ORIGINAL ARTICLE

THE FRACTURE PATTERN OF MAXILLARY INCISORS IN CHILDREN AND ADOLESCENCE: A NEW MORPHOLOGICAL CLASSIFICATION

[1]KHATTAR S HADDADIN
[2]MAAN AL-FAR

ABSTRACT

Traumatic dental injuries are frequent in the maxillary anterior teeth for variety of reasons like falling down in street or school, collision and sports. Many local occlusal factors such as increased overjet and general factors such as increased activity may predispose and modify these traumatic injuries.

Many studies have attempted to classify the types of traumatic dental injuries based on the extent of the tooth structure involvement and the severity of the trauma.

Central incisors act as one unified segment during traumatic injuries and do fracture always in certain repeated morphological patterns every time they are subjected to impact trauma.

One hundred and forty (140) children were examined at their first presentation in the restorative-pediatric dentistry department and data was collected from new dental traumatic injuries in order to classify these morphological patterns of trauma and see which of them are happening more than others and their relationship with overjet.

Data revealed that there were repeated fracture patterns which can be divided into seven morphological categories and increased overjet was more predisposeing factor.

Key Words: *Traumatic dental injuries, classification, Overjet, restorative and pediatric dentistry.*

INTRODUCTION

Traumatic dental injuries (TDI) for anterior teeth are considered an integral part of many disciplines such as restorative dentistry, paedodontics, endodontics and esthetic dentistry. They have received special attention and extensively studied due to their strategic, functional and esthetic roles. They are frequent in children and adolescents and usually are presented as separation or cleaving of the periodontal ligament or crushing injuries to the teeth and alveolar bone or both together, where falling down was the main cause.[1,2] However, crown fractures are the most common3 and the most frequently affected teeth are maxillary central incisors. Enamel fracture was accounted for about 45% of these injuries.[2,4]

Traumatic dental injuries to teeth and their supporting structures occur most commonly in young children, and vary in severity from enamel fractures to avulsions depending on the severity and nature of the trauma and on other occlusal factors such as overjet. These injuries are accounted for 50% of injuries for children before the age of 15 years, where 25% had sustained injuries more than once.[5] Crown fractures deserve special attention, due to their prevalence, variety of causative factors, and the diversity of clinical solutions proposed for the treatment of these fractures.[2,4,5] In recent studies researchers have investigated[7-9] new patterns of traumatic dental injuries.

Many attempts were made over the years to classify and organize the traumatic dental injuries.[10] Most of these classifications were based on the type of coronal fracture and the extent of dental hard tissue involvement for single tooth.[11] The currently used and accepted one is that proposed by the World Health Organization (WHO) Application of International Classification of Diseases in Dentistry and Stomatology[12], and modified by Andreasen[13] which could be applied to teeth and periodontium as well as to primary and permanent teeth.

However, new classifications are continuously proposed by authors for better description, categorization and diagnosis of these injuries, for proper treatment planning and management.[7,14] Studies showed that many factors predispose to the incidence and severity of traumatic dental injuries such as oral factors (increased overjet with protrusion), environmental determinants and human behavior.[15,16]

Study conducted in our departments of restorative and pediatric dentistry, it was observed that traumatic

[1] Khattar S Haddadin, BDS, MMedSci, Khattar S Haddadin, BDS, MMedSci, Senior Specialist in Conservative dentistry, Head of department of Dentistry – Prince Ali Bin Al Hussein, Royal Medical Services – Jordan
[2] Maan Al-Far, DDS, MSc, JDB, Maan Al-Far, DDS, MSc, JDB, Senior Specialist in Paediatric Dentistry, Head of Paediatric Dentistry Department Queen Rania Children Hospital, Royal Medical Services – Jordan
Correspondences should be addressed to: Dr. Khattar S. Haddadin, PO Box 2046, Amman 11821, Jordan
E-mail: Khattar2@yahoo.com

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dental injuries to the coronal tooth structure are following a repeated cleavage lines and therefore producing certain morphological fracture patterns that could be analyzed and classified according to its presentation in the clinic regardless the severity of the injury or the extent of dental hard tissue loss or pulpal involvement.

This study was carried out to determine and classify the fracture patterns of maxillary central incisors and provides a descriptive pattern of central incisors fracture in children and young adolescence and divides into categorizes which are informative and easy to be recorded.

