



RESEARCH ARTICLE

TRAUMATIC DENTAL INJURIES, MANAGEMENT AND COMPLICATIONS IN SCHOOL GOING CHILDREN AND ADOLESCENTS. AN UPDATE.

Dr. Ibrahim Mohammed Albakry¹, Dr. Saad Dhaifallah Alsilah², Dr. Zainab Hassan Ali Alfaraj³, Dr. Ahmed Hadi Al Mashni⁴, Dr. Fawaz Mana Al Zulayq⁵, Dr. Abdullah Hussain S Al Salem⁶ and Dr. Fesal Farag Nouman Alanezi⁷

1. King Khalid Hospital, Department of Maxillofacial Surgery, Najran, Kingdom Of Saudi Arabia.
2. King Khalid Hospital, Department of Maxillofacial Surgery, Najran, Kingdom Of Saudi Arabia.
3. Ministry Of Health, Najran Specialty Dental Centre, Najran, Kingdom Of Saudi Arabia.
4. Ministry Of Health, Najran Specialty Dental Centre, Najran, Kingdom Of Saudi Arabia.
5. King Khalid Hospital, Department of Maxillofacial Surgery, Najran, Kingdom Of Saudi Arabia.
6. Ministry Of Health, Bader Al Janob Hospital, Najran, Kingdom Of Saudi Arabia.
7. Ministry Of Health, Specialty Dental Centre, Arar, Kingdom Of Saudi Arabia.

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Abstract

Objective. The purpose is to outline the etiology, prevalence and potential consequences of dental trauma.

Material and methods. Micro electronic examination of Medline (PubMed), Cochrane, SSCI (Social Citation Index), SCI (Science Citation Index) records from 1995 to the present, using the following search words: tooth injuries, tooth trauma, traumatized teeth, dental trauma, dento-alveolar trauma, oral trauma, epidemiology, etiology, prevalence, prevention, pulp necrosis, inflammatory resorption, ankyloses, cervical resorption, was implemented.

Results. During the last decade, traumatic dental injuries were recognized as a public dental health problem worldwide. Prevalence of traumatic dental injuries varies among countries. In line with the existing data they are more prevalent in permanent than in primary dentition. All treatment procedures, in case of dental trauma, are directed to minimize undesired consequences despite the fact, that treatment of traumatic dental injuries in the young patient is often complicated and can continue during the rest of his/her life. The changing lifestyle and requirements of modern society have lead to an emergence of new patterns of dental trauma. A regular update of knowledge in dental traumatology is required.

Conclusion. The most frequent TDI included lateral luxation in primary teeth and enamel-dentine fractures in permanent teeth. We observed a delay in patients obtaining emergency dental care.

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Corresponding Author:-Dr. Ibrahim Mohammed Albakry

Address:-King Khalid Hospital, Department of Maxillofacial Surgery, Najran, Kingdom Of Saudi Arabia.

Introduction:-

Traumatic dental injuries (TDI) or tooth trauma have a global prevalence of 10–15%. These can occur in isolation or in association with pan-facial or bodily injuries. They exhibit two peaks of incidence in boys at 1–3 years and 10–12 years and one peak in girls at 1–3 years of age. The age of 2–3 years is the period of acquisition of walking skills with lesser control on motor co-ordination, which makes these children more vulnerable to falls and injury to front teeth. These injuries to primary or milk teeth are often ignored by parents if they involve tooth's crown, however in severe forms, the injury to the supporting structure alveolar bone is the cause of first visit to emergency services.¹²

The higher incidence of trauma to permanent teeth in boys is related to the increased indulgence in contact sports and adventurous activities. There have been multiple etiologies associated with TDI namely falls, sports injuries, fights, road traffic accidents, animal injuries and atrogenic tooth trauma caused during difficult oral intubation. There are certain factors which are important for determining the type and severity of injury, its emergency and comprehensive management, the sequelae and prognosis. These include age of the child, stage of tooth development, direction and intensity of force, size and shape of impacting object as well as the type and timing of emergency dental treatment provided.⁷

