A Retrospective Evaluation of the Prevalence of Cracked Teeth Among an Adult Population in Nevada

Jacob OZUNA, Benjamin BARBORKA, Neamat Hassan ABUBAKR

ABSTRACT

Objective: To identify the distribution and characteristics of cracked teeth in a Southern Nevada population attending the dental clinics of the School of Dental Medicine, University of Nevada, Las Vegas (SDM, UNLV).

Methods: A retrospective keyword search of the clinical notes of SDM, UNLV patient charts in AxiUm™ was performed using the search terms "crack" and "fracture" to discern the number of patients that had clinically identifiable teeth with cracks, and which teeth (if any) had documented symptoms consistent with the cracks. The inclusion criteria for the record search were individuals ≥18 years old, seen at the dental clinic between 2010 and 2018. Demographic data were analyzed using a Chi-square test against the demographics for Clark County's population.

Results: 893 patients presented with cracked teeth, of which 41% had documented symptoms. Patients in the 45-54 age range had the highest number of teeth with cracks (P<0.001). Males comprised 49% of the cases. Caucasians (58.9%) and African Americans (21.1%) represented a majority of the population with cracked teeth (P<0.0001). 1st and 2nd molars had the highest predilection for fractures (59.8%).

Conclusion: Mandibular and maxillary first and second molars were amongst the highest teeth affected with cracks.

Keywords: Asymptomatic teeth, cracked teeth, root canal treatment, symptomatic teeth

HIGHLIGHTS

- Patients in the 45-54 age range had the highest number of teeth with cracks.
- Caucasians and African Americans represented a majority of the population with cracked teeth.
- Mandibular and maxillary first and second molars had the highest number of fractures.

INTRODUCTION

The presence of incomplete fractures within the enamel and dentine of the crown and/or extending onto the roots, which may involve the pulp, of vital teeth can present with a number of symptoms referred to Cracked Tooth Syndrome [CTS] (1). Cameron, in 1964, was the first to use the term CTS (2). However, studies of cracks in teeth were reported as early as 1954 and were termed cuspal fracture (3). A number of terms has been introduced to describe cracks in teeth such as fissured fracture, greenstick fracture and, cracked cusp syndrome (3). The ability of a clinician to diagnose a cracked tooth may be difficult because the signs and symptoms can be intermittent and highly variable. Symptoms of a cracked tooth differ from patient to patient and can mimic those of trigeminal autonomic cephalalgias (4), occlusal trauma, acute periodontal disease, and dentine hypersensitivity (5). Some patients with a cracked tooth may not present with any symptoms. While other patients may report discomfort when chewing or may have hypersensitivities to hot, cold, and sweets. A Tooth Slooth can induce pain upon biting or release, and a clinician can sometimes localize the source of pain to a particular cusp (1, 6, 7).

In the literature, there are many attempts to find a sequence of clinical tests to help clinicians locate, identify, and treat a cracked tooth (6). These tests include percussion, thermal tests, bite test, stainless steel band placement, methylene blue dyes, desiccation, anesthetic blocks, periapical radiographs, bitewings, cone-beam computed tomographic (CBCT), transillumination, optical inspection, and quantitative light-induced fluorescence (QLF) (1, 5, 8). Radiographs are

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often not useful for the detection of smaller cracks in teeth, especially when the cracks are parallel to the film (9). Some of the more promising clinical tests are transillumination, bite test with a Tooth Slooth, and stabilization of the tooth with stainless steel bands (10). The transillumination method can disclose whether or not cracks exist but have limitation in determining the depth of cracks. Difficulties are also associated with the use of dyes, such as methylene blue, because it is reliant on the direction and position of the crack (8). Recently, research has indicated that QLF technology will be a valuable clinical tool for diagnosing enamel cracks due to its nondestructive nature (8). However, even with the advent of these newer technologies, diagnosing the exact extent and location of the crack is often not fully discovered until the tooth is prepared for a restoration or root canal therapy [RCT].

