

Radiographic study of the problems and failures of endodontic treatment

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Abstract

Objectives: The aim of the present study was to determine radiographically the different reasons and problems of endodontic treatment failure.

Methods: The periapical radiographs of 100 patients with one hundred teeth (130 root canals) were examined to identify the problems and failures of endodontic treatment. The various reasons of failure that is under filling, poor filling, over filling and presence of procedural errors were recorded for each root filled canal. Chi square test was used to determine statistical significance between different parameters.

Results: Under fillings were found in 46.9% of the root canals. The percentage of poor fillings and over fillings were 28.5% and 13% respectively. Separated instruments and strip perforations were present in 4% and 3% of the teeth, while the presence of furcal perforation and coronal leakage was observed in one case each (1%). Endodontic problems and failures were most commonly observed in molars compare to anterior and premolar teeth. Mesiobuccal, mesiolingual and distobuccal root canals were the most frequently canals with endodontic problems and failures. The relationship between mesiobuccal, mesiolingual and distal canals in mandibular molars and mesiobuccal, distobuccal and palatal canals in maxillary molars in terms of endodontic failures were statistically significant by chi square analysis ($P \leq 0.05$).

Conclusion: The most common cause of endodontic treatment failure was under filling followed by poor filling and over filling and first molar was the most frequently involved tooth with endodontic problems and failures.

Keywords: Endodontic treatment failure, Endodontic errors, Periapical radiograph, Radiographic evaluation

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Introduction

The primary goal of endodontic treatment is to eliminate or reduce the microbes from root canal space by chemomechanical preparation and to prevent re-infection and promote periapical healing by hermetically sealing the root canal space. ⁽¹⁾This treatment has a high rate of success, when the highest standards are followed during the procedure. The literature reported 90-95% of success rate of root canal treatment. ^(2, 3)

Despite all these root canal treatment can fail for various reasons. Majority of the studies determine the endodontic treatment failure on the basis of radiographic findings and clinical signs / or symptoms of the treated teeth. ⁽⁴⁾The quality of root canal treatment is mainly based on radiographic evaluation. Radiographic evaluation provides contrast, density, taper and homogeneity of the quality of root canal filling. ^(5, 6)Periapical health and healing depend on the quality of root canal filling. The research has proved a direct relationship between low quality of root canal filling and periapical changes. These studies reported high prevalence of periapical lesions in endodontically treated teeth with inadequate root canal fillings. ^(7, 8)

Chemomechanical preparation and obturation confined to root canal space that is 0-2 mm from the radiographic apex is associated with less complication compare to obturation beyond the apex. ⁽⁹⁾Also obturation is considered adequate when there are no voids within and between the root canal fillings and root canal walls. Post treatment disease is also caused by extrusion of necrotic debris into the periapex. ⁽¹⁰⁾ According to European Association of Endodontists, a satisfactory root canal treatment shows a tapered canal from crown to apex and completely filled with no space between canal filling and canal wall. In addition, it should be 0-2 mm short of the radiographic apex to prevent post treatment failure. ⁽¹¹⁾Research has confirmed that endodontic root canal fillings more than 2 mm from the radiographic apex, extruded beyond the apex and non-homogenous with voids between the fillings increase the risk of endodontic treatment failure. ⁽¹²⁾

There are many other causes of root canal treatment failure which include, separated instruments, ledges, transportations, perforations, missed and blocked canals. All

these affect the final outcome of root canal treatment. These procedural errors are not directly responsible for endodontic failures. In fact these errors are hindrance to proper cleaning, shaping and obturation of root canal, which in turn prevent the control of endodontic infection. The presence of a separated instrument for example prevents full chemomechanical preparation to the working length of the root canal and thus causes periapical disease after endodontic treatment. ⁽¹³⁾ When these procedural errors occur during the treatment of infected teeth, the failure is more likely to occur. The primary cause of endodontic failure is the presence of pathogens in the poorly treated or untreated root canal system. ⁽¹⁴⁾