The factors such as reclined upper front teeth and problems related to abnormality in gait or motor coordination make children more susceptible to TDI. Since these injuries generally occur while playing at home and school, there is an inherent need to increase the awareness for emergency measures to be taken in event of TDI among parents, children, school teachers, health workers and medical practitioners including pediatricians and anesthesiologists. Untreated traumatized teeth often lead to unsightly discoloration of the fractured crowns of teeth. This may not only put the child at risk of future infection flare/acute symptoms but also can cause psychological stress⁸

Definition-Dental traumas are injuries to the teeth, periodontium, and surrounding soft tissues. They are quite common in dentistry, comprising 5% of all traumatic injuries in people seeking first aid and up to 17% of all bodily injuries among preschool children. Children and adolescents experience mild or severe dental trauma from various causes, such as unsafe playing on playgrounds, accidents at schools, in motor vehicle accidents, car crashes, or violence.

According to Anderson, the prevalence of traumatic dental injuries (TDIs) in children and adolescents is approximately 20% and varies little. Pettiet al³ found that traumatic dental injuries occur in both primary and permanent dentitions, although the prevalence in primary dentition is higher. The prevalence differs with age and sex, with a global male-to-female ratio of the suggesting that men are more likely to develop TDI than are women. TDI in primary dentition can affect the development of permanent teeth. Damage and/or disturbances to permanent teeth and tooth germs, depending on the mouth area affected, can range from mild to severe.^{1,3}

TDI in permanent teeth can cause permanent complications, such as pulp necrosis and internal and/or external root resorption and influence maxillofacial development. In most cases, emergency care after TDI is needed to improve tooth prognosis and prevent complications. Dental avulsion, for example, is one of a few emergency situations in dentistry where urgent help is needed to save the tooth.⁸ Even if an avulsed tooth is replanted immediately (within 5 minutes after TDI), the success rate may not be 100%. First aid should therefore be provided on site, ideally by medical personnel, but also by parents, teachers, coaches, or capable available persons.⁷ However, studies indicate that teachers and coaches lack adequate knowledge of appropriate behavior in emergency situations involving dental trauma. Children with dental traumas are an important concern now a days, not only for their possible negative outcomes and frequent common occurrence but also because they can reduce quality of life.¹¹

In addition, people with untreated dental traumas more often experience chewing problems and difficulties with social interaction, such as excessive concern about what others think, avoiding smiling and laughing, and not talking to other children. In Lithuania, general dentists in primary health care centers or specialists in hospitals are the main providers of first aid for children who suffer TDI.¹⁶ Typically, TDI patient's first visit their primary health care center or a private clinic of their choosing. General dentists usually refer patients with complicated or severe TDIs or both to pediatric dental specialists in hospitals. Yet, research on TDI is scarce in Lithuania. Thus, our aim was to investigate the causes of traumatic dental injuries (TDIs), the time elapsed from injury to first visit to the dentist, treatment method, and complications in children under 18 years.^{4,6,10}

Existing data on prevalence of traumatic dental injuries varies between countries. For examples- Saudi Arabia differences of design of performed studies could be one of the explanations of such variety of the results. Most of the studies are cross-sectional except few longitudinal. One's registration of traumatic dental injuries in cross-sectional studies has

certain degree of subjectivity due to the fact that information about the previous traumatic accident is partly taken from interview of children or their parents. Possibly not all traumatic injuries are reported.

Local environmental, behavioral and cultural diversities of countries could have an influence on the results as well. Oral trauma are uncommon and make up 5% of all injuries parts of the body in all ages while in age group of 0-6 years it comprises about 17%. Traumatic dental injuries are more prevalent in permanent (58.6%) than in primary dentition where they constitute 36.8%. Dental injuries mainly involve front teeth of the upper jaw.

