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Pattern of Pediatric Mandibular Fracture in Central India

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Abstract:
Introduction: *The etiology and pattern of mandibular fracture vary considerably among different study populations. Despite many reports about the incidence, diagnosis and treatment of mandibular fracture there is limited knowledge about the specific type or pattern of mandibular fractures in central India. This study attempts to delineate patterns of fracture based on patient age and mechanism of injury in central India.*
Materials and methods: *the medical records of patients with mandibular fractures treated over 2 years period were identified and analysed based on age, sex, mechanism of trauma, number and anatomic location.*
Results: *We reviewed 54 patients having mandibular fractures with age ranging from birth to 18 years. Out of 84 patients with maxillofacial trauma, 34 patients (62.96%) had mandibular fractures. Their ages ranged from 2 to 18 years and there were 24 males (70.58%) and 10 females (29.41%). Male: female ratio was 2.4:1. The highest incidence of mandibular trauma was in the age group of 13-18 years (47.05%), followed by the age group of 6-12 years (35.25%) and 0-5 years (17.64%). Most common cause of mandibular fracture was Road Traffic Accident (RTA) (47.05%) particularly in those travelling by motorcycles followed by bicycles (35.25%) and falls (17.64%).*
Keyword: Paediatric mandibular fractures

I. Introduction:

Paediatric facial injuries are common due to children's high level of activity, decreased parental supervision, and a tendency towards risk taking behaviour. Facial fractures are uncommon injuries in children. [1]

Facial injuries in children always present a challenge in respect of their diagnosis and management. Since these children are of growing age every care should be taken so that later the overall growth pattern of facial skeleton in the children is not jeopardized. The phenomenal increase in automotives on the road has led to a tremendous rise in number of road traffic accidents leading to facial injuries of which children are the most unfortunate victims. With the future morphological and anatomical changes in mind the management of these facial injury victims becomes a more complicated and arduous task for a surgeon.[2]

In childhood a generally impetuous nature and adventurous spirit combine to encourage participation in physical activities with little thought to immediate consequences, still paradoxically facial injuries in children are much less common than adults. Paediatric facial injuries are common due to children's high level of activity, decreased parental supervision, and a tendency towards risk taking behaviour. Facial fractures are uncommon injuries in children. The etiology and pattern of mandibular fracture vary considerably among different study populations.

A child is more difficult to examine both clinically and radiographically. The small size, lack of development, and lack of pneumatisation of paranasal sinuses makes the diagnosis of maxillofacial trauma by radiographic examination much more difficult in child than in adult. Clinical evaluation and palpation in child are less rewarding diagnostically than in the adult .The maxilla and the mandible of a child contain unerupted teeth or there is mixed dentition. This produces a more stable structure, requiring greater force to cause fracture and makes the fixation more difficult via either internal means or by intermaxillary fixation. The concomitant intracranial and other trauma may accompany maxillofacial trauma in children more frequently than in adults. Because the facial bones of the child heal much more rapidly than do those of the adult, stabilisation is required at an earlier time, usually within 5 days. Unwarranted operative intervention in child, including unnecessary internal fixation, inadequate treatment, recognition of chondritis, haematoma or seroma, may lead to greater long-term deficits and deformities in child than in adult. Due to these basic principles, children are a peculiar subpopulation of craniomaxillofacial trauma patients[3].

Despite many reports about the incidence, diagnosis and treatment of mandibular fracture there is limited knowledge about the specific type or pattern of mandibular fractures in South Asian countries. This study attempts to delineate predictable patterns of fracture based on patient demographics and mechanism of injury. Increased frequencies of RTA and domestic violence have emerged as the etiological factors in mandibular fractures in developing countries like India. Furthermore, there is an increase in the proportion of adolescent and young adults sustaining these injuries.

The type and direction of traumatic force can be extremely helpful in diagnosis. Fractures sustained in vehicular accidents are usually far different from those sustained in personal altercation. Since the magnitude of force can be much greater, victims of automobile and motorcycle accidents tends to have multiple mandibular fractures, whereas the patient hit by a fist may sustain single non displaced fracture.

