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THE EFFECT OF TRAUMATIZED ANTERIOR TEETH ON VITALITY IN JORDANIAN CHILDREN AND ADOLESCENTS

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ABSTRACT

Aim: This study sought to examine, in the light of a two-year follow-up, the diagnostic and prognostic value of vitality tests in teeth that suffered a fracture in the enamel and dentin without pulp exposure, to assess the period in which late pathologic changes may occur, and to determine the recommended time intervals for follow-up examinations and review. **Methods:** Seventy children, aged 8 to 14 years old, attending King Hussein Medical Center and Queen Rania Alabdallah Hospital for Children, who sustained traumatic injuries to the permanent teeth with uncomplicated crown fracture confined to enamel and dentin were examined and followed up prospectively. Eighty-five traumatized permanent Maxillary central Incisors were included in this study. The data of this study were entered to SPSS program for statistical analysis. Pearson's chi-squared test was used. In all the evaluations, *p* values < 0.05 were considered statistically significant. **Results:** Forty-four (62.9%) males and 26 (37.1%) females with a mean age of 10.5 years were selected for this study. Eighty-five traumatized permanent Maxillary central Incisors were examined both clinically and radiographically, 40 (47%) right central incisors and 45 (53%) left central incisors. 87% of these teeth were "vital" at the initial examination, and most of these remained vital throughout the two years. Most pathologic changes occurred within six months after the trauma. A strong correlation was found between teeth vitality and time elapsed since trauma to presentation. In less than 14 days of attendance, there were 17 vital and 5 non-vital teeth, whereas in more than 15 days, there were 29 vital and 34 non-vital teeth. **Conclusion:** It is recommended that the follow-up review should be performed according to the time interval; it was found that the safety margin of time interval is less than six months after the trauma. Moreover, patients had the best management outcome was within fourteen days following traumatic dental injury.

KEYWORDS: Adolescent; Anterior teeth; Children; Traumatic injury; Vitality.

INTRODUCTION

Traumatic dental injuries (TDIs) are relatively common amongst children and young adults (World Health Organization, 2020), contributing to 5% of all injuries. It is estimated that 33% of adolescents and adults experience dental trauma to one or more of their permanent teeth, and crown fractures are commonly reported.[1]

TDIs for anterior teeth are considered an integral part of many disciplines in restorative dentistry, such as conservative, paediatric, endodontic, and aesthetic. They receive special attention and are extensively studied due to their strategic, functional, and aesthetic roles. They are frequent in children and adolescents, and usually presented as a separation or cleaving of the periodontal ligament or crushing injuries to the teeth and alveolar bone or both together; falling down is the main cause.[2,3]

Crown fractures are the most common, with enamel fracture accounting for about 45% of these injuries. The most frequently affected teeth are the maxillary central incisors.[4] Reports suggest that most dental injuries occur during the first two decades of life, usually around 8–12 years and that 70% of these injuries involve maxillary central incisors, followed by maxillary lateral incisors and mandibular incisors.[5]

Coronal fractures represent a high proportion of the dental trauma to the permanent dentition, ranging

between 26–76% of dental injury, and approximately 16% of coronal fractures are complicated presenting pulp exposure.[6] Home and school are usually the places where traumatic dental injuries occur. It is shown in the study carried out by Bendo that the place of injury is related most to gender (i.e., the most frequent location of injury for boys is school followed by home while for girls, this was vice versa).[7]

Treatment of dental trauma is not an ordinary 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 place of the injury. So, not only the dentist but also the parents, teachers, and coaches must have the basic knowledge of emergency management of dental trauma.

No studies have been reported to investigate dental trauma in the form of the correlation between vitality compared with time and type of injury in Jordan. Therefore, the objective of this prospective study was to examine, over a period of a two-year follow-up, the diagnostic and prognostic value of vitality tests in teeth that had suffered a fracture in the enamel and dentin without pulp exposure, to assess the period interval in which late pathologic changes may occur and to determine the recommended time intervals for follow-up examinations in Jordanian children and adolescents aged 8–14 years old.