The quality of coronal restoration also has a good impact on the periapical health of the endodontically treated teeth. A poorly filled root canal with good coronal restoration may remain successful for long time; on the other hand a well obturated root canal with poor coronal restoration may fail in a short time. ⁽¹⁵⁾

In majority of cases the endodontic failure is due to the microbes persistent in the apical portion of root canal even in well treated teeth. Research has shown that, there are areas in the root canal that cannot be cleaned, shaped and obturated with the present instruments, materials and techniques, so the infection cannot be eliminated. ⁽¹⁶⁾The radiograph may show an adequate root canal filling; even though these inaccessible areas may contain necrotic tissue and bacteria. A radiograph of well treated tooth indeed does not mean the complete cleaning and obturation of the root canal filling. ⁽¹⁷⁾

Data regarding radiographic problems and failures in endodontic treated teeth as well as frequency of procedural errors in cases treated by general dental practitioners are scarce in Saudi Arabia. This data will help in assessing the success of endodontic treatment. The purpose of this study was to investigate radiographically the problems and failures in root filled teeth.

Materials and Methods

This descriptive cross sectional study was carried out at College of Dentistry, Aljouf University, Saudi Arabia. The study was approved by the college ethical committee. A total of 100 new patients during the period from

September 2013 to December 2014, reported to the Endodontic Department of the College with endodontic treatment failures were randomly studied. Informed consent was taken from the patients. After taking the medical and dental history, the teeth and soft tissues were clinically examined for tenderness, swelling, sinus and crown fracture. Patients with good oral hygiene, having permanent dentition and close apices of the teeth were included in the study. The exclusion criteria were patients having apicoectomy, cyst enucleation, vertical root fracture, periodontally compromised teeth and non restorable teeth. The third molar was also not included in the study. Two periapical radiographs were taken for each patient, one with straight angle and the other with mesial shift with long cone parallel technique using Kodak E-speed films. All the radiographs were systematically examined in a darkened room using an illuminated viewer box with magnifying glass. The following data were recorded regarding endodontic treatment failure cases for each patient on a proforma specially designed for the study:

Demographic information like age, gender, affected tooth, total number of canals in the affected tooth, name of the affected canals, total number of affected teeth, and total number of canals that have problems and the reason / reasons of endodontic treatment failures were recorded.

The root canal obturation more than 2mm from the radiographic apex was considered under filling while extending beyond the radiographic apex was considered over filling. Presence of voids, non homogenous root canal fillings were considered as poor filling and root canals without fillings as lack of fillings in the root canal.⁽¹⁶⁾ Furcation perforation was diagnosed when extrusion of filling material through the furcation area was detected in multi-rooted teeth. Strip perforation was diagnosed when extrusion of filling material was detected in the lateral wall of any root. Presence of a separated instrument was diagnosed when one was detected inside a root canal or its tip extending into the periapical area. All the endodontic treatment failure cases were then retreated by endodontic specialists.

Statistical Analysis

SPSS 17 for windows software (SPSS Inc. Chicago, IL, USA) was used for data processing and statistical analysis. The chi square test was used for statistical evaluation of the results. A P value ≤ 0.05 was considered statistically significant.

Results

A total of 100 patients with one hundred teeth (60 males and 40 females) with problems and failures in root canal treatment were recruited into the study. Their mean age ranged from 34 ± 12 years. According to tooth types, Maxillary anterior teeth were 10 (10%), maxillary premolars 8 (8%) and maxillary molars 27 (27%). Mandibular anterior teeth were 6 (6%), mandibular premolars 8 (8%) and mandibular molars 41 (41%). There was no statistically significant difference between the maxillary and mandibular teeth in terms of failure of root canal fillings ($P > 0.05$).

