after ERC approval and included; demographics, mechanism of injury, its types and patterns.

Results

Total 215 patients sustaining oral & maxillofacial trauma were included, with the patients age ranged from 11–18 years. The average age of the patient was 11.25 ± 5.12 years with 178 (82.79%) males and 37 (17.21%) females and most of the children represented urban area (90.7%). Regarding symptoms, all study patients had pain 50.2% and swelling, 25.1%. There were 67 children (31.16%) who fell from height, 126 (58.6%) were injured by road traffic accident and 5 (2.33%) children sustained firearm injury, 13(6.05%) had sports injury and 4(1.86%) sustained trauma from unknown reasons with male to female ratio consisted 1.15:1.39. Regarding injury type; all 215 patients (100%) sustained facial trauma in which, 37(17.21%) sustained bony trauma with soft tissue injury and 178(82.79%) sustained only facial bone trauma. Amongst facial trauma; 74.9% were mandible fractures, 20% maxilla, 7% zygomatic bone, 18.6% zygomaticomaxillary complex fracture, 3.7% orbital fracture, 12.6% Nasal Bone Fracture, 2.8% Frontal Bone Fracture, 1.9% Naso orbitoethmoidal and 2.8% Palatine Bone fracture.

Conclusion

This study shows, male children are more susceptible to oral & maxillofacial trauma with Road traffic accidents and fall as the leading trauma causes. Pain forms most consistent clinical feature and Mandible fractures is most frequent bone with condyle fracture forming most common sub site. Our study provides valuable insights into the causes, types of injuries, presentations with new management method shared. By focusing on targeted prevention strategies and tailored treatment protocols, oral healthcare policymakers in Pakistan can significantly contribute to reduce the incidence and severity of pediatric maxillofacial injuries.

INTRODUCTION

Oral & Maxillofacial injury occurring to the orofacial area is surgically managed by maxillofacial specialists and all complex cases are often associated with high morbidity. The maxillofacial region anatomically is separated into three sections: (a) the upper face – the frontal bone and frontal sinus (b) the midface – the nasal, ethmoid, zygomatic and maxillary bones; and (c) the lower face – the mandible. [1] Maxillofacial trauma can happen as a separate physical issue or might also be related with various wounds to the affected patients both physically and emotionally traumatized and could also be fatal at times. [2–3] According to The European Union (EU), the age limit of the pediatric population is from birth till 18-years. [4] Whereas, the American Association of Maxillofacial Surgeons considers children of up to 12 years old [5], and are generally referred to the early adolescence phase. Whereas, infancy is the age from the birth to the 12 months of age and is a multifaceted important age domain encompassing physical, psychosocial developmental and mental health [6]. Once infancy phase is over the childhood phase starts and lasts until 12 years of age as early adolescence, followed by the adolescence stage which ends at the adulthood stage at 18 years old age. In Pakistan, every citizen is issued the Computerized National Identity Card (CNIC) when reached the age of 18 as per the minutes of section 9 & 10 of NADRA Ordinance, 2000. [7]

Facial trauma is uncommon in pediatric patients but when occurs, cause extreme stress for parents due to significance of the face being most important part of the human body in all societies and also due to extremes of low pain threshold amongst this partcular patient population. The maxillofacial trauma in pediatric population represents a significant public health concern due to its potential impact on facial growth, function, and psychosocial development, especially when untreated can lead to severe facial disfigurement with associated complications. [8] Mostly reported complex facial pediatric trauma especially in infants, involves; mandible, requiring immediate, urgent surgical execution to avoid fractured jaw complications due to rapid healing potential of facial bones. Untreated, traumatic lower jaw gets moderately united in 4–6 days, thus making reduction of fractures challenging from 7th day onwards. To address infant mandible, fracture many closed reduction techniques are used and, in this regard, “Prof. Katpar’s innovative Splint Technique for mandible,” provides a new, cost-effective, simple, complex armamentarium free procedure for mitigation in infant and pediatric mandibular trauma. Furthermore, splint removal does not need a second general anesthesia and offers rapid, early surgical treatment within the first 72 hours with optimum results and is now routinely used at our surgical unit. [9]

2019 study from USA reports about hundred and thirty thousand cases of maxillofacial injuries were related to the unsafe motor biking accidents and failure to comply safety regulations. Major studies show maxillofacial trauma causes; road traffic accidents (RTA), being the main reason, having higher ratios of bike accidents, ranging from 3% to 20%. [10] The National Trauma Data Bank also mentions that, concerning reason of paediatric facial fractures is vastly linked to the motor vehicle collisions (MVCs) mostly occurring with the mandible bone being more commonly injured as compared to others [11]. Remaining causative factors include; trauma due to falls, firearms injuries, sports activities, industrial trauma and child abuse etc. [12–15] The pattern and severity of oral and maxillofacial injuries in children differ from adults owing to differences in craniofacial anatomy, elasticity of bones, presence of developing dentition etc [16]. Children are particularly vulnerable to facial injuries as compared to the adults, ranging from 1% to 15% collective of all the facial fractures, mainly because of anatomical, behavioural, and environmental factors; including