Our Hypotheses

During traumatic dental injuries, maxillary central incisors will usually behave more or less as a unified segment of teeth by following a certain morphological fracture patterns that are reproduced continuously depending on the type, direction and severity of trauma and the occlusal relationship or variations in overjet.

METHODOLOGY

One hundred and forty (140) children attended the restorative and pediatric dentistry departments at King Hussein Medical Center and its peripheral hospitals, complaining from traumatic dental injuries in 193 traumatized maxillary anterior teeth. They were examined at their first presentation by one of the authors to register the pattern of maxillary teeth fracture that resulted from different traumatic dental injuries such as falling down in street or school and interpersonal collision.

Selection criteria were limited to sound teeth with no previous trauma or restorative procedure and without anterior crowding. Impact injury to the face and teeth, sport injuries, crowned or previously traumatized teeth and carious teeth were excluded from this study. The traumatic injuries were recorded and classified according to morphological patterns of the fracture lines.

RESULTS

Of the 140 patients selected for this study, 135 patients were having repeated patterns of fractures (96.4%). The number of the traumatized teeth was 193. 190 (98.4%) were central incisors and 3 (1.6%) were lateral incisors.

Table 1 summarizes the patterns of central incisors fracture and their percentage and lists the mean overjet accompanying each pattern. Five cases were not following any of the mentioned patterns and were excluded for lack of repetition and lack of logical explanation. Fig 1-7 illustrate examples of the clinical presentation.

Fracture of the two mesial edges of both central incisors were accounted for the highest morphological fracture patterns (23.7%), fracture of the mesio-distal incisal edge of one central incisor (22.2%), fracture of the mesial edge one central incisor (20.7%), fracture of the distal edge of one central incisor (14%), fracture of the mesial edge of one central incisor and mesio-distal incisal edge of the other central incisor (11.9%), fracture of the mesio-distal incisal edges of both central incisors (5.2%), fracture of the distal edge of one central incisor and mesial edge of adjacent lateral incisor (2.2%).

Fracture of the thin mesial incisal angles was accompanied by normal or slightly increased overjet as seen in (FP1, FP2 and FP3), where fracture involving the thick distal incisal angle or the mesio-distal incisal edge were accompanied with increased overjet as seen in FP4, FP5, FP6 and FP7.

DISCUSSION

Studying the pattern at which maxillary central incisors fracture or respond to trauma as a result of falling down injuries, may improve our understanding of how maxillary anterior teeth behave as one aesthetic and functional unit and might give us a better insight for formulation of treatment planning.

Clinically, central incisors fractures caused by frontal impacts fall into three categories according to the direction and position of fracture lines: (a) horizontal crown fracture involving the mesio-distal angles or (oblique fracture of the whole incisal edge) (b) oblique fractures involving the mesial angle of the central incisors (c) oblique fractures involving the distal angle of the central incisors. The morphological classification relied on the percentage of occurrence of one or combination of more than one of the aforementioned individual fracture lines.

This study along with other studies demonstrated that central incisors were the most affected teeth by the frontal trauma due to their most anterior position.[1-9] However, lateral incisors showed far less involvement than the central incisors and that might be attributed to their slight inward position palatal to the central incisor and shorter incisal edge. The canines showed no involvement due to their anatomic position near the corner of the mouth, hiding at the curve of the dental arch protected by the soft tissues of the lips, which make

TABLE 1: PERCENTAGE OF FRACTURE PATTERNS OF MAXILLARY ANTERIOR TEETH AND THE CORRESPONDING OVERJET

Pattern of Fracture	FP1	FP2	FP3	FP4	FP5	FP6	FP7	Total
Number of Cases	32	30	28	19	16	7	3	135
Overjet in mm	3.47	4.65	3.76	6.58	5.95	5.41	5.23	—
Percentage	23.7%	22.2%	20.7%	14%	11.9%	5.2%	2.2%	100%

Fig 1: Fracture Pattern 1 (FP1): Fracture of the two mesial edges of both central incisors

Fig 2: Fracture Pattern 2 (FP2): Fracture of the mesio-distal incisal edge of one central incisor

Fig 3: Fracture Pattern 3 (FP3): Fracture of the mesial edge one central incisor

Fig 4: Fracture Pattern 4 (FP4): Fracture of the distal edge of one central incisor