Determining the proper course of treatment to eliminate a crack and its symptoms is as difficult as it is to diagnose the crack. It has been suggested that if the crack extends only into the dentine without cuspal involvement, a direct restoration could suffice (1). If the pulp is involved, RCT could be indicated and has shown high initial survival rates, at least in the first two years (11, 12). The long term prognosis for these different treatment options, however, has not been well studied (11, 12). The unpredictability of crack propagation can render these treatments useless, and patient perception of the clinician's competence is challenged. A regional comparison of cracked teeth in the United States ranked the population in the Southwest second for highest in occurrence of cracked teeth, following behind the South Central (13).

The aim of this study was to identify the characteristics, treatment, and patient demographics of cracked teeth in an adult patient Southern Nevada population.

MATERIALS AND METHODS

Approval
The study was approved by the University of Nevada, Las Vegas (UNLV) Biomedical Institutional Review Board and was given exempt status [IRB no. 1288126-1].

Patient sample and data collection
Our data collection methods followed a previous study where the data was collected by searching the clinical notes from patients' records (14). A keyword search in the clinical notes of patient charts in AxiUm™ was conducted. The search terms were "crack" and "fracture". This was used to identify the number of entered notes that documented the words crack and fracture in any variation. All patient identifiers were removed from the collected data. The inclusion criteria for the patient population encompassed patients who were 18 years and older and were seen at SDM, UNLV from 1/1/2010-8/1/2018. Vertical root fractures associated with endodontically treated teeth were excluded. Other excluded entries included ones that contained the non-related phrases such as cracked dentures, cracked restorative material, cracked retainers, and phrases like "crack sound" or "crackling" when explaining TMD (Fig. 1). The patient charts were reviewed individually to ensure each patient and cracked tooth was counted once.
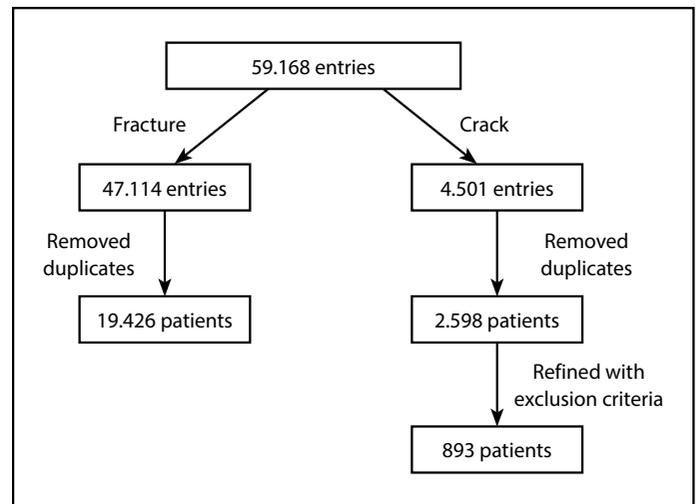
Figure 1. Descriptive data collection flowchart

Statistical analysis
The Demographics of the data collected were analyzed using the Chi-square test using GraphPad QuickCalcs web site: https://www.graphpad.com/quickcalcs/chisquared1/against the demographics for Clark County, Las Vegas, Nevada (accessed November 2018).

RESULTS
893 patients with a total of 1.085 teeth were identified by clinicians as having a cracked tooth, based on the clinical notes. Of the 893 patients, 49.1% of the study population was male. African Americans (21.1%) and Caucasians (58.9%) were among the highest ethnic groups represented (Table 1). The age group that had the most people with cracked teeth was 45-54 years old (22.8%) (Table 1). There was a near equal distribution of maxillary teeth to mandibular teeth, 565 teeth and 532 teeth, respectively. The teeth types that were most likely associated with cracks were the first and second molars consisting of 59.8% of the teeth in this study. Of the maxillary teeth, the first premolars (21%) and first molars (27%) were cracked more than other tooth type. Of the mandibular teeth, the first (40%) and second (35%) molars represented a large number of the cracked teeth in the arch and overall.