increased outdoor activity, lack of supervision, and risk-prone behaviors in children, as their age advances. [17] Some studies show that maxillofacial fractures in children aged less than 16 years, represent 1%–14% of all fractures, whereas kids aged under 5 years, represent just 0.87%–1%. [18] This low occurrence rate might be clarified by the flexibility of paediatric bones, the enormous amounts of soft tissues of the face, the presence of unerupted teeth, the absence of paranasal sinus pneumatization, the protection given by elders and schooling staff [19–21] and also due to protection of the malar cheek region by buccal fat pad, making appearance chubby. [16] The diagnosis of maxillofacial injuries in the paediatric patients may challenge the maxillofacial team as these injuries can be missed at routine clinical and radiographs and are sometimes also not reported. [19] In paediatric population, the maxillofacial fractures show different clinical signs due to the less occurrences of maxilla and zygoma bones trauma as compared to dentoalveolar and mandibular fractures. The facial skeleton fractures are most frequently seen in male children, due to more active social gender activity etc. The causative factors and facial fracture patterns in patients more than 10 years old also resembles to adults. [22] The location and fracture presentation fashion is also dependent on the inter relationship between etiology, force and magnitude of the impact on facial anatomical region and the exclusive anatomic features of the child's development stage. [23]

This study aims to determine the demographics and etiology of paediatric maxillofacial trauma pattern as there is major scarcity of published international literature from Pakistan, though only few are reported. We are also witnessing few local studies published from Punjab Province but none from Karachi being the economic- financial hub city of Pakistan and capital of Sindh Province. Thus, we report that, Paediatric facial trauma occurs greatly in Karachi, but remains under reported and this is a pioneer study published from Karachi, Sindh Province aiming to contribute, fill literature gaps and provides insight from DUHS and SMBBIT as leading tertiary care public sector Institutes of Sindh Province. Our work place Maxillofacial Surgical Unit, offers, the largest Paediatric and adult Oral & Maxillofacial Trauma services for Sindh Province and also for nearby provincial border cities of Balochistan and Punjab provinces. Due to important socio-economic opportunities, active sea port harbor city, having international connections for trade and strong commercial status, Karachi city gets influx of people from all over country for business, job and educational opportunities and thus, we also get referred maxillofacial patients of all types, including Pediatric trauma from whole country [24].

METHODS

This paediatric maxillofacial trauma study is done at the Oral & maxillofacial surgery department, Dow Dental College / DUHS. Our surgical ward for patient admission is located at Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT) just adjacent in same vicinity. All paediatric patients attaining facial trauma, attending ER and referred to OPD were examined and admitted. Study time Period ranges from August 2023 to August 2024.

Study inclusion criteria support; both gender Paediatric Patients, aged 1 to 18 years, sustaining oral and maxillofacial bony trauma from any cause, with or without soft tissue involvement. Patients also included, sustaining concomitant injuries to other body areas with Parents / Guardians giving consent for their children included in study.

Exclusion Criteria includes; Pediatric patients sustaining exclusive soft tissue facial injuries, any previous maxillofacial trauma which was treated earlier, patients with trauma complications, oncology, cysts/tumors and patients/guardians not giving consent to participate for children were all excluded.

The study was approved by the SMBBIT Institutional Ethics Review Committee, *ERC Ref #: ERC-000116/SMBBIT/Approval/2024*, Dated: Oct 26th, 2023.

All the parents/ guardians of the study participant patient population were given informed consent forms and were dully filled. Data analysis included patient demographics, mechanism of injury, types and patterns.

Statistical analysis

Study Patient data was collected from Departmental HMIS System and data analyzed using SPSS version 26. Quantitative variables such as age and duration of symptoms was presented as mean (SD) / median (IQR) based on normality. Shapiro Wilks test was applied to assess the normality of data. While qualitative variables such as gender, residence, presenting complaint, mechanism of injury, type of injury and type of fracture was reported as frequency and percentage.

Effect modifiers such as age, gender, residence, presenting complaint and duration of symptoms were controlled through stratification. Post stratification chi-square/Fischer Exact test was applied, taking p-value ≤ 0.05 as significant.

RESULTS

A total of 215 patients who sustained oral and maxillofacial trauma were included in this study. The leading results show, that majority of the patients were aged 11 to 18 years (figure 1). The average age of the patients was 11.25±5.12 years (table 1). There were 178(82.79%) male and 37(17.21%) female (figure 2). Most of the children were living in urban area (90.7%) (figure 3). Regarding symptoms, all had pain with 50.2% as majority, followed by bruising (table 2).

Regarding Cause/ mechanism of injury, 126(58.6%) were injured by road traffic accident, forming majority, followed by trauma due to fall with 67(31.16%) with other causes. (figure 4).

Amongst these facial trauma cases, the major bones involved; 74.9% were mandible, 20% maxilla, 18.6% zygomaticomaxillary complex fracture etc. (table 3).

