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Maxillofacial Trauma of Paediatric Patients: University of Malaya Experience

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ABSTRACT

This study aimed to determine the incidence, aetiology, types of injury, management and the outcomes of the treatment of maxillofacial trauma among paediatric patients treated in Faculty of Dentistry, University of Malaya. A retrospective study (2005-2015) was carried out which involved retrieving past records (manual/ electronic form) of paediatric patients (under 16 years old) who presented with maxillofacial trauma. Data collected was organized using descriptive statistics with SPSS version 12.0.1. The total number of patients was 120 but only 93 had complete records. The ratio of boys to girls was 2:1. The main cause of injury was falling (54%) followed by motor-vehicle accident (MVA) (42%), assault (3%), and sport (1%). The total count of soft tissue injury only was about 41% while 59% presented with maxillofacial fracture. Midface were the most common fracture occurred followed by mandibular fractures. Both fractures were mostly managed by open reduction and internal fixation (ORIF) using non-resorbable plates except for condylar fractures which were mostly managed conservatively. In conclusion, the incidence of maxillofacial trauma in children increased within the time frame of this study. The most common aetiology was fall. Hard tissue injury accounting for most of the cases whereby midface was the most common site involved. ORIF was the treatment of choice for most of the fracture cases except for condylar fractures (conservative management). All patients had achieved reasonable outcomes postoperatively in terms of form and functions.

Keywords: Trauma; maxillofacial; oral; paediatric; fracture; treatment

INTRODUCTION

The oral and maxillofacial regions are the first foci of human interaction. Ironically, the facial areas are the most frequent targets of trauma and incidence of such is increasing at an alarming rate. The maxillofacial region includes organs carrying out essential functions of the body like respiration, smelling, mastication, and speech (1). Therefore, special attention must be paid in cases of facial trauma as it may potentially cause disfigurement and loss of function.

Trauma is the leading cause of morbidity and mortality in children of the United States (2, 3). As reported in previous publications, the causes and incidence of children involved in facial fractures differ as a result of social, cultural, and environmental factors. A majority of these injuries are encountered in boys who are involved in motor vehicle accidents (4, 5). Previous studies also state that the most common site of maxillofacial trauma in children aged 0 until 16 is the mandible (59%) compared to the midface (42%) (6).

Although maxillofacial trauma in children is not common worldwide, it is considered a challenging case for surgeons as their initial management could be complex. This is because children and adults have significant differences in terms of facial skeleton.

They exhibit small facial bones, non-pneumatized sinuses, presence of developing tooth buds in the jaws, a fast healing process, and, frequently, difficulty with compliance and cooperation as compared to that of adults (7). As children are in their growing phase, every care should be taken to prevent the facial skeleton growth pattern from being jeopardized (8). Any disturbance to the growth pattern of the facial skeleton can cause impairment in their development (8). Thus, some special considerations should be taken in treatment to improve the quality of life of the children, which might demand multidisciplinary approach depending on the type and severity of the trauma (9)

Oral and maxillofacial surgeons should follow the treatment protocols in managing paediatric patients with trauma. Open reduction with internal fixation in children more than 12 years old and a conservative approach in children less than 10 years old have shown to be useful (10). However, conservative treatment of the growing bone is more desirable than open reduction whenever possible. This is because it may interrupt the osteogenic potential of the periosteum and create scarring, which may then restrict growth (11-13). In previous studies, paediatric mandibular condylar fractures were treated with closed reduction by using intermaxillary fixation (IMF) which provided functional stimulation for remodelling the fractured condyle (6). In cases without or with mild malocclusion, conservative management such as soft diet, splint, and interdental wires was delivered (6).

Children are growing individuals who need special care in terms of medical and health care. There should be a medical team working together in order to deliver treatments with proven success for even the most complex conditions of trauma in paediatric patients. Thus, the purpose of this study was to retrospectively review and analyse the cases of oral and maxillofacial trauma of paediatric patients referred to the Faculty of Dentistry, University of Malaya. The study aimed to determine the incidence, common aetiology, types of injury, management and the outcome of treatment delivered in Faculty of Dentistry, University of Malaya. The data related to treatment of paediatric maxillofacial injuries in this centre is therefore important and serves as an audit for future records.