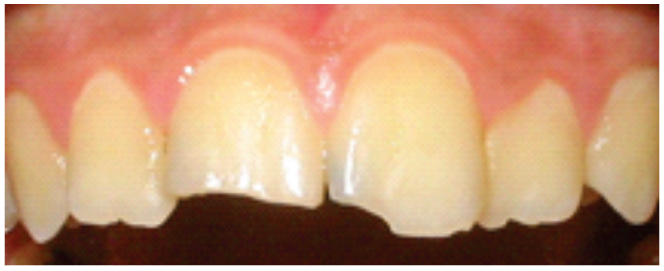

Fig 5: Fracture Pattern 5 (FP5): Fracture of the mesial edge of one central incisor and mesio-distal incisal edge of the other central incisor

Fig 6: Fracture Pattern 6 (FP6): Fracture of the mesio-distal incisal edges of both central incisors

Fig 7: Fracture Pattern 7 (FP7): Fracture of the distal edge of one central incisor and mesial edge of adjacent lateral incisor

it difficult to be affected by frontal impacts resulting from falling down or collisions.[2]

The anatomy of the incisal edge of the central incisor reveals that the distal incisal angle is thicker and more rounded than the mesial incisal angle, which consequently makes it prone to fracture with relatively less impact forces than the distal angle.[17] Therefore patterns of fractures that involves the mesial incisal edges (like fracture patterns 1,2 & 3) is almost twice the incidence of those that involves the distal incisal angles like fracture patterns.[4-7]

In their study Schatz et al 2001 showed the importance of tooth structure thickness in resisting impact forces. In a comparison of stability after a defined impact stress, he showed that maxillary canines and premolars have significantly higher resistance to fracture than maxillary incisors which also have low fracture resistance when compared to canines or premolars.[18]

Because of these anatomic differences, most of the fracture lines came as oblique fractures, which came in agreement with the clinical findings by Leif et al 2004 who demonstrate that the outcomes for frontal tooth impacts typically involve oblique crown fractures.[1]

The loss of dentinal support in the incisal edge of incisor teeth has an important risk factor for the patterns of fracture. Kishen et al 2004 investigated the importance of dentine infrastructure support on the severity of dental fractures and concluded that the loss of inner support dentine has predisposed to catastrophic tooth fractures.

Overjet has been always related to increased risk to dental traumatic injuries.[15] Available evidence shows that children with an overjet greater than 3mm have

double the risk of dental trauma as those with an overjet of less than 3mm.[20]

The results of this study revealed that patients with increased overjet of more than 3mm showed a more sever and extensive pattern of tooth fracture, manifested by increased number of fractured teeth (fracture of both mesial incisal angles) or fracture of the distal edge of the central incisor as seen in fracture patterns 2 and FP4-7 (Table 1), which came in agreement with a literature review of cohort studies by Gelnor U 2009 which states that increased overjet has twice the tendency for traumatic dental injuries (TDI) than their normal counterparts. These risk factors are further aggravated in the presence of lip incompetence.[15]

In dynamic finite element analysis, Huange et al 2005 investigated the fracture patterns occurring when a human upper central incisor is subjected to impact loadings at various angles. He found that impact direction played an important role in terms of outcome for the fractured incisor[9], where he showed that forces at right angle to the labial surface of the maxillary incisor have the greatest effect on the pattern of injury. Although present study did not investigate the direction of the impact forces to teeth, yet we got similar patterns of fractures in this study similar to that of Huange et al 2005. Taking into consideration that the finite element analysis was for individual teeth, where current study investigated the fracture patterns in the anterior segment which involves a combination of anterior teeth, namely, the maxillary central incisors.

CONCLUSION

In this study, the central incisors segment acted as one unit in response to traumatic dental injuries by reproducing certain morphological patterns of fracture lines which were recorded and classified in this study.

Based on the results presented in the present study, we the authors thought that we introduced a new morphological classification that could be used as an important descriptive adjunct to other already present classifications, which will aid in clarifying the clinical picture of the dental trauma in the mind of the clinician and may facilitate the formulation of the esthetic and functional treatment planning process. Future studies may include more dental and occlusal variables so that a complete and comprehensive picture of these patterns may be studied and analyzed in each and specific variable.

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