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Original Article

Pattern of Root Fracture among Adult Patients with Traumatic Dental Injuries to Anterior Teeth

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Abstract

Background: Dental trauma is a major public health issue, with the prevalence of traumatic dental injuries varying by country, geographic location, and age group. The study aimed to assess the pattern of root fractures in adult patients with traumatic dental injuries. Do traumatic dental injuries influence the pattern of root fractures?

Methodology: This was a descriptive cross-sectional study of patients presenting with dental traumatic injuries. Data was collected via an interviewer-administered questionnaire. The data collated were analyzed using IBM SPSS version 26.0. The data was subjected to analysis using descriptive statistics. The chi-square test was used to determine associations between categorical variables with a p-value set at 0.05.

Result: Eighty patients with radiographically confirmed root fractures of the anterior teeth were recruited to undertake this study. The participants were aged between 23 years and 69 years. The most prevalent presenting complaint was pain (53.8%). The main etiological factor of the traumatic incident was interpersonal violence (42.4%). The arch most involved was the maxillary arch (75.0%) with the central incisor being the most affected teeth (75.0%). The fracture of the apical third was the most recorded (67.5%). There was a statistically significant association between the gender of the patient and the location of the root fracture with 90.0% of males presenting with apical root fracture and 40.0% of females presenting with coronal third root fracture.

Conclusion: The study concluded that traumatic dental injuries are common and different patterns of fractures were reported. Apical third fracture was reported as the most common pattern of root fracture in this study to be the most common in terms of pattern. The clinical relevance is to improve the high index of suspicion of apical root fracture in traumatic dental injuries.

Keywords: Pattern; Root Fracture; Traumatic Dental Injuries.

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Introduction

Dental trauma is a significant public health problem with the prevalence of traumatic dental injuries varying from country to country and from geographical location to geographical location as well as age groups. Traumatic dental injuries can occur to any dental tissue and any part of the tooth from the crown to the root and the supporting structures. It can vary in severity from a simple infraction on the enamel, and root fractures to complete tooth avulsion.

Root fracture involves dentine, cementum, and pulp. It can be classified according to the displacement of the coronal fragment as vertical or horizontal.[1] It can be localized at the apical, middle, or coronal third[2] with the cervical third further classified into supracrestal and subcrestal.[3] The prevalence of root fractures in permanent teeth has been reported to be 0.4% to 7.7% of all injuries [4-8] and as high as 46.5% in a retrospective study in Brazil [9], while in primary teeth it was recorded to be 1.9% to 3.8%.[6,8,10]

Root fractures are clinically challenging to diagnose as there may be no outward signs.[11] It however may be associated with a fracture of the clinical crown, with partial loss of dental hard tissue or displacement. Patients may report abnormal mobility and sensitivity to percussion of the tooth. Also, they may present with or without clinical signs of luxation of the coronal fragment. It is pertinent that all traumatized teeth be radiographed to investigate the existence of root fracture [9] as this is an important factor considered when drawing up a treatment plan.

Root fractures are not a frequently reported type of trauma as they are rarely reported compared to other forms of dental trauma. [3,12]. On the contrary, a study by Eva Lauridsen et al reported root fracture as the most common type of injury associated with TDIs.[13] There have been inconsistencies in the pattern of root fractures diagnosed following dental trauma, [6,9,13] hence this study was designed to assess the pattern of root fractures in adult patients with traumatic dental injuries.

Methodology

This was a descriptive cross-sectional study of patients who came to the dental clinic with traumatic dental injuries. All the patients were screened for the presence of root fractures and those diagnosed with root fractures of one or more teeth were included in the study. Data was collected via an interviewer-administered questionnaire to obtain information on the socio-demographic characteristics of the participants (age, gender, occupation, and marital status), presenting complaints, and aetiology of the traumatic incident. The participants underwent clinical examination of the oral cavity to determine the involved arch and teeth and theses were recorded.

Following the ethical and research committee approval, informed consent was obtained from all participants.

Root fracture was identified by mobile or displaced coronal segment and confirmed by radiographic evidence. Based on location, the root fracture was classified as horizontal or vertical.

The data collated was screened for completeness and analyzed using IBM SPSS version 26.0. The data were analyzed using descriptive statistics in the form of mean, standard deviation, frequency, and percentages. The chi-square test determined associations between categorical variables with a P-value set at 0.05.