MATERIALS AND METHODS

A retrospective study was designed to fulfil the research objectives and the approval from the Dental Research Ethics was obtained (**DFOS1613/0035(U)**). Records of paediatric patients that had sustained maxillofacial trauma across January 2005 to December 2015 who were treated in the Faculty of Dentistry, University of Malaya, Kuala Lumpur were reviewed and analysed. Patients aged 16 years old and below who had received treatment for any kind of oral and maxillofacial trauma (soft and hard tissue) in Faculty of Dentistry, University Malaya were included in this study. Patients' whose records contained incomplete data and who requested to be transferred to other hospitals for continuation of definitive treatment were excluded from the study.

Patients' case records were retrieved from the Department of Oral & Maxillofacial Clinical Sciences' database while their names and registration numbers were manually searched from the Oral & Maxillofacial Surgery Postgraduate On-Call Logbooks, Oral & Maxillofacial Surgery In-Patient Logbooks (Ward Book and OT Book), patient attendance records from the Dental Informatics' database, and list of attendance of the Trauma Clinic of Oral & Maxillofacial Surgery Unit. All data including age, gender, race, cause of injury, type of injury, type of treatment recieved, and outcome at 1 month, 3 months, 6 months and 1 year post-operative were retrieved from Dental Information System (DEISY) and patients' folders. The age of all the subjects were then further divided into 3 types to include three main categories for children, which were toddlers (0-4 years old), pre-teenagers (5-10 years old) and teenagers (11-16 years old) for ease of data analysis. All data were recorded and analysed descriptively using SPSS version 12.0.1.

RESULTS

A total of 120 paediatric patients sustaining oral and maxillofacial trauma were recorded as having sought treatment from the Faculty of Dentistry, University of Malaya from 2005 to 2015 where we can see an increase in the trend from year by year (Figure 1) except there was slight decrease during 2011. Among these patients, only 93 who complied with the inclusion criteria were included in this study. These patients were as young as 7 months up to 16 years old. Majority of them were Malay (70%), followed by Indian (17%), Chinese (10%), and others (3%) (Table1). Data from Table 1 shows that 69% of subjects were boys, giving an overall male to female ratio of 2:1. Falling was the most common cause of trauma, occurring in 50 patients, where the most of them ranged from 0-4 years old. Motor vehicle accident was the next commonest cause of trauma involving 42% patients, despite it being documented as the most frequent cause in children aged 11 to 16. Injuries sustained while playing sports and due to assault carry 1% and 3% respectively (Table 2).

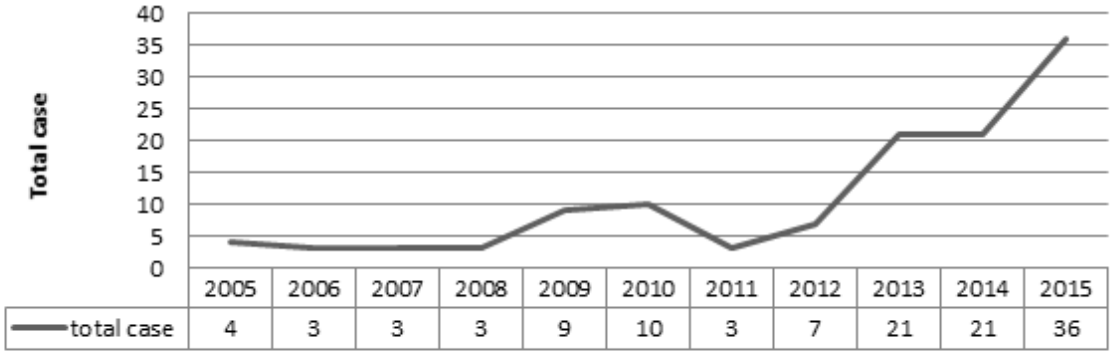

Figure 1. Total Cases of Maxillofacial Trauma of Paediatric Patients in Faculty of Dentistry, University Malaya, Presented By Year

Table 1. Demographic Profile of Paediatric Patients Sustained Oral and Maxillofacial Trauma In Faculty Of Dentistry, University Of Malaya From The Year 2005-2015

Subject	Total
Race	**n = 93 (%)**
Malay	65 (70)
Chinese	9 (10)
Indian	16 (17)
Others	3 (3)
Gender	**n = 93 (%)**
Male	**64 (68)**
0-4 y/o	19 (20)
5-10 y/o	17 (18)
11-16 y/o	28 (30)
Female	**29 (32)**
0-4 y/o	12 (13)
5-10 y/o	10 (11)
11-16 y/o	7 (8)