Most of the fractures were compound 157(73.02%), simple fractures were seen in 28(13.02%), greenstick was 20(9.3%), comminuted 8(3.72%) and 2 had mixed fractures (figure 5).

Patients having Maxillofacial fractures with concomitant injuries to their body were 12 (5.58%) (table 4) .

Table 1: Demographic characteristics of patients

Variables	Mean± SD	Median (IQR)
Age (Years)	11.25±5.12	12(9)
Duration of Symptoms (hours)	8.19±11.03	4(8)

Table 2: Presenting complaint of patients n=215

Variables		Count	%
Pain	Yes	215	100%
	No	0	0
Swelling	Yes	108	50.2%
	No	107	49.8%
Bruising	Yes	54	25.1%
	No	161	74.9%
Numbness	Yes	0	0
No	0	0	

Table 3: Major Facial Bones Involved, representing Pattern of oral & maxillofacial trauma n= 215

Pattern	Count	%
Mandible fracture	161	74.9%
Maxilla fracture	43	20.0%
Zygomatic bone Fracture	15	7.0%
Zygomaticomaxillary Complex Fracture	40	18.6%
Orbital Fracture	8	3.7%
Nasal Bone Fracture	27	12.6%
Frontal Bone Fracture	6	2.8%
Nasoorbitoethmoidal Fracture	4	1.9%
Palatine Bone Fracture	6	2.8%

Table 4: Maxillofacial fractures with concomitant injuries to the body (Polytrauma cases)

n=215

Pattern	Count	%
Polytrauma cases (Maxillofacial + other body parts injuries)	12	5.58%

DISCUSSION

Trauma is associated with significant morbidity and mortality in children. Although maxillofacial injuries are uncommon in children, when occur often cause functional impairment and aesthetically unacceptable appearance. Several studies were carried out to understand the incidence and characteristics of paediatric maxillofacial injuries. In this study, we retrospectively evaluated maxillofacial injuries in a paediatric population (1 to 18 years). This study shows, boys suffered more (82.79%) facial injuries than girls (17.21%), with the average age of the patients being 11.25 ± 5.12 years. These inferences are resonant with previous investigations of Khan *et al.* and Ul Haq and Khan from Lahore, suggesting male gender predominance in the incidence of facial trauma within the age range of 1–16 years having ratios of male: female; 1.8:1 (males: 70% and females 31%) [14], and male; female 2:1. [25] The prevalence of oral & maxillofacial trauma occurring in paediatric population in Pakistan is around 34% as mentioned by Zafar *et al.* [16] Another study carried out by Mukhopadhyay *et al.* in Kolkata, India also mentions the male dominance over female patients with the age between 0 to 12 years old making the ratio of 1.39:1. [26] The study conducted by Jaber *et al.* in Al-Fujairah, UAE also supported the male predominance. The study undertook patients of ages between 3–64 years, and the mostly recorded patients were male with the lead of n = 579 (83.5%) and females with n = 118 (16.5%) from the total of 716 samples. [27] According to Kazi *et al.* the presumed thought is that the occurrence of injuries in preschool children might be due to age-related childhood activities and the greater male predominance in older children and adolescents could be due to the fact that males are more often involved in outdoor activities, sports, and also violence. [28]

In our study, most of the cases recorded are from children residing in urban areas (90.7%) and this has been also discussed by Jaber *et al.* stating that most of the cases belonged to the urban regions (113 cases, 82.5%) as compared to the rural areas (24 cases, 17.5%). The main reason for this distinction could highly be the hazardous circumstances of the urbanized area, crowded places, high-risk activities/jobs, constructions, heavy flow traffics with unsuitable social system. [27]. In our country Karachi city is the economic hub for Pakistan and people from all walks of life and social status come from rural areas for socioeconomic reasons and during their stay also sustain facial trauma. In Pakistan the prior studies have also mentioned the cases that were observed in urban regions (Peshawar and Faisalabad) rather than rural areas. [15–16]

Regarding symptoms, the patients were observed with pain 50.2%, had swelling 25.1%, bruising and numbness were not observed. In these regards, Panesar *et al.* and Kamath *et al.* have mentioned that it is observed that the clinical presentation typically includes pain, swelling, erythema, and functional impairment, though the spectrum of symptoms may vary depending on the site and severity of injury. Early diagnosis and appropriate management are essential to prevent long-term complications, including facial deformities, malocclusion, and growth disturbances. [29, 5]