Results

Eighty patients with radiographically confirmed root fractures of the anterior teeth were recruited to undertake this study. The participants were aged between 23 years and 69 years with a mean age of 37.44±15.10 years. The majority (85.0%) were 50 years and younger. There was a higher proportion of males, accounting for 62.5% of the study population. Dependents accounted for a higher proportion of the respondents (41.3%) while 76.3% had tertiary education,45.0% were single and 12.5% were widowed (Table 1)

Table 1: Socio-demographic characteristics of the participants

Characteristics	Frequency	Percent	Confidence interval
Age group			
<30 years	34	42.5	32.5-53.8
31-50 years	34	42.5	31.3-52.5
>50 years	12	15.0	7.5-23.8
	Mean age 37.44±15.10		
Gender			
Male	50	62.5	51.2-72.5
Female	30	37.5	27.5-48.8
Occupation			
Professional	10	12.5	6.3-21.3
Skilled worker	17	21.3	12.5-30.0
Semi-skilled worker	5	6.3	1.3-12.5
Unskilled worker	15	18.8	11.3-28.7
Dependents	33	41.3	28.8-51.2
Level of education			
Primary	8	10.0	3.8-17.5
Secondary	11	13.8	6.3-22.5
Tertiary	61	76.3	60.3-85.0
Marital Status			
Single	36	45.0	33.8-55.0
Married	26	32.5	22.5-42.5
Divorced	8	10.0	3.8-17.5
Widowed	10	12.5	6.3-21.3
Total	**80**	**100.0**	

The most prevalent presenting complaint was pain (53.8%) followed by fractured teeth (41.3%) (Figure 1). The most prevalent aetiological factor of the traumatic incident was interpersonal violence (42.4%) followed by Road Traffic accidents (Figure 2).