The total number of root canals with problems and failures were 130. Regarding canal location in maxillary molar teeth, more endodontic failures occurred in mesiobuccal and distobuccal root canals compared to palatal root canal. The results were statistically significant by chi square analysis between mesiobuccal and palatal, distobuccal and palatal canals ($P < 0.05$). Similarly in mandibular molars, more failures were recorded in mesiobuccal and mesiolingual canals than distal canals. The differences were statistically significant by chi square analysis between mesiobuccal and distal, mesiolingual and distal root canals ($P < 0.05$).

Under filling was the most common reason of failure followed by poor filling and over filling. The relationship between the filled root canals and their reasons of failures are shown in **Table 1**. Some of the reasons of failures in this table have overlaps. The results were not statistically significant by chi square analysis ($P > 0.05$).

Under fillings and poor fillings were associated with periapical radiolucencies. The relationship between under fillings, poor fillings and periapical radiolucency was statistically significant ($P < 0.05$).

The frequency of various reasons of endodontic problems and failures are shown in **Table 2**.

Table 1: Reasons of endodontic treatment failures according to teeth and root canal fillings. Data are shown in n (%)

Tooth group	Root canal fillings with failure	Reasons of failure							
		Separated instrument leakage	under fillings	Over fillings	Lack of fillings	Poor fillings	Strip perforation	Furcal perforation	Coronal perforation
Maxillary anterior (10)	10(7.7%)	0(0%)	3(30%)	1(10%)	0(0%)	6(60%)	0(0%)	0(0%)	0(0%)
Maxillary Premolars (8)	9(6.9%)	0(0%)	5(55.6%)	1(11.1%)	0(0%)	3(33.3%)	0(0%)	0(0%)	0(0%)
Maxillary Molars (27)	42(32.3%)	2(4.8%)	26(61.9%)	5(11.9%)	0(0%)	7(16.6%)	2(4.8%)	0(0%)	0(0%)
Mandibular anterior (6)	6(4.6%)	0(0%)	2(33.3%)	1(16.7%)	0(0%)	3(50%)	0(0%)	0(0%)	0(0%)
Mandibular premolars (8)	8(6.2%)	0(0%)	5(62.5%)	1(12.5%)	0(0%)	2(25%)	0(0%)	0(0%)	0(0%)
Mandibular molars(41)	55(42.3%)	2(3.6%)	20(36.4%)	8(14.5%)	6(10.9%)	16(29.1%)	1(1.8%)	1(1.8%)	1(1.8%)
Total (100)	130(100%)	4(3.1%)	61(46.9%)	17(13%)	6(4.6%)	37(28.5%)	3(2.3%)	1(0.8%)	1(0.8%)

Chi square (X^2) = 25.94 P= 0.867

Reason of failure	Frequency	Percent
Under filling	61	46.9
Poor filling	37	28.5
Over filling	17	13
Lack of fillings in the canal	6	4.6
Separated instrument	4	3.1
Strip perforation	3	2.3
Furcal perforation	1	0.8
Coronal leakage	1	0.8
Total	130	100

Table 2: Frequency (percent) of various reasons of endodontic treatment failures of root canal fillings

Discussion

Periapical radiographs of the patients were used to assess the problems and failures of root canal treatment. It is the most commonly used method to check the success and failures of endodontic treatment but it has some limitations. Radiographs show two dimensional images of a three dimensional structures and superimposition of adjacent anatomic structures; especially in area of maxillary molars makes it difficult to interpret the radiographs.⁽¹⁸⁾

According to guidelines by European Society of Endodontology, the assessment of root canal filling should be checked with a radiograph and this radiograph should show the root apex with at least 2-3 mm of the periapical region.⁽¹¹⁾

In the current study even if endodontic failure was due to one canal in multi-rooted teeth, the tooth was considered as failure. The present study recorded more failures in molar teeth compare to other teeth. The endodontic failures were mostly observed in maxillary and mandibular first molars. As these are the first teeth to erupt, so more prone to caries and pulpal pathology and are subjected more often to endodontic treatment. The results of this study were similar to the previous studies.^(19, 20) This is due to complex morphology and anatomy of root canals in these teeth. Curved, narrow and presence of additional root canals make these teeth difficult to treat.