Table 2. Causes Of Maxillofacial Injury According to Age Group

Age (years)	Fall n (%)	MVA n (%)	Assault n (%)	Sport n (%)	Total n (%)
0-4	27 (29)	4 (4)	1 (1)	-	32 (34)
5-10	17 (18)	8 (9)	1 (1)	-	26 (28)
11-16	6 (7)	27 (29)	1 (1)	1	35 (38)
Total	50 (54)	39 (42)	3 (3)	1 (1)	93 (100)

The current study showed that 59% of patients presented with maxillofacial fracture while 41% presented with soft tissue injury alone (Table 3). Laceration wounds predominate among all soft tissue injuries. As for maxillofacial fracture, results showed that midface were the most common site of fracture (38%), followed by mandibular fracture (28%) and dento-alveolar fracture (21%). The remaining 13% of patients sustained other isolated cranial fractures. Table 4 provides a detailed tabulated representation.

Table 3. Types Of Maxillofacial Injury According to Age Group

Age (years)	Hard Tissue Injury n (%)	Soft Tissue Injury n (%)	Total n (%)
0-4	13 (8)	23 (14)	36 (22)
5-10	18 (11)	24 (15)	42 (26)
11-16	64 (40)	20 (12)	84 (52)
Total	95 (59)	67 (41)	162 (100)

Table 4. Types of Maxillofacial Fracture According to Age Group

Age (years)	Midface n (%)	Mandibular n (%)	Dentoalveolar n (%)	Others n (%) (cranial + frontal)	Total n (%)
0-4	2 (2.1)	4 (4.1)	5 (5.2)	2 (2.2)	13 (13.6)
5-10	5 (5.3)	3 (3.1)	9 (9.5)	1 (1.1)	18 (19.0)
11-16	29 (30.6)	20 (20.8)	6 (6.3)	9 (9.7)	64 (67.4)
Total	36 (38)	27 (28)	20 (21)	12 (13)	95 (100)

Notably, it was observed that the incidence of midface fractures was dominant in the age group of 11- 16 years old. Among various sites of the midfacial area, the zygomatic complex was the most frequent site of fracture (39%) as compared to other sites. This was followed by Le Fort fractures – with Le Fort I and II accounting for 30% respectively –and orbital fracture (22%), naso-orbital-ethmoid fractures (6%), while nasal fracture accounting for 3% (Table 5). Reported cases of mandibular fracture were presented as either multiple or isolated fractures. Among all types of mandibular fracture, condyle, body, and parasymphysis were the most common types of fractures sustained by paediatric patients where each type accounted for 26% apiece. Detailed data representation is shown in Table 6.

Table 5. Types of Midfacial Fracture According to Region and Age Group

Age (years)	Types Of Midfacial Fracture							
	Le Fort I n (%)	Le Fort II n (%)	Le Fort III n (%)	ZMC n (%)	Orbit n (%)	NOE n (%)	Nasal n (%)	Total n (%)
0-4	-	-	-	1 (2.8)	1 (2.8)	-	-	2 (5.6)
5-10	1 (2.8)	-	-	2 (5.6)	2 (5.5)	-	-	5 (13.9)
11-16	4 (11.2)	6 (16)	-	11 (30.6)	5 (13.7)	2 (6)	1 (3)	29 (80.5)
Total	5 (14)	6 (16)	0	14 (39)	8 (22)	2(6)	1 (3)	36 (100)

** ZMC – Zygomatic Complex*
NOE – Naso-orbital-ethmoid

Table 6. Types of Mandibular Fracture According to Region and Age Group

Age (years)	Types Of Fracture					
	Condylar n (%)	Body n (%)	Parasymphysis n (%)	Angle n (%)	Symphysis n (%)	Total n (%)
0-4	1 (3.7)	1 (3.7)	1 (3.7)	-	1 (3.7)	4 (14.8)
5-10	1 (3.7)	-	2 (7.4)	-	-	3 (11.1)
11-16	5 (18.6)	6 (22.3)	4 (14.9)	3 (11)	2 (7.3)	20 (74.1)
Total	7 (26)	7 (26)	7 (26)	3 (11)	3 (11)	27 (100)

Most of the soft tissue injuries were managed actively by doing toilet and suturing (82%). The few patients who came with very minimal laceration wounds were not intervened actively; only reassurance was given with advice to consume soft diet and prescription of analgesics.