TABLE 1. Demographics distribution of patients with reported crack

Variable	Present study (%)	Clark County, Nevada (%)	P value
Gender	Male (49.1)	49.90	0.633
	Female (50.9)	50.10	
Ethnicity	American Indian (0.13)	0.70	<0.001
	Asian 22 (2.86)	9.30	
	African American (21.1)	10.40	
	Hispanic (17.0)	28.40	
	White (58.9)	51.20	
Age	18-24 (4.9)	11.40	<0.001
	25-34 (15)	18.50	
	35-44 (17.1)	18.20	
	45-54 (22.8)	17.40	
	55-64 (20.4)	15.40	
	65-74 (15.6)	11.80	
	75+ (4.2)	7.30	

TABLE 2. Distribution of the crack according to location of the teeth

Type of tooth	Maxilla	Mandibular	Total no. (%)
Central Incisor	46	6	52 (4.8)
Lateral incisor	24	6	30 (2.8)
Canine	13	0	13 (1.2)
1st premolar	120	29	149 (13.7)
2nd premolar	74	56	130 (12)
1st molar	150	212	362 (33.4)
2nd molar	101	186	287 (26.4)
3rd molar	33	29	62 (5.7)
Total	561	524	1085 (100)
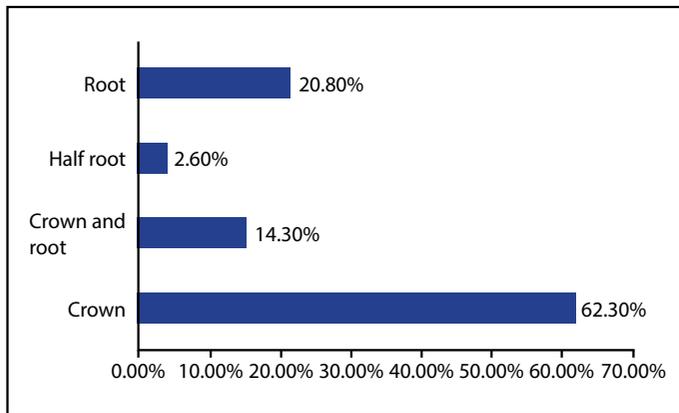
Figure 2. Anatomical location of the tooth crack
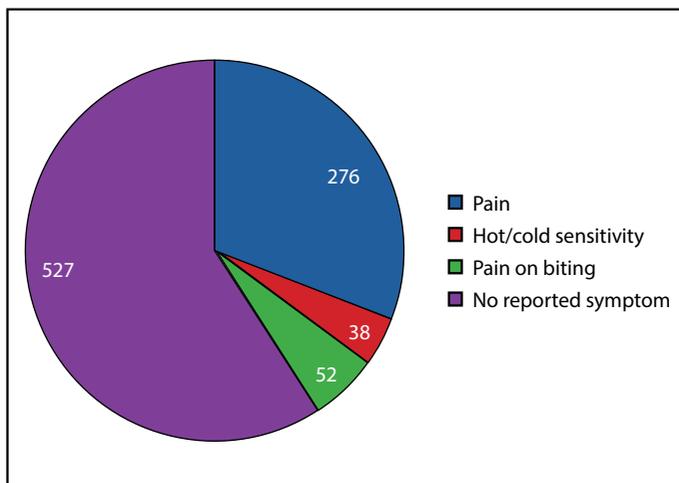
Figure 3. Symptoms associated with tooth crack

(Table 2) The most commonly reported anatomical location of the crack was in the crown (62.3%), while only 2.6% were reported in the root (Fig. 2). Vertical cracks (85%) were reported as the most common crack orientation. Teeth with amalgam restorations (76.6%) had a higher reporting for cracks in the tooth when compared to teeth with resin composite restorations (23.4%). There were no documented symptoms in the majority of patients. When symptoms were documented, "pain" was the most common descriptor followed by thermal sensitivity and pain when biting or chewing (Fig. 3). Extraction (54.7%) was the most common treatment modality for the documented symptomized teeth followed by indirect restoration (18.2%) (Fig. 4).
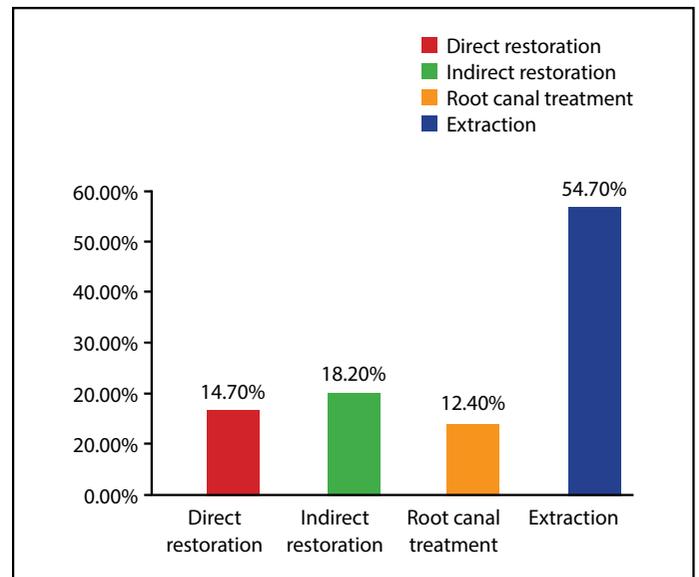
Figure 4. Type of treatment done for symptomatic crack teeth