The endodontic treatment in this study was performed by general dental practitioners. The studies reported low quality of root canal fillings carried out by general dental practitioners.⁽²¹⁾ This may be due to not

following the principles and standard techniques of endodontic treatment that were taught at dental schools.⁽²²⁾ A study in England reported that general dental practitioners need more post graduate courses and continue education to improve their clinical skills in endodontics. The success rate of teeth treated by endodontists was significantly higher than those treated by general dental practitioners. This study showed that high skilled dentists are less likely to perform procedural errors that may compromise prognosis.⁽²³⁾

In a 5 year follow up study Burke et al. reported that length of the root canal filling is the most important factor for the success of endodontically treated teeth.⁽²⁴⁾ The most common reason of endodontic failure was under filling in the present study. This was in agreement with Buarrieshi-Nusair et al.⁽²⁰⁾ and Peak et al.⁽²⁵⁾ they recorded more than 34% under fillings in their studies. It was contrary to the studies by Dadresanfar et al.⁽²⁶⁾ and Er et al.⁽²⁷⁾ they reported 18% under fillings in their studies.

Adequate density of root canal filling is an important factor for long term success of endodontic treatment. Poor fillings can lead to endodontic treatment failure due to microleakage along the root canal walls.⁽²⁸⁾ Poor root fillings occurred in 28.5% in the present study. The results were similar to the previous studies by Barrieshi-Nusair et al.⁽²⁰⁾ who reported 27.4% poor density fillings and Bahareh Dadresanfar et al. reported 29.3% in their study.⁽²⁶⁾ However, it varied with other studies.^(7, 27)

Periapical radiolucency was common with short fillings and poor fillings. The patients were treated at different places and the previous records or periapical radiographs were not available, so it was the limitation of the current study whether the periapical radiolucency was present before or after endodontic treatment and their role on the endodontic treatment failure. Yan Zhong et al.⁽²⁹⁾ reported a greater influence of periapical radiolucency on the prognosis of endodontic treatment. Teeth with periapical radiolucencies have bacteria present in the apical area compared to vital teeth. Peak et al.⁽²⁵⁾ however, found a better endodontic treatment outcome in teeth with pre-existing periapical lesions than without the lesions.

Over fillings were found in 13% in the present study. Peak et al. found 18% of over fillings in their study while other studies found lower percentages of over fillings.^(13, 20)

Procedural errors are an important factor for long term success of endodontically treated teeth. They lead to inadequate chemomechanical preparation and obturation of the root canals.⁽¹³⁾ In the present study separated instruments were recorded in 4%, strip perforation 3%, furcal perforation and coronal leakage in 1% of the root canals. The results concurred with the study by Dadresanfar et al.⁽²⁶⁾ where strip perforation was 4% and instrument separation was found in 3 root canals. However, the results were contrary to the findings of Eleftheriadis et al.⁽¹³⁾ who found strip perforation in one canal and Balto et al.⁽¹⁹⁾ reported 0.5% instrument separation.

Modern endodontic practice adjuncts such as electronic apex locators and rotary nickel-titanium instruments were not used during the treatment of these cases. It has been shown that electronic apex locators are more accurate than radiographs to identify the working length of the root canal. Furthermore Ni-Ti rotary instruments shape the root canal better than conventional stainless steel instruments with less iatrogenic errors.⁽³⁰⁾

Conclusion

Within the limitations of the present study, it was concluded that endodontic treatment failures most commonly occurred in underfilled root canals followed by poorly filled root canals. Posterior teeth had high failure rate than anterior teeth. The endodontic treatment performed by general dental practitioners was not up to the accepted clinical standards.

Conflict of interests: There is no conflict of interests regarding the publication of this paper.

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