As for hard tissue injuries, 55% of dento-alveolar injuries were managed conservatively while the other 45% were managed actively by constructing composite splint to reduce the fracture, toileting with/without reimplantation of avulsed tooth socket, and extraction or root canal treatment for complicated crown fractures. The majority of midface and mandibular fractures were managed actively either by open or closed reduction while the rest were treated conservatively. Detailed tabular representation is provided in Table 7.

In terms of active management, more than half of the midface fracture cases were managed by open reduction while 25% were managed conservatively and the remaining 8% by closed reduction. Open reduction was more preferred in cases of Le Fort fracture, where only one case was treated conservatively (Table 8). In mandibular fractures, more than half were intervened actively

Table 7. Treatment for Hard Tissue Injury According to Age Group

Age (years)	Treatment						Total n (%)
	Conservative n (%) Closed reduction		Active n (%)				
			Open reduction				
	Mandibular#	Midface#	Mandibular #	Midface #	Mandibular #	Midface #	
0-4	1 (1.5)	1 (1.6)	-	-	4 (6.3)	1 (1.6)	7 (11.0)
5-10	2 (3.2)	2 (3.2)	-	-	1 (1.6)	3 (4.7)	8 (12.7)
11-16	5 (8.0)	6 (9.5)	1 (1.6)	3 (4.8)	13 (20.7)	20 (31.7)	48 (76.3)
Total	8 (12.7)	9(14.3)	1 (1.6)	3 (4.8)	18 (28.6)	24 (38.0)	63 (100)

** # - fracture*

Table 8. Treatment for Midfacial Fracture According to Region

Type	Open Reduction & Internal Fixation n (%)	Closed Reduction n (%)	Conservative n (%)	Total n (%)
Le Fort I	5 (14)	-	-	5 (14.0)
Le Fort II	5 (14)	-	1 (2.8)	6 (16.8)
Le Fort III	-	-	-	-
Zygomatic Complex	7 (19.5)	2 (5.3)	5 (13.9)	14 (38.7)
Orbit	6 (16.8)	-	2 (5.5)	8 (22.3)
Nasal	-	-	1 (2.8)	1 (2.8)
Naso-Orbital-Ethmoid	1 (2.7)	1 (2.7)	-	2 (5.4)
Total	24 (67)	3 (8)	9 (25)	36 (100)

by open reduction (66%). All angle and symphysis of mandible fractures were managed by open reduction. Meanwhile, most of the condylar fractures were managed conservatively. Detailed tabular representation is provided in Table 9.

Table 9. Treatment for Mandible Fracture According to Region

Type	Open Reduction & Internal Fixation n (%)	Closed Reduction n (%)	Conservative n (%)	Total n (%)
Condylar	1 (3.7)	1 (3.7)	5 (18.6)	7 (26)
Body	6 (22.3)	-	1 (3.7)	7 (26)
Parasymphysis	5 (18.6)	-	2 (7.4)	7 (26)
Symphysis	3 (11.0)	-	-	3 (11.0)
Angle	3 (11.0)	-	-	3 (11.0)
Total	18 (66.6)	1 (3.7)	8 (29.7)	27 (100)

Out of all cases that involved open reduction and internal fixation, only 3 patients were treated with resorbable plates; one had a symphysis fracture and the other two patients were orbital fractures. The rest were treated using non-resorbable plates. There was one reported case in the present study whereby a 7-month old Malay boy - who was allegedly involved in a motor vehicle accident - sustained displaced symphyseal fracture and right condylar fracture. The patient was managed surgically by open reduction and internal fixation using resorbable plate for the symphyseal fracture while the condylar fracture was left for conservative treatment.

Based on the study, treatment done in Faculty of Dentistry, University of Malaya had achieved reasonable outcomes and all fracture sites had regained their form and function. None of the cases reported any permanent incidence of neural damage or growth disturbances. The duration of follow-up was 1 month, 3 months, 6 months, and 1 year post-operative. Of all the cases, the longest follow-up was about 6 years which involved only 1 case.

DISCUSSION

Maxillofacial trauma in paediatric patients is infrequent worldwide but there is a marked increment of incidence reported in the Dental Faculty, University of Malaya from 2005 until 2015 (Figure 1). This may be due to more patients being referred to Dental Faculty, University of Malaya for treatment during recent years. It was also noted that from year 2012 onwards the commencing of Trauma Clinic in the Oral and Maxillofacial Department could mainly attribute the increased in number of patients seen in the centre. The overall results from the current study suggested that boys were more likely to be involved in trauma including falls, assault, and motor vehicle accidents as compared to girls (ratio 2:1) and this result was consistent with existing research reports (14-18). This is possibly because boys seem to have more aggressive behaviour than girls and also tend to engage in a lot of outdoor and risk taking activities (14-18).