This study observed regarding the mechanism of injury that there were 67 (31.16%) cases of trauma sustained due to fall, 126 (58.6%) were injured by road traffic accident, 5 (2.33%) were firearm injuries, 13 (6.05%) had sports injuries and 4 (1.86%) others. These inferences are fairly reflected in several prior research works like in the studies of Khan *et al.* and Zafar *et al.* conducted in Peshawar and Lahore, it is

perceived that RTAs and falls are the protagonists of the maxillofacial injuries followed by firearm injuries, and sports. [15–16] The study of Anand *et al.* in Mumbai, mentions fall incidents (43.3%) that are more than RTAs (34.2%), [30] whereas, the study of Adeleke *et al.* in sub-Saharan African region also mentions that accidental cases reported had the higher mechanism of RTAs mainly involving motorbike collisions. [31] Segura-Palleres *et al.* and Mohammadi *et al.* investigated that most frequently reported causes were falls (24%) in younger children while adolescents are more prone to high-velocity injuries such as RTAs (36%) and sports-related trauma (21%). [32–33] Other than these, the studies have also mentioned the injuries caused by animal-interactions, interpersonal violence, child abuse, stab injuries, assaults, drug consumption, and workplace incidents. [16, 25–27, 31] Globally, the incidence and etiology of paediatric maxillofacial trauma vary widely depending on geographic, socioeconomic, and cultural factors. Road traffic accidents (RTAs), falls, sports injuries, and interpersonal violence have been identified as the leading causes, with RTAs being predominant in developing countries due to rapid urbanization and poor road safety measures. [34–35] The high incidence of facial injuries underscores the need for protective measures, such as helmets and face guards, particularly in activities prone to causing such injuries. This agrees with the discourse of Stassen *et al.* as well. [10]

Amongst facial bones sustaining trauma, 74.9% were mandible fractures, 20% maxilla, 7% zygomatic bone, 18.6% zygomaticomaxillary complex fracture, 3.7% orbital fracture, 12.6% nasal bone fracture, 2.8% frontal bone fracture, 1.9% Nasoorbitoethmoidal, and 2.8% palatine bone. Regarding these, the studies found in Pakistan have mentioned similar patterns of the observed fractures with the mandibular fractures having the dominance, [14–16, 25] in addition to this, Khan *et al.* has also mentioned sustaining nerve injuries (47%) in a total of 253 subjects. [15] *Zafar et al.* has also mentioned the mid palatal split (2 cases) and orbital floor fracture (1 case). [16] Whereas, the Indian studies have also mentioned the observations of soft tissue injuries with mandible fractures having higher occurrence with 82.8% of the entire recorded fractures. [26] Comprehensively, the studies carried out in India have showed the occurrence of various maxillofacial traumas them being upper third region of face, mid-face, and lower third facial region with the dominance of mandibular fracture occurring frequently. [36–37] The research conducted in sub-Saharan African region reported that cases included a majority of mandibular fractures along with some other mid-facial and hard tissue injuries. [31] In the study of Cleveland *et al.* the diversity in maxillary fractures were observed as being the cohort with 30.9% and mandibular fractures with 36.9% whereas, younger children mostly experienced condylar fractures and teenagers typically had angle fractures. [38] Supporting further, another study exposited that the observed patients with the mandibular condyle fracture (180 patients) and second condylar fracture (37 patients). [39] In a three-year-long study on patients aged from 0 to 19 by Bataineh and Koul *et al.* the mandibular fractures were the most commonly reported [40–41] and Kazi *et al.* found that dentoalveolar fractures were the most common type (199 fractures, 58.5%) of fractures seen in the patients. [28] This highlights the importance of protecting the mid face and lower face areas in trauma prevention strategies.

In the presenting study most of the fractures were compound 157 (73.02%), simple fractures were seen in 28 (13.02%), greenstick was 20 (9.3%), comminuted 8 (3.72%) and 2 had mixed fractures. Although there

appears to be the scarcity in the literature regarding these findings but in these regards, Rogan *et al.* and Atanelov and Bentley have exposited that the cranio-maxillofacial trauma and fracture patterns such as greenstick fractures are more commonly seen in younger children due to increased bone elasticity, whereas older children tend to present with complete or compound fractures. [42–43]

At our Oral & Maxillofacial Surgery ward, we have operated 1355 trauma cases from year 2018 till year 2022. Amongst these, 387 were paediatric trauma so; the incidence of paediatric trauma cases at our ward is 28.56% (Table 5). This data includes patients from Karachi city, the entire Sindh province, Balochistan and some parts of Punjab province.

Moreover, we have also operated large number of Rhino-Orbito-Cerebral Mucormycosis patients (ROCM). In our published study, we operated 28 cases of ROCM in a single year from December 2022 to December 2023. [44] Furthermore, our ward is also a big referral center for the cases of firearm injuries. We receive and operate a large number of firearm injury cases in our routine practice. In another published study from our Unit, we have admitted and operated 60 firearm injury cases from December 2022 to July 2024, more research studies are in pending. [45]

Majority of patients received at ward are from urban population because in big cities like Karachi, Hyderabad and Larkana etc, road safety regulations are unfortunately not routinely followed. Our maxillofacial Centre has become the largest referral Unit for Sindh province and is also becoming one of the leading Unit in Pakistan, due to vast variety of patients being treated free of cost. We treat not only trauma, but also manage; cervicofacial necrotizing fasciitis, odontogenic infections, mucormycosis and oral cancer, as our dominant work load strengths [24, 45, 46]. In addition, we also get patients from outside Sindh province, from other parts of Pakistan.