II. Materials And Methods:

This study is a retrospective study analysis of pediatric trauma cases reported in Department Of Oral and Maxillofacial Surgery, SPPGIDMS, Lucknow. The medical records of patients with facial trauma treated over last two years (June 2012 to November 2013) were reviewed. A total of 84 cases were identified, of that 34 were having some form of mandibular fracture. The complete medical records of these 32 patients were obtained viz., case history, clinical notes, radiographs, photographs, if any surgical notes etc. Then data were analysed based on the following parameters- age, sex, mechanism of trauma, anatomic location of fracture, association of age with location.

III. Results

Out of 84 patients with maxillofacial trauma, 34 patients (40.4%) had mandibular fractures. Their ages ranged from 2 to 18 years and there were 24 males (70.58%) and 10 females (29.41%). Male: female ratio was 2.4:1. Boys accounted for 73% of the affected children, supporting other studies that reported a higher incidence of paediatric facial fractures in boys, perhaps because boys are more active, engage in more dangerous activities, have a more aggressive nature. The highest incidence of mandibular trauma was in the age group of 13-18 years (47.05%), followed by the age group of 6-12 years (35.25%) and 0-5 years (17.64%) as shown in table 1.

Table 1: Distribution of Mandibular Fracture According To Age

AGE	NUMBER	PERCENTAGE
0-5 years	6	17.64
6-12 years	12	35.25
13-18 years	16	47.05

The main etiology of trauma were animal hit, assault, car, bike, bicycle accidents, fall and sports injury. Among these, the most common cause of mandibular fracture was Road Traffic Accident (RTA) (47.05%) particularly in those travelling by motorcycles followed by bicycles (35.25%) and falls (17.64%).

The most common location of mandibular fractures was found to be the parasymphysis region (20.58%), followed by angle and body region (14.70%) and condyle (11.76%). Surprisingly dentoalveolar fractures were found to be very less (8.82%). The parasymphysis fractures were most common in RTA (14.70%).

Of the total number of mandibular fracture, 18 (52.94%) patients had only one fracture, while 16 (47.05%) had two fractures.

In European countries, vehicular accidents represent 30% to 80% of maxillofacial trauma,[3] whereas that in Africa, the principal cause of maxillofacial trauma was violence. In our sample, falls and bike accidents were the most common causes of maxillofacial injury (63% and 13%, respectively) with higher incidence in boys. For bicycle accidents, the use of safety devices is still very limited or simply not respected by parents or by the individual, showing deficiencies in the programs for education and accident prevention.[4]

Our results showed an increase of maxillofacial fractures according to age, with a high frequency in the adolescent group.(Table 10) The etiology of lesion also presented relationship with age: in patients younger than 6 years, the trauma presented low or middle energy (falls), whereas in patients older than 12 years, the trauma was related to high-energy trauma (transport vehicles). These results are in agreement with other researches.

IV. Discussion

Trauma is the leading health problem that children are facing today **(Gassner et al.,2000)**[5], being among the major causes of infant mortality **(Haug and Foss, 2000)**.[6] Although children are more susceptible to craniofacial trauma because of their greater cranial mass-to-body ratio **(Wymann et al., 2008)**.[4] Social, cultural and environmental factors influence the incidence and etiology of maxillofacial trauma **(Zimmermann et al.,**

2006). However low incidence of facial fractures can be explained by the lack of pneumatisation of paranasal sinuses, developing bone, greater elasticity of bone.

Anatomic Differences Between Children And Adults, And Their Consequences In Trauma

In general, children tend to have a smaller body mass than adults, which during a traumatic episode, results in a greater force per unit of body area. The child's incompletely calcified skeleton is close to the internal organs with less fat and more elastic connective tissue. These factors result in multiple internal organ injuries, often without external signs. Children have a higher surface-area-to-body volume ratio, which makes them prone to the quick development of hypothermia and can complicate hypotensive management by pooling blood in the peripheral vasculature rather than supplying the viscerum. Children also have a higher metabolic rate and cardiac output which, when coupled with higher oxygen demand, result in a low reserve during resuscitation.

The child's airway is of a smaller caliber, with relatively large and flaccid oral and pharyngeal soft tissues, a cephalad larynx, a shorter trachea, and a shorter, narrower epiglottis. This results in increased airway resistance, easy obstruction, difficult intubation, and easy self-extubation. The child's ribs and sternum are extremely compliant, resulting in a decreased reserve when respiratory efforts are diminished. The diaphragm aids in breathing and abdominal distention, or increased intrathoracic pressure diminishes ventilation. Therefore, with low pediatric lung compliance, ventilation becomes inefficient during respiratory distress.