Etiology:

The most frequent cause soft injuries are falls, sport activities, bicycling, and traffic accidents. Predisposing factors of dental trauma could be related to the person's anatomic features namely increased overjet, inadequate lip coverage of the upper anterior teeth etc. Home and school are places where traumatic dental injuries usually occur. It has been shown that the place of injury was related to gender, that is the most frequent location of injury for boys was school followed by home, while the opposite is vice-versa.^{2,9}

Treatment of dental trauma is not a common situation in daily dental practice. The outcome of the treatment is highly related to the knowledge and skills of the dentist as well as to the emergency aid at the time and place of the injury. So, not only the dentist, but also parents, teachers and coaches must have basic knowledge in emergency management of dental trauma. A person with injured tooth become challenge for the dentist due to the rarity of the situation and uncertainty of the treatment prognosis.

It is not a routine procedure for the majority of the practicing dentists and it demands precise diagnosis, adequate emergency management and correct treatment with follow-ups. All treatment procedures in case of dental trauma are directed to minimize undesired consequences which might lead not only to the loss of the tooth, but also to the loss of the alveolar bone and in such way as to impede the realization of possible treatment plan.^{1,12}

It is important to realize that treatment of traumatic dental injury in the young patient is often unpredictable, complicated, and expensive and can continue during the rest of his/her life. Due to the fact that the peak of the traumatic injuries in permanent dentition is between 10-12 years of age, the consequences of dental traumas may have life long impact on person's quality of life. For this reason treatment planning often involves specialists from different discipline of dentistry.⁵

Search methodology

An electronic search of Medline (Pub Med), Cochrane, SSCI (Social Citation Index), SCI (Science Citation Index) data bases from 1995 to the present, using the following search words: tooth injuries, tooth trauma, traumatized teeth, dental trauma, dento alveolar trauma, oral trauma, epidemiology, etiology, prevalence, prevention, inflammatory resorption, tooth ankylosis, cervical resorption and review, was performed.

Classification of traumatic dental injuries

Classification of traumatic dental injuries comprises trauma to the hard dental tissues and the pulp, to the periodontal tissues, including to the supporting bone and as well as oral mucosa. It reflects the Application of international classification of diseases to dentistry and stomatology by World Health Organization (WHO).

Table 1. Classification of traumatic dental injuries (15, 16)

Type of injury (code according WHO)
Injuries to the hard dental tissues and the pulp
Enamel infraction (N 502.50)
Enamel fracture (N 502.50)
Enamel- dentin fracture (N 502.51)
Complicated crown fracture (N 502.52)
Uncomplicated crown- root fracture (N 502.54)
Complicated crown-root fracture (N 502.54)
Root fracture (N 502.53)
Injuries to the periodontal tissues
Concussion (N 503.20)
Subluxation (N 503.20)
Extrusive luxation (N 503.20)
Lateral luxation (N 503.20)
Intrusive luxation N 503.21
Avulsion (N 503.22)
Injuries to supporting bone
Comminution of the maxillary alveolar socket (N 502.40)
Comminution of the mandibular alveolar socket (N 502.60)
Fracture of the maxillary alveolar socket (N 502.40)
Fracture of the mandibular alveolar socket (N 502.60)
Fracture of the maxillary alveolar process (N 502.40)
Fracture of the mandibular alveolar process (N 502.60)
Fracture of the maxillae (N 502.42)
Fracture of the mandible (N 502.61)
Injuries to gingiva or oral mucosa
Laceration of gingiva or oral mucosa (S 01.50)
Contusion of gingiva or oral mucosa (S 00.50)
Abrasion of gingiva or oral mucosa (S 00.50)

**Figure 1:-** (Intrusion in 2 years old child).



Figure 2:- (Fracture in 51 in 4year's old child).