The most common aetiology of injury was falls (54%) and children aged 0-4 years old accounted for most of the reported cases in the present study. The reason is perhaps that while toddlers are experiencing a time of great cognitive, emotional, and social development, they are less coordinated compared to children above 4 years old. Furthermore, curiosity and the lure of adventure can cause children to be engaged in dangerous activities. However, there was one case reported in the present study involving a 14 year-old boy who fell from a 3-storey school building as he attempted suicide after losing control over himself. This patient sustained fractures of right angle and left parasymphysis of the mandible and was managed surgically by open reduction and internal fixation. After completing his trauma management, the patient was referred to the Psychology Department as he was diagnosed with having schizophrenia.

MVAs, which were the second commonest cause of trauma, were seen frequently among children aged 11-16 years old. The reason might be because children at this particular age are eager to try new things, immature, and lack experience in cases of alleged motorbike accidents. Although the minimum age to obtain a motorcycle license in Malaysia is 16, there are still many teenagers riding motorcycles illegally in Malaysia. This attitude may contribute to the rise of MVAs among children. Moreover, based on the statistics supplied by the Ministry of Transport Malaysia (MOT), in 2014 there were 5, 949, 485 motor vehicles in the Federal Territory of Kuala Lumpur which is only 243 square kilometres in size (19). The significant increase in number of motor vehicles causes severe congestion leading to heavy traffic problems in the city daily especially during peak hours. However, there are also MVA cases reported that involve pedestrians. For example, there was one case reported in the present study where a 14 year old Chinese boy with autism was involved in an MVA when he tried to run away from his house and was hit by a car while crossing a road. This patient sustained severe soft tissue injuries, intracranial bleeding, frontal, naso-orbital-ethmoid injuries, and fractures of right body and left parasymphysis of mandible (greenstick

fractures). All hard tissue injuries and fractures were managed conservatively.

These results regarding the cause of trauma are in line with reports in literature (20-22) which reveal that young children tend to suffer injuries from low velocity forces (falls, for example), while older children are more likely to be exposed to high velocity forces such as MVAs.

The most common type of traumatic injury among paediatric patients is maxillofacial fracture which accounts for 59% of the current study. This result shows a significant difference compared to previous literatures (6, 17), where it was found that soft tissue injuries would usually exceed the total number of fracture cases in terms of type of injury. Based on our results, the increased number of maxillofacial fractures in children especially in the 11-16 year old group was also consistent with the commonest cause of trauma injury in that particular age group, which are MVAs. Previous study (23) showed that there is a distinct relationship between the type of injury and cause where accidents with minimal forces such as falls tend to cause less severe injuries such as soft tissue injuries only, whereas more complex and multiple fractures occur when the impact was greater.

Many studies reported that the mandible is the most common site of facial fracture among children. However, our study showed that midface fractures have the highest incidence in children which accounted for 38% of reported cases. As the maxillary sinuses expand and the permanent teeth erupt, the incidence of midface fractures increase over the age of 5 (24). A study found that children aged 13-15 have the highest frequency in midface fractures (25) which coincided with our study that showed this particular fracture area was dominant in the age group of 11-16. Among various sites, the zygomatic complex is the most frequent to fracture (39%) which was in line with a previous study (26). Le Fort fractures were the second commonest fracture sites (30%), followed by orbit fractures (22%). A review article (3) revealed that Le Fort fractures were found commonly in patients aged 10 years old above due to fully developed para-nasal sinuses. We encountered 11 cases of Le Fort fractures among the children aged 11-16, but only one Le Fort fracture among children aged 5-10. Meanwhile, mandibular fractures were the second commonest type of facial fractures in children with condylar, body, and parasymphysis being the most common sites involved. The condyle is susceptible to fracture because of the highly vascularised and thin neck which is poorly resistant to low velocity trauma during falls (27).

Soft tissue injury in paediatric patients presented in the Dental Faculty, University of Malaya were commonly managed by toilet and suturing. Only a few cases with very minimal wounds (either lacerations or abrasions) were managed conservatively. Most of the patients who sustained soft tissue injury only were managed as outpatients and were prescribed with analgesic - usually syrup paracetamol along with antibiotic medication such as syrup amoxicillin or Augmentin.