When considering pediatric circulation during trauma evaluation and resuscitation, the surgeon must remember that children have a higher cardiac output and increased oxygen demand, resulting in a low oxygen reserve. The pediatric stroke volume is smaller than that of an adult, and as a result, cardiac output is rate-determined. Thus bradycardia leads to hypoxia and hypercapnea, both ominous signs. Even minor injuries could result in blood loss that is physiologically meaningful. The child's blood pressure is maintained through physiologic compensation such as vasoconstriction, tachycardia, and myocardial contractility, which may mask other signs of volume reduction. With this physiologic compensation, symptoms of volume depletion may not occur until it is too late to recover.

Pediatric abdominal injury requires immediate surgical intervention. The skeleton is not completely calcified or mature, and skeletal injury may result in growth disturbance, a higher proportion of greenstick fractures, and blood loss that is proportionally greater than in the adult.

There are differences between the pediatric and adult head and spine that should be considered during trauma. Children are susceptible to secondary brain injury because of differences in cerebral physiology and oxygen demand. The cranial-mass-to-body-mass ratio is high, which results in higher-energy impacts to the cranium. The child has a lower total body blood volume; thus scalp lacerations and subgaleal or epidermal bleeds could result in hypotension. With mobile cranial suture lines and open fontanelles, expanding mass lesions may be hidden until rapid decompensation occurs. Vomiting after trauma is common for children and is not necessarily indicative of increased intracranial pressure. The characteristics of the pediatric cervical spine include flexible interspinous ligaments, incomplete articulations, flat facet joints, and anteriorly wedged vertebral bodies with a greater cranial mass. The result is increased susceptibility to spinal cord injury without radiographic abnormality.[7]

This study is a retrospective analysis of mandibular fractures treated over last 2 years at Department Of Oral & Maxillofacial Surgery, SPPGIDMS, Lucknow.

Table 2. Paediatric Normal Values

Pediatric normal values

	Pulse(beats/ mm)	Respir-ations (per mm)	Blood pressure range, systolic, diastolic	Caloric require- Urinary output (cm3/h)	ment (cal/kg/24 h)	Maintenance fluids (cm*/day)	Endotracheal tube size (mm)	Distance of midtrachea to teeth/ gingiva (cm)	Average wt (kg)	Blood volume (cm*)
Neonate (0-28 d)	80-180		60-90,20-60	2.5	110-130	For children <1 mo, 250	Uncuffed 2.5-3.5	8-10	>2.5	0.46 x hemacrit x63
Infant (1st y)	75-160	30-60	87-105, 53-66	4-10	100-130	250-110	Uncuffed 3.0-4.5	9-11	4.10	300-800
Pre-school (2-6 y)	60-110	22-40	95-105, 53-66	12-20	75-90	1100-1500	Uncuffed 4.5-5.5	12-15	12-20	900-1600
School age (6-11	60-110	18-30	97-112,57-	20-23	60-75	1560-1660	Cuffed uncuffed	5.5-6.5 15-17	20-33	1600-2640

y)			71							
Adolescent (11-19 y)	50-90	12-16	112-128,66-80	35-70	30-60	1800-2500	Cuffed 7.0-8.0	18-20	35-70	2625-5600

Posnick et al (1993) indicated that paediatric patients aged 6-12 years were the group most frequently affected by maxillofacial trauma, also the incidence of facial fractures increases with age. The aetiology is variable. The main causes are motor vehicle accidents, falls and sport related injuries **(Posnick et al., 1993; Holland et al., 2001; Imahara et al., 2008)** and they depend on the age group involved. Most of the facial fractures are situated in mandible **(Heitor et al., 2009)**.