Etiology of dental trauma-

Predisposing factors for traumatic dental injuries can result from either direct or indirect impact. The extending in the damage is related to such factors as energy of impact, resilience and shape of the impacting object, direction of the impact and there action of the tooth-surrounding tissues. Studies show that dependency of type and causes of the traumatic dental injuries to permanent and primary dentition exists. This phenomenon might be related to the features of the underlying bone structure which, in primary dentition, is less mineralized than in permanent one.¹²

Therefore Trauma in primary dentition more often results in displacement of the tooth. In primary dentition there was a greater range of trauma associated with falls and collisions due to the increase of in dependent movements in age group between 0-6 years, while accidents during playing, sport increased in age group between 7-15 years and violence resulted in dental injuries most frequently in age group 21-25 years. It was revealed that falls were the main cause of traumatic dental injuries (from 31.7 to 64.2%) followed by sport activities (up to 40.2%), bicycling accidents (up to 19.5 %), road traffic accidents (up to 7.8%), physical violence (upto 6.6%). From this group of causes, traffic accidents constitute a special group of trauma due to predominant multiple injuries including supporting tissues. Moreover, new types official trauma occur from air bag development in cars during traffic accidents.⁷

Bicycling accidents are common cause of dental trauma in school children group. According to the results of the studies, if the obligatory wear of bicycle helmets reduced incidence of facial trauma by 65%, incidence of dental trauma incidence by this measure was not reduced. Although sport activities is one of the main causes of dental trauma are classified according to its risk categories: namely high-risk such as American football, hockey, ice hockey, lacrosse, martial sports, rugby and skating and medium-risk sports such as basket ball, team handball, diving, squash, gymnastics, parachuting, water and polo.

Distribution by age and gender

Studies have shown that males experienced traumatic dental injuries at least twice as often as females. The male: female ratio varies from 1.5:1. To 2.5:1.0. Such ratio could be a tribute to a greater participation of boys in contact sports, fights and car accidents. Also it could be related to the fact that girls are generally more mature in their behaviors than boys, who tend to be more energetic and active. However, some of the studies have shown a reduction in the gender ratio which might be due to increased sports activities among girls.⁶

Altunet al⁹ observed some association between gender and type of injury. Boys more often suffered from dental hard tissue and pulp injury than girls. According to the results of the studies, for gender has been determined as one of the predisposing factors of dental injuries, while now traumatic dental injuries are more likely to be related to the activities and the environment. Another well-known risk variable of traumatic dental injuries is age. Results of various studies showed the existence of the target groups. According to Lam ET al⁴, up to 92% of traumatic dental injuries occur before the age of 34 years. Distinct age groups are determined and majority of the injuries occur in the age groups from 0-14 years.

Discrepancies can be seen in the group of 6-14 year-olds in the rate of traumatic dental injuries with in smaller sub-groups. Altunet al¹ observed that injury rates were highest among children age 6-10 years. Eyuboglu et al. showed the highest frequency of traumatic dental injuries at the age 8-10 years. While Diazetal⁹ observed that the highest ratio of dental injuries in permanent dentition occurred in age groups of 7-9- and 10-12- year-olds. A study by Navabazam and Farahani identified the 9-10 age range as the period of life when majority of the dental trauma occur. However In a study by Faus-Damia et al. the highest prevalence of traumatized children was at the age of 12.2 years old.^{4,5}

Prevalence of dental trauma

Data from many countries showed that one third of all preschool children have suffered traumatic dental injuries involving the primary dentition and 25% of all school children and almost one third of adults have suffered trauma to the permanent dentition. Prevalence of dental trauma varies between different countries, age groups, genders, socio-economic environments etc. The prevalence of traumatic dental injuries among school children aged 12-15 years varies between 14.4-33.8%.