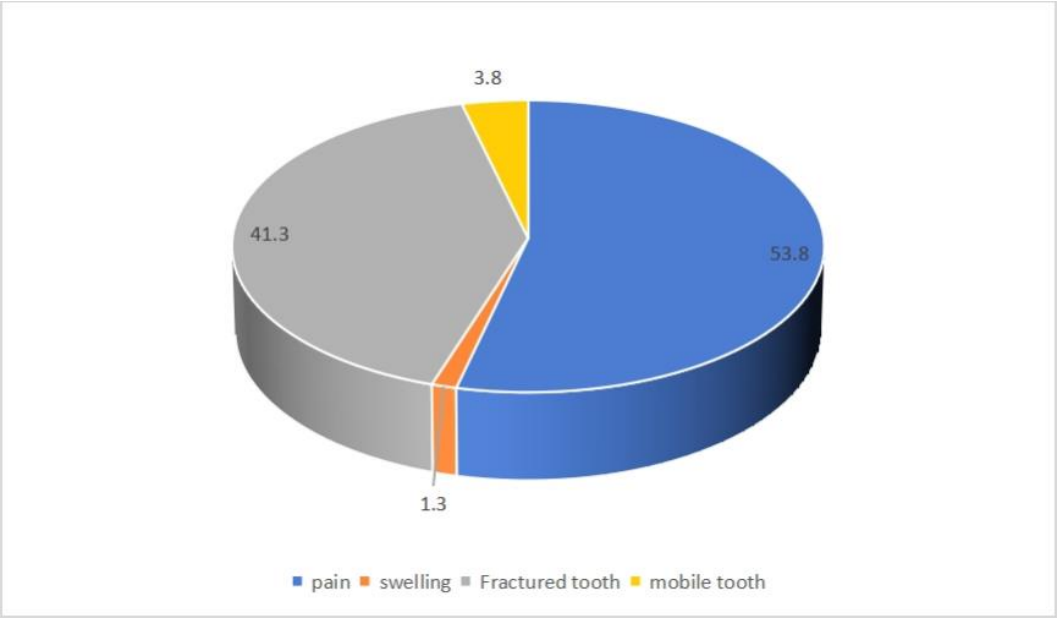

Figure 1: Presenting complaints of the participants

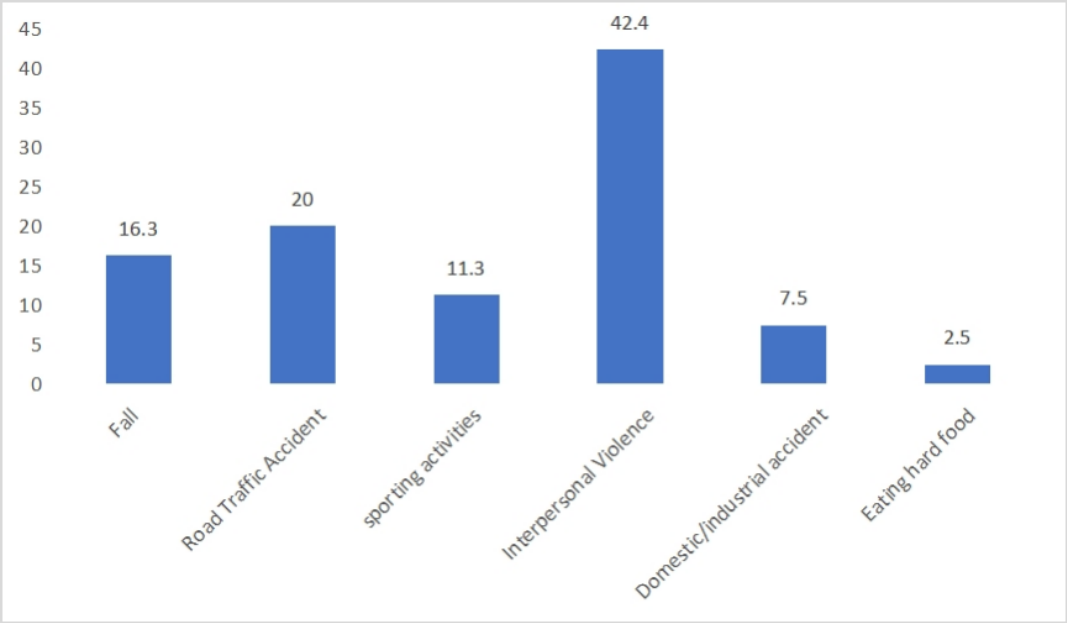

Figure 2: Aetiology of traumatic incidents among the participants

The arch most involved was the maxillary arch (75.0%) with the central incisor being the most affected teeth (75.0%). The maxillary central incisor comprised 57.5% of the root fractured teeth followed by the mandibular central incisor (17.5%) and maxillary lateral incisor (16.3%). The mandibular canine was not involved at all (Table 2).

Table 2: Distribution of teeth with root fracture among the participants

Characteristics	Frequency	Percent	Confidence interval
Arch			
Maxillary	60	75.0	65.0-83.8
Mandibular	20	25.0	16.3-35.0
Tooth type			
Central incisor	60	75.0	65.0-83.8
Lateral incisor	19	23.8	15.0-33.8
Canine	1	1.3	0.0-3.8
Tooth			
Maxillary central incisor	46	57.5	46.3-67.5
Maxillary lateral incisor	13	16.3	8.8-23.8
Maxillary canine	1	1.3	0.0-3.8
Mandibular central incisor	14	17.5	10.0-26.3
Mandibular lateral incisor	6	7.5	2.5-13.8
Total	**80**	**100.0**	

Fracture of the apical third was the most recorded (67.5%) followed by the coronal third accounting for 18.8% of the root fractures (Figure 3). There was no statistically significant association between the arch (p=0.337) and root-fractured teeth as well as the teeth with root fracture (p=0.323) and the location of the root fracture (Table 3).