Table 5
Data of Facial Trauma patients treated at OMFS ward since 2018

Total number of trauma cases treated at omfs ward from 2018 till 2022	**1355**
Total number of paediatric trauma cases treated at omfs ward from 2018 to 2022	387
Incidence of paediatric trauma treated at omfs ward	28.56%

Limitations

This includes; single-centered cross-sectional study to limit generalizability, also long-term outcomes with follow ups not available. We support multi-centered and longitudinal studies to provide a more comprehensive understanding of paediatric maxillofacial trauma and with known advantages, publishing more research work will further validate Prof. Katpar innovative Splint's Technique. [46, 47]

CONCLUSION

This study provides valuable insights about causes, types of injuries amongst paediatric population and findings show; male population is more susceptible to oral & maxillofacial trauma, Road traffic accident and

fall from height are the leading causes, Pain is the most consistent clinical feature and Mandible forms the most frequent jaw bone fractured. We are unable to find a Postgraduate Training Program offered in Asian, including Pakistan and due to large number of patient population attending our Surgical Unit, we recommend, starting Paediatric Maxillofacial Surgery postgraduate clinical program. This study further signifies the importance of introducing conservative surgical strategies for Pediatric Population and recommends; manufacturing, non-existing helmet riding a motor bike and using seat belts for small children in cars in Pakistan as done internationally. Both above protective gears should also be cost effective for low- and middle-income parents affordability. In addition, there is also a dire need of spreading active social media awareness for masses and policy makers to promote precautions and improve traffic protocols nationally to combat rising trauma incidents and also to promote maxillofacial surgical specialty awareness. [24, 45, 46]

Abbreviations

European Union (EU), Computerized National Identity Card (CNIC), National Data Base and Registration (NADRA), Road traffic accidents (RTA), motor vehicle collisions (MVCs), Dow University of Health Sciences (DUHS), Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Rhino-Orbito-Cerebral Mucormycosis (ROCM).

Declarations

Ethics Approval and Consent to Participate:

The study was approved by the SMBBIT Institutional Ethics Review Committee, *ERC Ref #: ERC-000116/SMBBIT/Approval/2024*, Dated: Oct 26th, 2023 and informed Consent taken from the parents or guardians of the study participants. Also stated, that this study done in accordance with the Principles of Declaration of Helsinki and furthermore, is shared from original dissertation submitted as essential requirement for appearing at the Oral & Maxillofacial Surgery Fellowship Final Exit Exam by the 1st Author.

Consent for Publications:

Not Applicable

Availability of Data Materials:

All data presented is available with the corresponding author and can be provided, if required and requested.

Competing interests:

Not Applicable

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Author's Contributions:

1. Dr. Hassaan ul Qamar.: Study design, data collection, write-up and final study approval.
2. Prof. Shahjahan Katpar: Study conception, supervision and final study draft approval
3. Dr. Hajra Rana: Helped in study write-up and data collection.
4. Dr. Shahid Jamil Awan: Assisted with References collection.
5. Dr. Memuna Khan: Assisted with data collection.
6. Dr. Usman Ghani Anwar: Assisted with collecting Patient details.