Even in the studies from the same country differences are evident. A study by Kumar ET al⁴ in India showed that the prevalence of dental trauma was 14.4 % while in another district of South India it constituted 6% this was rather low compared to other studies among 12-year-old school children. Differences observed in prevalence of trauma could be related to the discrepancies of the performed sampling procedures (1430). The prevalence of dental trauma among 5th and 6th grade school children in eastern Jerusalem was reported to be 33.8%. While in Canada, in a sample of 2422 school children, aged 12 and 14, traumatic dental injuries were less prevalent (11.4%). In a study of children and adolescents the group of 7 to 12 year olds had the highest frequency of traumatic dental injuries, i.e 66.6%. Bendo CB et al. reported the prevalence of traumatic dental injuries of 17.1% out of 1612 school children aged 11 to 14 years attending public and private schools. A slightly higher percentage of dental traumas was reported in another study from Brazilian population, where the prevalence of traumatic injuries among adolescent's aged 15 to 19 years old constituted 24.7%. It should be noted that there is an observed increase in the prevalence of dental trauma over the last decade which could be attributed to a greater participation in sporting activities.^{3,2}

Treatment of traumatic dental injuries

The results of surveys performed in USA showed that almost every third child with primary teeth and every fourth adult showed evidence of traumatic dental injuries. However Low rates of treatment of dental trauma are observed world wide. This phenomenon could be related due to the fact that uncomplicated injuries to the mild enamel-dentin are not perceived as a situation which needs immediate treatment. Treatment of dental trauma especially luxation injuries is expensive, time-consuming and involves different specialists and needs long follow-up.

The average number of treatment visits in case of dental trauma ranges from 1.9 to 9.1 per 1 year. Results of Glendor study showed that in Sweden a total cost of treatment of dental injuries in the 0–19 years old patients made up US \$3.3–4.4 million per one million individuals per year. In Denmark the annual cost of treatment of dental injuries irrespective of age (per year) ranged from US \$ 2 to 5 million per one million in habitants. Traumatic dental injuries might alter facial appearance of children. Corteset al⁵ showed that children with untreated fractured teeth reported 20 times more a negative impact on their daily life than children without traumatic dental injuries. Children with dento-facial deviations experienced teasing, embarrassment and lack of social acceptance.

Outcome of traumatic dental injuries

The most favorable outcome of traumatic dental injuries is healing of the pulp and surrounding tissues. However, traumatic dental injuries are often accompanied by complications of different types and severely like pulp necrosis, apical periodontitis, and discoloration of tooth (crown) fistulas, and external inflammatory root resorption. The outcome of dental trauma depends on the type of injury, time lapse prior emergency treatment and quality of treatment.²

Consideration has to be given to the fact that complications of dental trauma can occur several months or even years after the injury. Traumatic dental injuries to the hard dental tissues and the pulp such as uncomplicated or complicated crown or root fractures could be accompanied by pulp necrosis.

The consequences of traumatic dental injuries to the surrounding tissues of the tooth, in case of avulsion or intrusion injuries, can be even more serious, example various types and degrees of root resorption could be expected. Traumatic dental injuries like infraction, enamel fracture, uncomplicated or complicated crown fracture represent different possible pathways for bacteria to enter pulp space and (to become) cause of pulp inflammation and necrosis as a consequence.⁷

Pulp necrosis as complication following uncomplicated crown fracture are and range between 2% and 5%. The rate of pulp survival in more severe traumatic injury like complicated crown fractures varies from 63% to 94%. If these injuries are treated in an appropriate way, a long-term maintenance of pulp vitality can be expected.⁶

The chosen treatment method and the time period between the trauma and treatment initiation have a significant influence. Two main methods used in this case are pulp capping and pulpotomy. Pulp capping was less successful in maintaining pulp vitality and pulp necrosis has been found in 45.5% of cases, while partial pulpotomy resulted in considerably higher success rate, i.e. pulp necrosis has developed only in 13.6% of treatment cases.

Pulp survival was also reported from 60% to 80% in cases of root fractures. Pulp necrosis is related to the extent of the damage to the neurovascular supply of the pulp. Its severity depends on the type of the luxation injury, development stage of the root apex and quality of emergency treatment. Injury to the neuro vascular supply could range from minor degree such as stretching, compression of the nerves and blood vessels to a complete disruption of them.