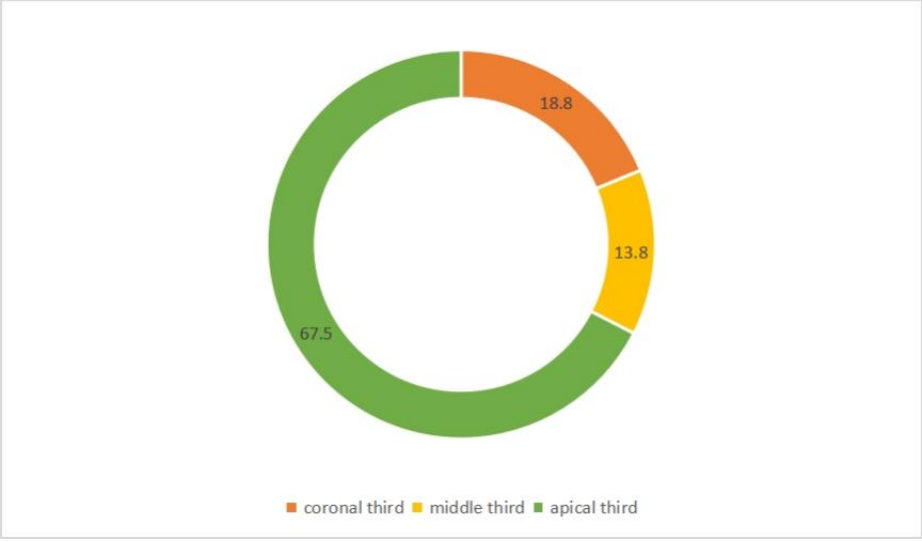

Figure 3: Location of root fracture among the participants

Table 3: Association between tooth type, arch involved, and location of root fracture

	Location of root fracture			
	Coronal third	**Middle third**	**Apical third**	**Total**
Arch				***P=0.323**
Maxillary	9 (15.0)	9 (15.0)	42 (70.0)	60 (100.0)
Mandibular	6 (30.0)	2 (10.0)	12 (60.0)	20 (100.0)
Tooth type				***P=0.337**
Central incisor	10 (16.7)			60 (100.0)
Lateral incisor	5 (26.3)			19 (100.0)
Canine	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)
Total	15 (18.8)	11 (13.8)	54 (67.5)	80 100.0)

*Fischer's Exact

There was a statistically significant association between the gender of the patient and the location of the root fracture with 90.0% of males presenting with apical root fracture and 40.0% of females presenting with coronal third root fracture (P< 0.0001). There was a decline in the proportion of individuals presenting with apical third root fractures as age increased. More than half (66.7%) of those over 50 years old exhibited middle-third root fractures, while none presented with coronal fractures. This difference was statistically significant (p < 0.0001) as shown in Table 4.)

Table 4: Association between gender and age group of the participants and location of the root fracture

Characteristics	**Location of root fracture**			**Total**
	Coronal third	**Middle third**	**Apical third**	
Gender				**P<0.0001**
Male	3 (6.0)	2 (4.0)	45 (90.0)	50 (100.0)
Female	12 (40.0)	9 (30.0)	9 (30.0)	30 (100.0)
Age group				**P<0.0001**
<30 years	4 (11.8)	2 (5.9)	28 (82.4)	34 (100.0)
31-50 years	11 (32.4)	1 (2.9)	22 (64.7)	34 (100.0)
>50 years	0 (0.0)	8 (66.7)	4 (33.3)	12 (100.0)
Total	15 (18.8)	11 (13.8)	54 (67.5)	80 (100.0)

All those who presented with swelling and mobile teeth had apical third root fracture while 90.9% of those who presented with fractured tooth had apical third root fracture and 30.2% of those who presented with pain had coronal third root fracture and this was statistically significant (p=0.005).

All those whose traumatic incident was due to sporting activities and domestic/industrial accidents had apical third root fractures while a higher proportion (76.9%) of those whose traumatic incident was occasioned by falls had coronal third root fractures and the majority (82.4%) of those whose traumatic incident occurred from interpersonal violence recorded apical third root fracture and this was statistically significant, p<0.0001 (Table 5)

Table 5: Association between presenting complaint, etiology of the traumatic incident, and location of the root fracture

	Location of root fracture			
	Coronal third	**Middle third**	**Apical third**	**Total**
Presenting complaint				***P=0.005**
Pain	13 (30.2)	10 (23.3)	20 (46.5)	43 (100.0)
Swelling	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)
Fractured tooth	2 (6.1)	1 (3.0)	30 (90.9)	33 (100.0)
Mobile teeth	0 (0.0)	0 (0.0)	3 (100.0)	3 (100.0)
Etiology				***P<0.0001**
Fall	10 (76.9)	1 (7.7)	2 (15.4)	13 (100.0)
Road traffic accident	0 (0.0)	8 (50.0)	8 (50.0)	16 (100.0)
Sporting activities	0 (0.0)	0 (0.0)	9 (100.0)	9 (100.0)
Interpersonal violence	4 (11.8)	2 (5.9)	28 (82.4)	34 (100.0)
Domestic/industrial accidents	0 (0.0)	0 (0.0)	6 (100.0)	6 (100.0)
Eating hard food	1 (50.0)	0 (0.0)	1 (50.0)	2 (100.0)
Total	15 (18.8)	11 (13.8)	54 (67.5)	80 (100.0)

*Fischer's Exact

Discussion

Root fracture following dental traumatic injuries is usually confirmed radiographically. The pattern of root fracture may be reflective of the pattern of traumatic dental injuries as they may not be isolated injuries. This study showed that more males presented with root fractures following traumatic dental injuries compared to females. This is consistent with the findings of other studies. [6,8,9,15-18] The higher prevalence in males recorded in this study may be attributed to the fact that they are more involved in sporting activities, and outdoor activities, as well as violent behaviour, falls, and road traffic accidents (RTA). However, falls and violent activities were found in our study to be the most common presenting etiologies.