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Figures

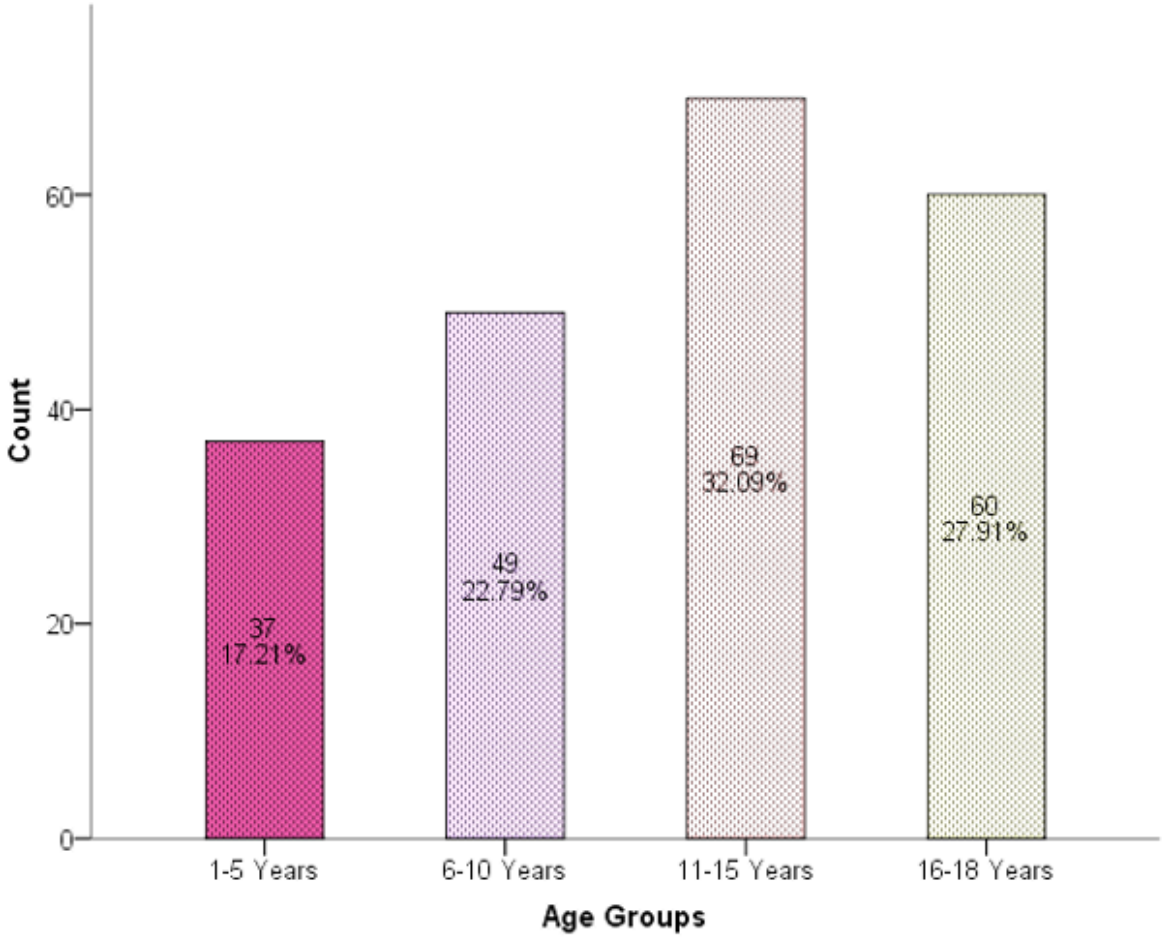


Figure 1

Age distribution of the children n=215

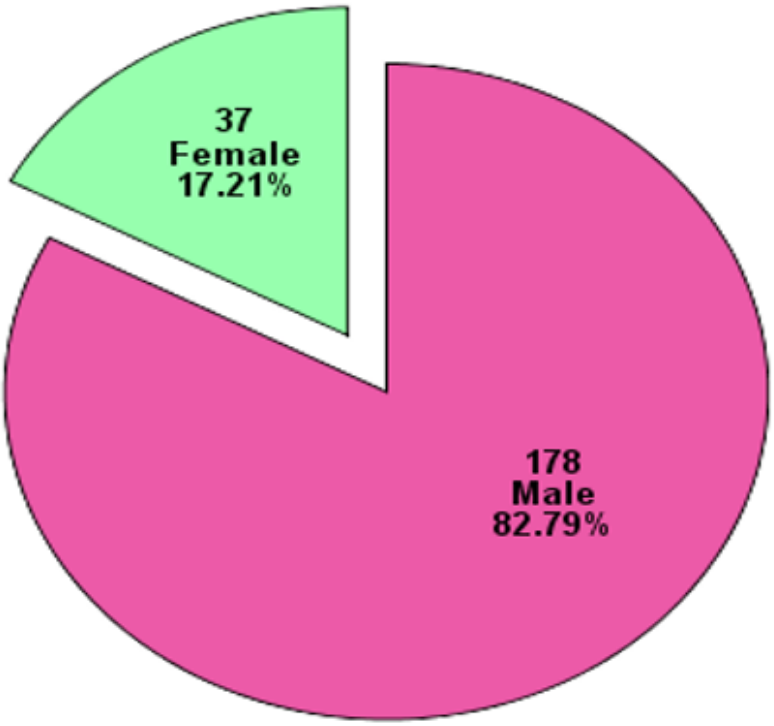


Figure 2