Several investigations about paediatric maxillofacial injuries have been performed to recognize their patterns and treatments. Some factors such as geographical location and socioeconomic status are related to the causes of injuries.[1]

Literature reviews about maxillofacial injuries in paediatric patient:

Table no. 3 **Literature Reviews About Maxillofacial Injuries in Pediatric Patient**

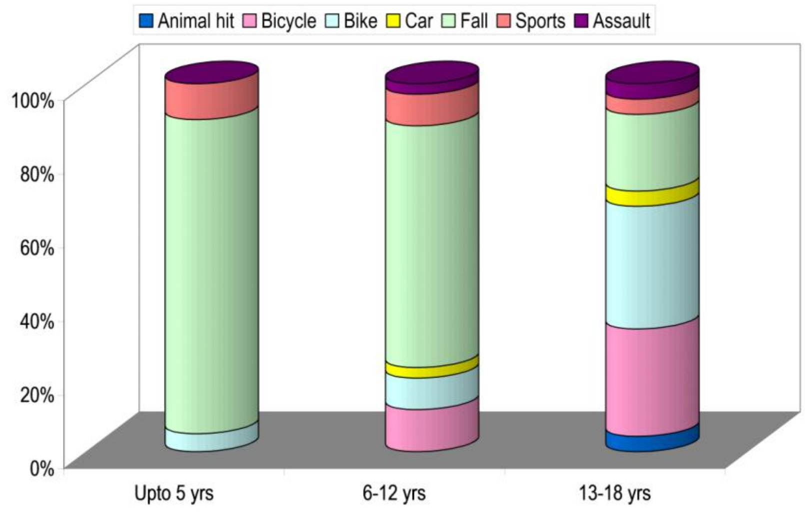
	Etiologies, %								
Reference	Country	Years	No. Patients	MVA	Falls	Violence	Sports	Others	Mean Age, y
Tanaka et al[1]	Japan	13	81	20	28	25	18	26	1-15
Qudah et al [15]	Jordan	5	227	20	52	17	8	3	11
Bamjee et al [11]	South Africa	4	326	29	23	48	0	0	1-18
Gassner et al[17]	Austria	10	381	30	24	14	17	15	10
Posnick et al[13]	United States	4	137	50	23	0	20	7	10
Zachariades et al[19]	Greece	25	202	14	74	0	5	7	0-14
Gussack et al[22]	United Stales	2	30	64	10	13	0	13	11
Oji[6]	Nigeria	12	40	28	65	7	0	0	0-11
Current study, 1999-2008	Brazil	10	757	12*	28	8	7	6	0-18

* Including road traffic and motorcycle accidents.
MVA indicate motor vehicle accident

In this research, we evaluated patients from 0 to 18 years, as reported in other studies.[1,7,12] The World Health Organization considers children as those with ages ranging from 0 to 18 years. However, there are differences within this group related to age, such as the etiology of trauma and its treatment. Children younger than 5 years live in a protected family environment, which contributes to the low frequency of accidents. On the other hand, the face is protected by the frontal prominence with a small projection of the face mainly by the lack of development of the paranasal sinuses and the presence of temporary teeth.

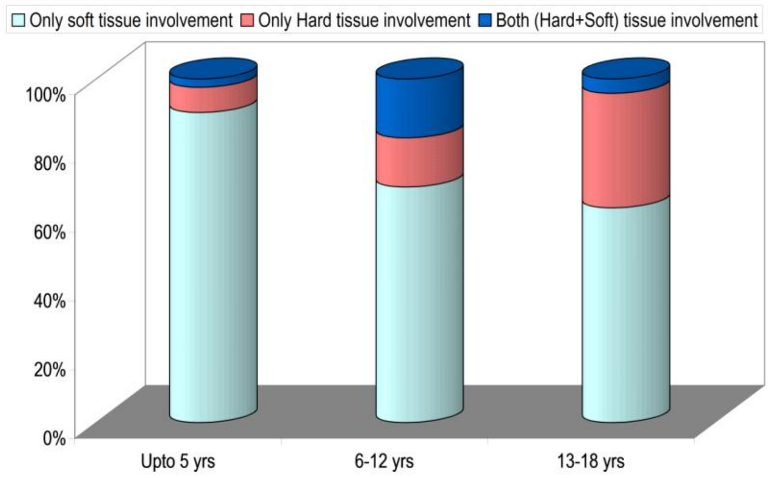
With increasing age and development of paranasal sinuses, the face becomes less flexible and less protected. In fact, for a child patient, the cranium-face ratio is 8:1, whereas for an adult patient, this ratio decreased to 2:1. Given this relationship, if the infant receive a direct trauma, he is more likely to present a fracture of the cranium when compared with an older child or adolescent who will likely to present a face fracture.[13] On the other hand, in maxillofacial trauma, some researchs showed that boys were more affected than girls with ratios ranging from 2:1 to 6:1.[1,7] The results of our study are consistent with these previous reports.