The majority of facial fractures in paediatric patients were intervened actively in the Dental Faculty, University of Malaya either by closed or open reduction. However, among all the maxillofacial fractures there were only 4 cases that were treated using closed reduction while the remaining 42 cases were managed by open reduction. Open reduction and internal fixation using mini plates and screws were frequently chosen by the maxillofacial surgeons in the Dental Faculty, University of Malaya to treat this kind of fracture.

Placing fixed non-resorbable plating systems in the growing, immature craniomaxillofacial skeleton of infants and children has been a controversial issue in many previous studies. It became a topic of debate as several studies showed that surgery and rigid fixation may induce growth restriction and alters the craniofacial morphology of the expanding cranium (28, 29). However, Wayne et al. 1999, reviewed their experiences with non-resorbable plates in children had shown that it was safe to place mini-plates on a growing pediatric calvarium (30). Their studies proved that there is minimal risk of growth restriction or delayed growth and these plates did not need to be removed routinely unless a clinical assessment required such action. Based on our study, most of the maxillofacial fractures involving paediatric patients within the age of toddlers (0-4 years old) and pre-teenagers (5-10 years old) whom were managed by open reduction and internal fixation using non-resorbable plates showed positive outcomes and almost all fracture sites had regained their form and function. The current study showed none of the cases needed removal of any plates or screws at a later age.

Nevertheless, there were 3 cases treated by using resorbable plates which were indicated on a symphysis fracture and two orbital fractures. A previous study found that resorbable fixation devices were safe and efficient when used in paediatric maxillofacial fractures (31). Furthermore, they have no adverse effect on fracture healing, low infection rate, and reduced the need for secondary operations (31). The only problem in resorbable plates was the high cost, making them a not-preferred treatment of choice (31).

A previous study reported that the fastest and most satisfactory management was by doing

open reduction and fixation of most fractures (7). Nevertheless, according to Norholt et al. 1993, conservative management was recommended for patients who sustained condylar fractures, i.e. soft diet and splint based on restoration of occlusion, with or without using intermaxillary fixation, and followed by functional therapy (32). This is because mandibular condylar cartilage is the centre of growth in the craniofacial complex (33), thus excessive immobilization may lead to mandibular hypomobility while growth retardation or excess may happen due to inadequate- or over-treatment (34). Furthermore, growth potential may help to improve the long-term results, as with compensatory condylar growth after condylar fractures. Also, children in the deciduous and mixed dentition stages show some potential for spontaneous occlusal readjustment after injury and treatment, as deciduous teeth exfoliate and permanent teeth erupt (32). This is in line with the management carried out in the Dental Faculty, University of Malaya, where conservative management is the treatment of choice in cases of condylar fracture.

In our study, there were some limitations to acquire the complete records of patients' outcomes and follow up as some of the patients may not come to the post-operative review after initial active treatment. Hence, complete and thorough findings during follow up review were unable to be collected. This might be because they felt that their conditions were improving and there was no need to return for a review even though follow up appointment has been given. Besides, some of the outcomes also were not recorded by the dental officers during reviews, as there were no problems or complications arising after the treatment especially for cases with minimal injury such as soft tissue injuries. Hence, all clinicians to ensure records are kept updated should practice good clinical documentation regularly. In addition, this study was also limited by its sample size, as there were not many cases of paediatric patients presented to the Dental Faculty, University of Malaya within our research time frame. Nevertheless, this study should be extended to other government and university hospitals in order to get better picture and outcome of the management of maxillofacial trauma of paediatric patients in Malaysia.

CONCLUSION

As growing individuals, children have different patterns and incidence of trauma. The incidence of maxillofacial trauma in children increased within the time frame of this study and boys outnumber girls with a ratio of 2:1. The most common aetiology was falling which occurs commonly in children aged 0-4 while MVAs were the second most frequent aetiology which occurs mostly in children aged 11-16. The most common type of injury sustained by children was hard tissue injury as compared to soft tissue injury. Midfacial fractures were the most common fracture occurred in children followed by mandibular fractures. Both fractures were mostly managed by open reduction and internal fixation using non-resorbable plates and screws. This is excepting condylar fractures which were mostly managed conservatively. All treatment done in the Dental Faculty, University of Malaya had achieved reasonable outcomes and almost all fracture sites had regained their form and function.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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