Gender distribution of the children n=215

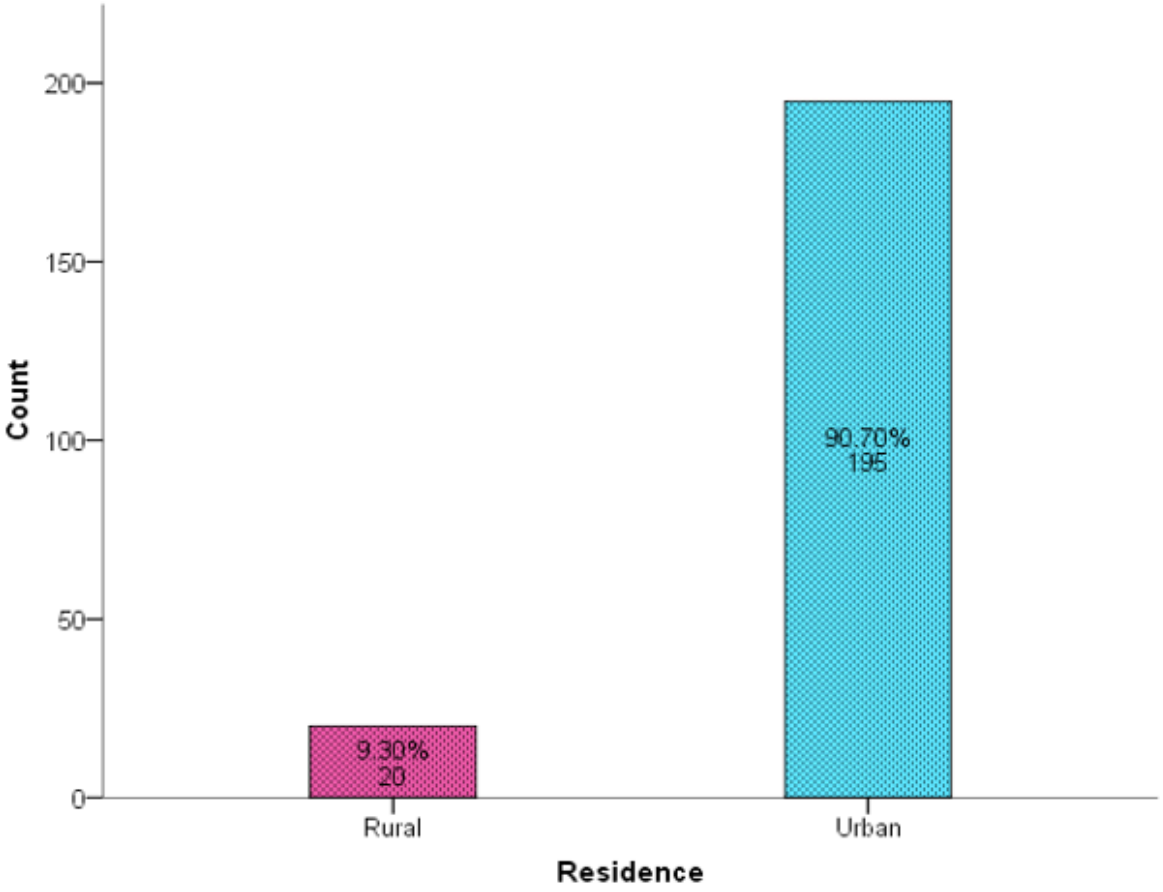


Figure 3

Residential Status of the children n=215

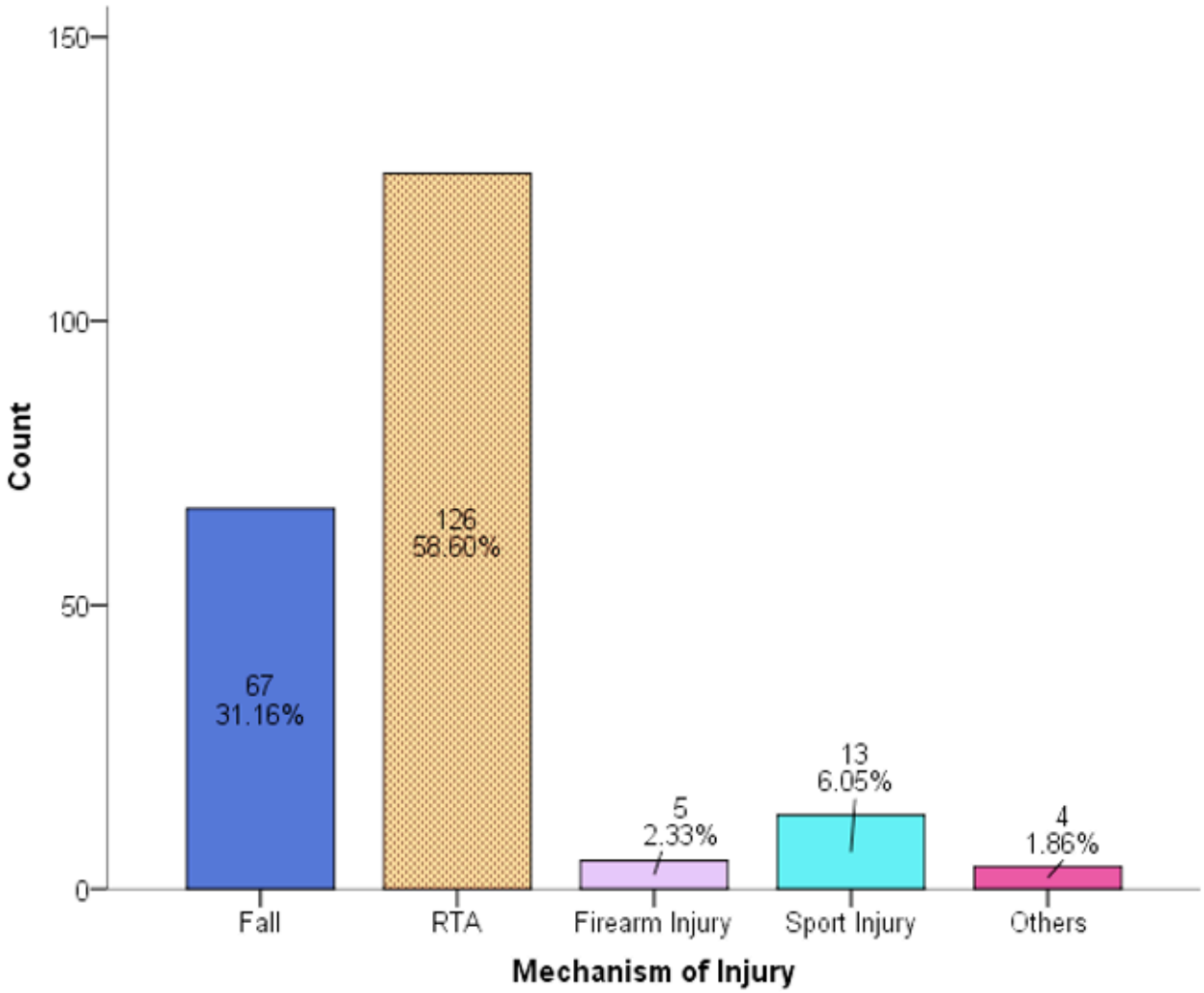


Figure 4