DISCUSSION

The data collection and treatment protocols were dependent upon the documentation and clinical judgment of overseeing clinicians. There is a lack of consensus for proper protocols and recommended treatment plans regarding cracks in teeth. In 2017, Alkhalifah et al. demonstrated that general dentists and specialists had different treatment protocols for cracked teeth and more explicit guidelines for treatment choices needed to be established (15). The present results showed a high prevalence of cracked teeth among the age range of 45 to 54 years, which compares with previous research indicating the majority of cracked teeth occur in the population between the ages of 50-59 (12); and may increase with age (13). The present study showed a statistically significant difference between ethnic subpopulation distributions when compared with the distributions of Clark County. The study showed that the Caucasians population (58.9%) falls within the range seen in Clark County (51.2%); on the other hand, there was a great difference between the African American Subpopulation distribution in the present investigation. The African American subpopulation for the study was 21.1%, while for the Clark County the distribution was 10.4%. The data are in agreement with the findings of Wu et al. (16) and Krell and Caplan (17), who reported mandibular first and second molars followed by maxillary first and second molars to be commonly affected with cracks. Another study found that teeth restored with amalgam and gold inlays had a higher incidence of cracks compared with teeth restored with resin composite restoration (1). This is consistent with the observation of the present study where teeth restored with amalgam had a higher number of documented cracks.

The prognosis of cracked teeth depends on the extent of the crack, and if it propagates apical to the cementoenamel junction onto the root surface. Sim et al. concluded that after RCT, teeth with coronal cracks had a higher survival rate than teeth with radicular cracks (18). The presence of the butterfly effect was considered as a risk factor for the formation of cracks, following ultrasonic root preparation or root resection, where cracks usually observed in the buccolingual direction (19).

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Determining the prognosis of cracked teeth and whether or not root canal treatment should be completed prior to restoring is a challenging task for clinicians. Some patients may have no symptoms, and a tooth that responds normal to pulp testing may soon develop symptoms, after a new restoration is placed. In the present study, there were inconsistencies in the treatment planning and diagnosis of the extent of fracture. In addition, patients chose extraction over other treatment options including, RCT and crown placement. This high percentage of extraction may be due to financial considerations as RCT and coronal restorations are significantly more expensive than extraction. Studies showed that endodontically treated cracked teeth has high survival rates at 2 and 5 years (11, 12, 18).

An investigation of the treatment approach of dental practitioners, and specialists toward different cracked teeth scenarios showed significant discrepancies in the approach to treatment planning for cracked teeth by general practitioners and specialists (15). A considerable variation in the treatment options involving asymptomatic teeth was reported (15). Endodontists recommending crowning cracked asymptomatic teeth rather than extraction, more than prosthodontists and general practitioners have been reported which could be attributed to different training programs and personal views based on previous education background (15).

It is essential to provide a better identification and definition of crack characteristics and classifications. In addition, the development of appropriate treatment modalities is imperative, especially in the cases of vital teeth with little or no symptoms. Clinicians need to be cautious and set appropriate expectations when making treatment decisions for a cracked tooth. A standardized, evidence-based guideline for the treatment of cracks would be beneficial.

CONCLUSION
Within the limitation of the present investigation, age, ethnicity, tooth location, and type of restoration were associated with a higher incidence of cracked teeth, and the most common modality of treatment was extraction.

Disclosures

Conflict of interest: The authors deny any conflicts of interest.

Ethics Committee Approval: The study was approved by the University of Nevada, Las Vegas (UNLV) Biomedical Institutional Review Board and was given exempt status [IRB no. 1288126-1].

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