METHODS AND MATERIALS

This prospective study was conducted at King Hussein Medical Center (KHMC) and Queen Rania Alabdallah Hospital for Children, Royal Medical Services, covering a population of West Amman in Jordan. A total of 70 children and adolescents aged 8 to 14 years and a number of 85 permanent maxillary incisors suffering from traumatic dental injuries were selected as the study sample.

They were examined by two examiners (a conservative and a paediatric dentist) to register the maxillary central incisor fracture that resulted from different traumatic dental injuries such as falling down on the streets or in school and interpersonal collision; these were followed up over a period of two years from June 2017 to August 2019, retrospectively.

The selection criteria were limited to sound teeth with no previous trauma to the face and sport injuries or restorative procedure, and complicated crown fracture (pulp exposed) was excluded from this study; carious teeth as well as crowned teeth were also excluded. Time elapsed since the trauma occurred till the time of attendance was recorded for each single case. The traumatic injuries were recorded and classified (Andreasen classification) [8] according to their type (Table 1). The teeth were isolated with rubber-dam, and cold pulp test (ethyl chloride) was used to assess the vitality of the injured teeth at their first presentation: two weeks, one month, three months, and six months throughout the period of the study. Appropriate treatment was carried out with composite fillings or reattachment of the fractured pieces for vital teeth. Root canal treatment was carried out in non-vital teeth.

Descriptive statistics were used to describe the data include mean, standard deviation, frequencies and percentages. A chi-square test was used to examine the association between vitality and time, and vitality and type of trauma. p values < 0.05 were considered statistically significant.

RESULTS

Seventy children, aged 8 to 14 years old, attending King Hussein Medical Center and Queen Rania AlAabdallah Hospital for Children in demographic areas in Amman Table 2, who sustained traumatic dental injuries to the permanent maxillary central incisors, with uncomplicated crown fracture confined to enamel as the first category and enamel and dentin as the second category, were examined and followed up prospectively.

Forty-four (62.9%) males and 26 (37.1%) females with a mean age of 10.5 years were a part of the study group. Eighty-five traumatized permanent maxillary central incisors were included in this study group: forty (47%) right permanent maxillary central incisors and forty-five (53%) left permanent maxillary central incisors.

The correlation between teeth vitality and time elapsed since trauma to presentation is shown in Table 3. Out of the 85 teeth that sustained dental injury, 22 had emergency dental treatment within 14 days following the trauma. In this group of patients that attended earlier than 14 days, 17 maxillary central incisors remained vital, 4 were vital and became nonvital, and 1 was nonvital. There was a strong relation between vitality and time, demonstrating statically significant [$X^2(2, n=85) = 9.23$, p value 0.01].

For those who sustained trauma to the maxillary central incisors for more than 15 days in total of 63 teeth, 29 were vital, 10 were vital and became nonvital, and 24 were nonvital. Table 43 shows statistical significance in the correlation between teeth vitality and type of teeth injury [$X2\ (2,n=85)=20.96$, p<.000].

DISCUSSION

The World Health Organization (WHO) classification is a comprehensive system that allows for minimal subjective interpretations. The WHO classification of oral trauma describes injuries to the internal structures of the mouth. Luxation injuries are grouped as one and not divided into intrusive, extrusive, and lateral luxations, as is the case with the Andreasen classification [8]. Injuries to the alveolar socket and fractures of the mandible or maxilla are not grouped under oral injuries with the WHO standards; rather, they are classified separately as fractures of face bones. There is a broad group

incorporated with the WHO standards, which allows for 'other injuries' including laceration of oral soft tissues.[9]

Prospective or cohort studies will only record injuries if the patient seeks dental treatment. This may occur rarely with minor enamel and dentine fractures or trauma without displacement injuries. Most of the prospective studies are based on subpopulations such as school children, children presenting to a paediatric dental service, or patients presenting to emergency department with road traffic accident (RTA).[10,11]

Epidemiological and clinical studies available on dental trauma to incisors among schoolchildren in Jordan are limited. In a pilot study, Hamdan and Rock (1995) investigated 10–12-year-old schoolchildren and found a prevalence of 19.1% and 15.5% of traumatic incisors among children in an urban and a rural area, respectively.[12]

Crown fractures of the permanent dentition comprise the most frequent form of traumatic dental injuries and constitute between 26% and 76% of all traumatic injuries (13). Data revealed in a study conducted by Haddadin et al. presented that there were repeated fracture patterns, which can be divided into seven morphological categories, and increased overjet was a more predisposing factor (14).