Pattern of oral & maxillofacial Bony trauma in term of Cause / Mechanism of Injury n=215

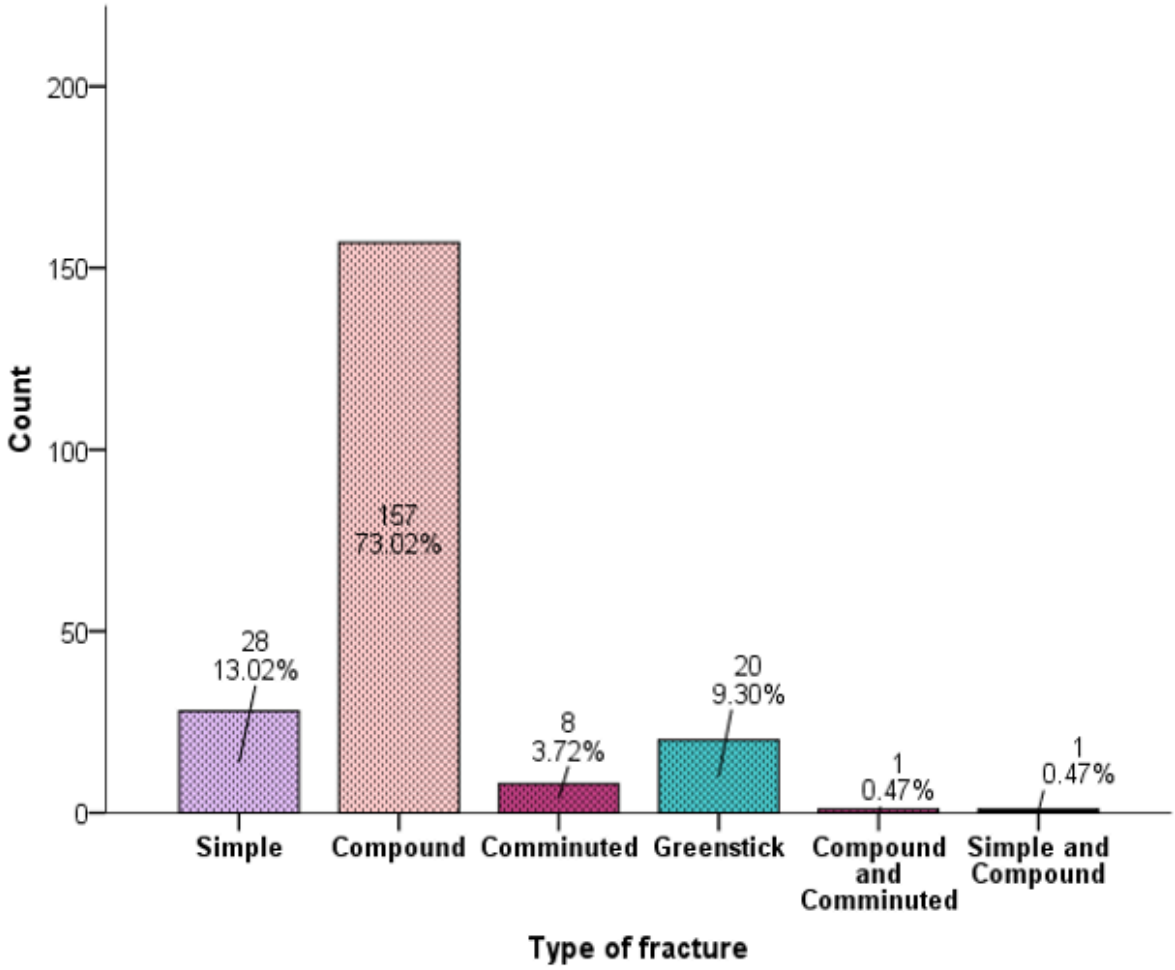


Figure 5

Type of Fracture, showing Pattern of oral & maxillofacial trauma n=215