More root fractures were recorded among the younger to the middle age group a finding similar to a previous report on traumatic root fracture [8] but inconsistent with a report that recorded an equal proportion of root fractures among young adults and older adults.[18] This can be attributed to the fact that people of these age groups take part more in violent activities which can also predispose one to traumatic injury. [19]

The most prevalent presenting complaint was pain followed by fractured teeth. This is not surprising as these presenting complaints are typical for traumatic dental injuries [18] and coronal third fractures have been associated with pain, [20], increased mobility, and bleeding from the periodontium. [21,22] The other likely reasons for the pain felt can be due to pulp exposure and soft tissue injuries. The most prevalent aetiological factor of the traumatic incident was interpersonal violence followed by RTA, a finding similar to a previous report [8,19]

The maxillary teeth were more commonly involved in root fracture secondary to traumatic dental injuries (TDIs) with the central incisors generally reported to be the most affected tooth type while canine teeth were less commonly affected. This is consistent with previous reports of root fractures following trauma. [8,9,17] This has been thought to be due to the frontal impact associated with these injuries. [8,23] This is also reflective of the general pattern of traumatic dental injuries, and it may not be unconnected with the fact that the maxilla is more prone to traumatic injuries as reported by previous studies. [18,24-28]

Dental trauma can result in different kinds of injuries depending on the extent, direction, location of the impact, and tooth development stage.[29] Fracture of the apical third was the most recorded type of root fracture in this study followed by a coronal. This is consistent with a previous Nigerian which recorded apical third fractures as the most prevalent type of root fracture, followed by coronal third and middle third fractures.[28] Andreasen et al [17], Caliskan and Pehlivan,[30] Panzarini et al,[9] Hovland,[23] and Gharechahi[31] all reported the middle third root fracture as the most common type of root fracture, followed by fractures to the apical and coronal third. While Skaare and Jacobsen,[14] reported the middle-third root fracture was the most prevalent type of root fracture, with fractures to the coronal and middle-third equal.

Furthermore, this study found that the apical-third fracture of the tooth was the most common in terms of the pattern of fracture and was usually associated with pain. This contrasts with a previous study that reported apical third fractures as not always symptomatic. [11]

With regards to the association between the tooth type, arch involved, and location of the root fracture, there was no statistically significant difference, showing that the tooth type and arch do not necessarily determine the type of root fracture. There was, however, a statistically significant association between gender, age, and location of fracture of the tooth was observed. This shows that gender and age may have a role in determining the location of a root fracture.

A decline was observed in the proportion of those who presented with apical third root fracture with increasing age. This may be connected to the level of resilience of the alveolar bone and tooth structure from withstanding the impact associated with trauma.

Tooth mobility, fractured teeth, and swelling were associated with apical third root fracture. It has been reported that apical and middle third root fractures are not always symptomatic while coronal third root fractures are associated with pain [20], increased mobility, and bleeding from the periodontium. [21,22]

Frontal impacts from accidents during sports, as well as domestic and industrial incidents, may result in fractures in the apical third of the root. In contrast, falls are more likely to cause fractures in the coronal third of the root. Additionally, cases of interpersonal violence have been associated with a higher occurrence of apical third-root fractures.

Conclusion

The study concluded that traumatic dental injuries are common and different patterns of fractures were reported. The apical third fracture was reported in this study to be the most common in terms of pattern. While the pain was the most common presenting complaint, the maxillary anterior teeth, especially incisors, were the more commonly affected teeth. Age and sex were observed to be important

determinants of the pattern of fracture**.** Interpersonal violence was found to be the most prevalent etiological factor in traumatic dental injuries. Males and the younger age group should be advised to be more careful and to avoid the etiological factors in TDIs.

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