Graph .1 Association Between Age And Etilogy



Our results showed an increase of maxillofacial fractures according to age, with a high frequency in the adolescent group.(Table 10) The etiology of lesion also presented relationship with age: in patients younger than 6 years, the trauma presented low or middle energy (falls), whereas in patients older than 12 years, the trauma was related to high-energy trauma (transport vehicles). These results are in agreement with other researches.[1,4,6]

GRAPH 2: ASSOCIATION BETWEEN AGE AND TYPE OF INJURY



In European countries, vehicular accidents represent 30% to 80% of maxillofacial trauma,[3] whereas that in Africa,[7] the principal cause of maxillofacial trauma was violence. In our sample, falls and bike accidents were the most common causes of maxillofacial injury (63% and 13%, respectively) with higher incidence in boys. For bicycle accidents, the use of safety devices is still very limited or simply not respected by parents or by the individual, showing deficiencies in the programs for education and accident prevention.[4] Our results showed only 2 patients younger than 6 years with facial fractures.

In our study the patients' mean age of 8.29 was lower than the range of other studies **(Holland et al., 2001; Ferreira et al., 2005; Scariot et al., 2009)**. Also peak incidence of facial fractures was seen in age group of 13-18 years and that of soft tissue injuries was seen in 0-5 years age when compared with other studies, since in Australia, **Holland et al. (2001)** reported 46 children under 14 years old with facial fractures during 4 years, **Tanaka et al. (1993)** reviewed 81 paediatric fractures seen in children under 15 years old during 14 years, in a Dental University of Japan and a Nigerian study showed an incidence of 40 paediatric patients under the age of 11 years treated in a teaching hospital for a period of 11 years **(Oji, 1998)**.

In our study the male to female ratio is 2.7:1compared to ratio of 1.8:1 reported by **Gassner et al. (2004)[9] and Iatrou et al. (2010)** and is lower when compared to those reported by **Ferreira et al. (2004)** and **Rahman et al. (2007)**. Boys accounted for 73% of the affected children, supporting other studies that reported a higher incidence of paediatric facial fractures in boys, perhaps because boys are more active, engage in more dangerous activities, have a more aggressive nature.

The majority of the studies reviewed showed motor vehicle accidents as being the most common cause of facial fractures **(Posnick et al., 1993; Holland et al., 2001; Ferreira et al., 2005; Rahman et al., 2007; Imahara et al., 2008; Vyas et al., 2008; Chrcanovic et al., 2010)**. European studies as reported by **Wymann et al. (2008)** showed that the high incidence of facial fracture caused by motor vehicle accidents is probably because of the continuously increasing road traffic in Europe. Reluctance to use helmets, exceeding speed limits, lack of tolerance and increasing competition among young men could explain the increased incidence of facial injuries and mandibular fractures in particular. On the other hand, in Malaysia the high incidence of motor vehicle accidents is probably attributed to the high use of motorcycle as the main vehicle for transport to work and school, also the age to obtain a rider licence is 16 years old **(Rahman et al., 2007)**. In our study, motor vehicle accidents represented the second most frequent cause of paediatric facial fractures, accounting for 15%.

Mandibular fractures were the most frequent type of fracture, similar to majority of the studies, which have reported the mandible as being the most common bone involved in paediatric facial fractures **(Posnick et al., 1993; Iida and Matsuya, 2002; Gassner et al., 2004; Ferreira et al., 2005; Ogunlewe et al., 2006; Imahara et al., 2008; Scariot et al., 2009)**. However, we must take into account that the higher incidence of mandibular fractures occurred in older age groups (13-18 years) **(Ferreira et al., 2005; Rahman et al., 2007; Imahara et al., 2008; Muñante-Cárdenas et al., 2010)**. Parasymphysis was the most affected mandibular region, differing from earlier studies in which condyle was the most affected site **(Ferreira et al., 2005; Rahman et al., 2007; Muñante-Cárdenas et al., 2010)**.

The absence of midfacial fractures including Le Fort and nasoorbital ethmoidal fractures may be explained by the lack of pneumatisation of paranasal sinuses, flexibility of osseous suture lines, thicker adipose tissue **(Posnick et al., 1993)** and the relative large size of mandible and cranium in children that is suggested to provide protection to midface **(Ogunlewe et al., 2006)**. Also patients presenting with these fractures generally are associated with cranial injury, being referred to a level-III trauma centre for neurosurgical evaluation.