Literature shows clearly that boys sustain more TDIs than girls; the general finding is that boys almost suffer twice from TDIs compared to girls, as they are more active in contact games and sports (15). These findings are consistent with our study that males are more prone to TDIs than females. However, recent studies show a reduction in this difference, as there has been a change in girls' behaviour in playing games. Prevalence increases with age due to the cumulative effect. This may be related to boys' tendency of being more energetic and choosing more active and vigorous games with higher trauma risk than girls.[16] Other reports examining postulated links between BMI (body mass index) to TDIs are also inconsistent. Soriano et al. found a statistically significant correlation between obesity and TDIs among a sample of 1,046 Brazilian children.[17]

The relatively low prevalence of dental trauma among females in our research can be explained by the fact that girls are more mature in their behaviour than boys who tend to be more energetic and inclined toward vigorous outdoor activities. The restricted behaviour of females enforced by conservative parents due to cultural and religious perspectives can be added to the possible factors that contribute to the low prevalence of trauma among girls.

Ethyl chloride was used in this study to assess vitality following traumatic dental trauma, as we found it the most accurate available tool in comparison with other tests used, especially for children; for example, results of thermal tests are not reproducible in terms of graded intensity, and normal pulp tissue may yield a negative response. A positive reaction usually indicates a vital pulp but may also occur in a non-vital pulp, especially in cases of gangrene, when heat produces thermal expansion of fluids in the pulp space, which, in turn, presumably exerts pressure on inflamed periodontal tissues. Heated gutta-percha is a stick that is heated and applied to the tooth on the middle third of the facial surface. The value of this test has been questioned, as the intensity of sensation reported by the patient is not reproducible, and even non-injured teeth may fail to respond. In contrast, ethyl chloride can be applied by soaking a cotton pledget and then placing it on the facial surface of the tooth to be tested.

The limitations of heated gutta-percha are also applied here, sensitivity: 0.86 and specificity: 0.41, while ethyl chloride gives more consistent results, where sensitivity is 0.83 and specificity is 0.93.[18,19]

Enamel-dentin fracture, without pulpal involvement, occurs more often than complicated crown fractures in both the permanent and primary dentitions. They are often confined to a single tooth, usually the maxillary central incisors, especially the mesial or distal corners. Fractures can be horizontal, extending mesiodistally. Occasionally, only the central lobe of the incisal edge is involved. In rare cases, the fracture can involve the entire facial or enamel surface.[14, 20]

The literature of many studies has shown that a few symptoms are related to this type of traumatic event (uncomplicated crown fracture), such as sensitivity to thermal changes and mastication, which are, to some degree, proportional to the area of dentin exposed and the maturity of the tooth; this explains that in enamel-dentin crown fractures, a large number of dentinal tubules are exposed (exposure of 1 mm^2 of dentin exposes 20,000 to 45,000 dentinal tubules). Dentinal tubules constitute a pathway for bacteria and thermal and chemical irritants that can provoke pulp inflammation.[21]

Luckily, the pulp has several defense mechanisms: a 'passive' mechanism consisting of an outward flow of dentinal fluid within the tubules due to positive pulpal pressure. Here, flow resists bacterial invasion through a gradient of hydrostatic pressure. The 'active' mechanism consists of the ability of the pulp to elicit an immediate inflammatory response to outside stimuli, bacteria toxins, or bacteria through the blood circulation.[22] This explains that the dental pulp has the ability to survive following concomitant uncomplicated crown fractures within a certain period of time; in our research, we found two weeks and less following traumatic dental injuries. The pulp can survive provided it has appropriate management and treatment because what appears to be critical to pulpal healing is how effectively the dentin is sealed from bacterial irritants. If deeply exposed dentin is adequately sealed, the non-exposed pulp will form