Pulp necrosis is frequent in luxated teeth with mature apex and quite rare in immature teeth. Two types of pulp necrosis are related to traumatic injuries: an ischemic sterile necrosis is caused by disruption of the blood supply at the apical foramen and infection-related liquefactive necrosis. The reported prevalence of pulp necrosis in luxated teeth varies from 17 to 100% in accordance with severity of trauma type. It is evident that an isolated crown fracture by itself carries a low risk of pulp necrosis if appropriate treatment is provided. If not, the fracture line may act as a pathway for bacteria to enter the pulp

Teeth with vital pulps are more resistant to bacterial invasion into the dentinal tubules than teeth with non-vital pulps. This can probably be explained by the defense mechanism of the healthy pulp which protects the tissue against bacterial invasion. However, if the neuro vascular supply to the pulp is compromised or completely disrupted, the defense mechanisms may be less efficient. A sub luxation injury is characterized by damage to the periodontal ligament with bleeding and abnormal mobility of the tooth but no displacement.

However, if (these two mild types of injury, i.e.) crown fracture and subluxation, occur simultaneously, the defense mechanisms of the pulp will become less efficient. A simultaneous luxation injury has been reported to increase the prevalence of pulp necrosis in teeth with crown fractures. This is due to the fact that any type of displacement of the teeth results in damage to the periodontal ligament and disruption of the neurovascular supply at the apex of the tooth. Lateral luxation, avulsion and intrusion are in the group of traumatic injuries commonly associated with more serious complications like external or replacement root resorption.

This is due to the severe damage to the surrounding tissues (periodontal ligament, neuro vascular bundle) as well as to un-mineralized and hard tissues of the tooth (cement, dentin). Lateral luxation results not only in damage to the periodontal tissues, but also in fracture of the labial bone plate. Avulsion of permanent teeth is seen in 0.5–3% of all dental injuries.^{2,5}

Avulsion of the tooth is accompanied by severe damage to the periodontal ligament. The cells of the periodontal ligament are predominantly damaged by inadequate storage of the avulsed teeth. Following replantation of avulsed teeth inflammatory root resorption could occur. The unique nature of the intrusion injury distinguishes it from other luxations.

In this type of trauma the periodontal membrane and root surface are severely disrupted. There is a high risk namely of external root resorption and long-term survival is doubtful. Three types of external root resorption, namely such as surface resorption, replacement resorption/ankylosis and inflammatory resorption are related to the outcome of luxation injuries. Inflammatory resorption is associated with the damage of periodontium at the time of trauma, necrosis of the pulp, presence of bacteria within the root canal and dentinal tubules.

This type of resorption can be controlled or prevented by efficient root canal treatment. Replacement resorption/ankylosis appears in teeth where periodontal ligament has been dried due to the long extraoral period in appropriate treatment handling. When any loss occurs in a growing patient, infra position of the tooth is highly likely leading to disturbance in alveolar and facial growth. Previous studies have reported that the prevalence of the root resorption varied between 57% and 80% in avulsed and replanted teeth and between 38–66% after intrusive trauma.⁸

Proper endodontic treatment is highly effective in management of inflammatory resorption related to infection in the main root canal. Endodontic treatment plays no role (in handling teeth) where replacement resorption is evident. Another important fact is that both a forementioned types of root resorptions could start in the same too that the same time. Therefore endodontic treatment is extremely important in order to prevent root resorption process related to infection and maintain tooth for a longer period of time which is very important in young patients.

Conclusions:-

Traumatic dental injuries are recognized public dental health problems worldwide. A tendency of an increase in prevalence of dental traumas due to the higher interest in sport activities can be observed. Moreover, the changing lifestyle and requirements of modern society lead to an Emergence of new patterns of dental trauma. To this end, a regular update of knowledge in dental traumatology is required.

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