When formulating a plan of treatment for pediatric patients with facial trauma, a number of elements must be considered. These include the age of the patient (to maximize growth and development), the anatomic site (to optimize form and function), the complexity of the injury (displacement, comminution, and the number of sites), the time elapsed since injury (ideal to treat within 4 days), concomitant injury (fitness for anesthesia and duration of surgery), and the surgical approach (closed versus open). The fixation preference will be dictated by the age, anatomic site, complexity, and approach.[6]

Monomandibular fixation, by means of an arch bar, acrylic splint (or stent), or thermoplastic material, may be the only acceptable alternative in situations such as the edentulous newborn with a mandibular body or symphysis fracture. This technique is particularly helpful for greenstick or minimally displaced fractures when the patient is partially edentulous (ages 5-12years). These patients generally require circummandibular wires or some form of skeletal suspension. Maxillomandibular fixation is usually maintained for 3 to 4 weeks. This fixation has the disadvantage of limiting anatomic reduction and restricting full function.[6]

By age 2years, 10 teeth exist in each arch, and maxillomandibular fixation may be achieved. Yet the lower height of contour of the primary dentition may require acrylic support, circummandibular wiring, or skeletal suspension. Thinner wire (28 or 30 gauge) is suggested for ligating the arch bar to the dentition. Before age 2 and after age 6, missing or resorbed teeth limit this technique. Maxillomandibular fixation with closed reduction may not permit anatomic reduction. Although nutrition and airway are concerns, child tolerance and subsequent compliance are the major drawbacks of this technique.

Internal fixation implies some form of open approach with subsequent subperiosteal dissection. This invasion has the potential to interrupt or limit the osteogenic potential of the periosteum, to create scars that may further restrict growth, or both. Proponents of this technique use experience with the surgical correction of pediatric craniofacial deformity as an example of successful treatment without adverse effects. A number of advantages are apparent when using this technique. Absolute anatomic reduction can be achieved, nutrition is improved by permitting a rapid return to a normal diet, the airway is less of a concern during extubation or reintubation than with maxillomandibular fixation, and tolerance and compliance are less important issues. Although resorbable technology for fixation now exists, it has been our experience that significant soft tissue inflammation occurs (especially around the orbit), which later results in immobile (leathery) soft tissues. As techniques and materials improve, this mode of fixation may approach ideal. Semirigid fixation with small (1.0-1.3 mm outer diameter) titanium plating systems currently offer the best fixation alternative. However, their effects on growth and the potential for migration to occur as the bones remodel are currently unknown. The hardware may then be removed 2 to 3 months after placement. Care must be taken in patients with a developing dentition to avoid damage to the tooth buds during screw placement.

In our study, there was no surgical treatment of condylar fractures. Although **Iatrou et al. (2010)** reported that open reduction and fixation of most fractures provided quick and satisfactory management of fractures in children, we obtained good outcomes, even with the majority of the patients being treated conservatively, with no major complications in any type of fracture.

V. Conclusion:

The present study revealed that the incidence of paediatric maxillofacial soft tissue trauma decreases with the increase in age. Boys are more prone to be the victims of maxillofacial tauma as they are involved in more aggressive activities. Accidental falls and bike accidents were the first 2 etiologic causes. Children below 5 years of age are exposed to low velocity forces like falls. So soft tissue injuries are mostly seen in this age group like abrasion and laceration. Children above 13 years are more involved in outdoor activities and are exposed to high velocity forces. Most common etiology of maxillofacial trauma in this age group was road traffic accidents mostly leading to hard tissue injuries like dental fractures or facial bone fractures. Mandible was the most involved in facial skeleton injury in which parasymphysis and angle fractures were mostly encountered.

Conservative treatment was generally preferred for paediatric patients below 5 years of age. In treatment of fractured jaws, two principles must be considered: early mobilization with a short period of fixation, and timely exercise training. Preventive measures should be emphasized both indoors or outdoors. Patients in the growing phase should be monitored periodically to detect and prevent early facial asymmetry or malocclusion. Our findings support the view that many factors related to trauma vary from one country to another.

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