reparative dentin even without calcium hydroxide. Additionally, microleakage around composite restoration is one of the major causes of restoration failure and can be counteracted by a strong micromechanical bond arising between a composite resin and acid etched enamel. A soft start is one of the techniques used to prevent microleakage around the composite filling and to achieve leakage free restoration, which, in turn, maximizes bond strength and prevents bacterial invasion to the exposed dentine.[23] All these factors play a major role in the success of the treatment outcome.

In our case, one out of 31 injured teeth with uncomplicated crown fracture confined to enamel were vital at the first presentation and became non-vital due to the failure of one of the above factors. Ten out of 54 with uncomplicated crown fracture confined to enamel and dentine were non-vital. Eighteen injured teeth with uncomplicated crown fracture enamel and dentine were vital and became non-vital. Another factor that should be kept in mind is the increase in fluid flow after dentin exposure, which may also have clinical implications with respect to moisture control in the use of dentin bonding agents.

To reverse the dentinal fluid flow, it may be reasonable to administer a local anaesthetic agent with adrenaline prior to restoring fractured crowns; however, further investigation is necessary to test this theory before it can be advocated universally.[24]

Table 1: Andreasen classification.

Class I	Enamel infraction (Crack)
Class II	Enamel Fracture (Uncomplicated crown fracture)
Class III	Enamel-Dentin fracture (Uncomplicated crown fracture)
Class IV	Complicated crown fracture (Enamel- dentin and pulp)
Class V	Crown–root fracture (Uncomplicated enamel-dentin and cementum)
Class VI	Complicated crown-root fracture (Enamel-dentin-cementum and pulp)
Class VII	Root fracture

Table 2: Demographics of participants.

Age (Mean±standard deviation)		11.37 ±1.92
Gender (n (%))	Female	27 (38.6%)
	Male	43 (61.4%)
Area of residence (n (%))	Assalt	5 (7.0%)
	Khalda	4 (5.7%)
	Mahes	15 (21.4%)
	Marj Alhamam	10 (14.3%)
	Na'ur	11 (15.7%)
	Sweileh	7 (10.0%)
	Wadi Alseer	18 (25.7%)

Table 3: Correlation between teeth vitality and time.

		0-14 days	15 days and over	total	Chi-square	p-value
	Vital	17 (77.3%)	29 (46.0%)	46 (54.1%)		
Vitality	Nonvital	1 (4.5%)	24 (38.1%)	25 (29.4%)		
	Vital- Nonvital	4 (18.2%)	10 (15.9%)	14 (16.5%)		
	Total	22	63	85	$X^2(2,n=85)=9.23$	.01*

**** Significant. p <0.05***

Table 4: Correlation between teeth VITALITY and Type of teeth injury.

		Uncomplicated/ *Enamel*	Uncomplicated/ *Enamel & dentine*	Total	Chi-square	p-value
	Vital	30 (96.8%)	26 (48.1%)	56 (65.9%)		
Vitality	Nonvital	1 (3.2%)	10 (18.5%)	11 (12.9%)		
	Vital- Nonvital	0 (0%)	18 (33.3%)	18 (21.2%)		
	Total	31	54	85	X^2 *(2, n=85)=20.96*	*.<.001**

****Significant. p< .05***

CONCLUSION

According to the findings in our study, which was conducted in King Hussein Medical Center (KHMC) and Queen Rania AlAabdallah Hospital for Children Royal Medical Services in West.

Amman in Jordan, it is recommended that a follow-up review should be performed according to the time interval; it was found that the safety margin of time interval is less than six months after the trauma. Moreover, patients with the best management outcome, regardless of the type of tooth injury, attended within 14 days following a traumatic dental injury. Traumatic dental injuries are, for the most part, unanticipated events that, if not managed appropriately, can have serious complication and lead to poor consequences for the patient.

Conflict of interest statement

The authors confirm no conflict of interest.

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