

ORIGINAL ARTICLE

Pilot study on relation of the periapical status and quality of endodontic treatment in an adult Sudanese population

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Abstract The purpose of the present cross-sectional pilot study was to evaluate the influence of the quality of root canal fillings and coronal restorations on the periradicular status of these teeth. Seventy adult patients attended the Conservative dentistry clinic (Faculty of Dentistry, University of Khartoum), seeking routine dental care (not emergency care) were included. Patients were examined and the coronal restoration status was scored according to a modification of Ryge's criteria for marginal adaptation. The quality of the root filling was assessed radiographically for length and homogeneity. The periapical status was categorized on the basis of presence or absence of signs of apical periodontitis (AP). The relationship between coronal status, quality of root filling and periapical health was determined statistically using χ^2 test. Thirty-four teeth (48.57%) showed signs of AP. The combination of adequate coronal restoration and adequate root filling resulted in significantly reduced incidence of apical periodontitis of 12.5% compared to 76.47% presence of AP when both parameters scored as inadequate. There was statistically significant relation between the quality of the treatment and the periapical status ($p = 0.001$). The incidence of AP in root-filled teeth was high. The importance of a good coronal restoration and an adequate root filling should be stressed as they both influence the periapical health.

Introduction

The pulp and the periodontium are in intimate relationship from the beginning of the development. As development progresses there's a direct vascular communication between the pulp and the periodontium through the apical foramen and accessory canals (Simon and Frank, 2004). Apical periodontitis is a chronic inflammatory disorder of periradicular tissues caused by aetiological agents of endodontic origin (Nair, 2006). Recently, growing attention has been given to procedures carried out after completion of the endodontic treatment and their impact

on the prognosis of devitalized teeth. These procedures may allow the passage of microorganisms and their by-products to the apical region of the root and into the alveolar bone, a potential cause of delayed failures. The consequences of these "events" may be important in determining the long-term success of the endodontic treatment (Heling *et al.*, 2002). Several cross-sectional studies have demonstrated that the reality for the overall population might be somewhat different, with only 35%-60% of the root canal-treated teeth exhibiting no disease (Segura-Egea *et al.*, 2004; Weiger *et al.*, 1997; Kirkevang *et al.*, 2000; Siqueira *et al.*, 2005; De Moor *et al.*, 2000; Sunay *et al.*, 2007). The great majority of these studies revealed a strong correlation between the quality of

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endodontic treatment and periradicular status (Siqueira *et al.*, 2005, Tavares *et al.*, 2009). These studies pointed to an association between the quality of root canal treatment and periapical bone status, and concluded that an improvement in the quality of root canal treatment in general dental practice was required in order to promote periapical health (Segura-Egea *et al.*, 2004). Some of these studies suggested that the quality of the coronal restoration may be of greater importance for the periapical status than the quality of the endodontic treatment (Kabak and Abbott 2005, Tronstad *et al.*, 2000). However, other studies stated that the quality of the root filling is more influential on the periapical health (Siqueira *et al.*, 2005, Ray and Trope 1995, Kirkevang *et al.*, 2000, Hommez *et al.*, 2002, Ricucci *et al.*, 2000).

The purpose of the present cross-sectional pilot study was to evaluate the influence of the quality of root canal fillings and coronal restorations on the periradicular status of these teeth.

Patients and methods

The subjects for this cross-sectional study were 70 patients, 47 (67.1%) were females and 23 (32.9%) were males, seeking routine dental care (not emergency care) at department of conservation (Faculty of Dentistry, University of Khartoum, Khartoum, Sudan). Patients who had a root filled permanent tooth for more than 1 year were included with the exclusion of teeth which has been retreated, or in which the coronal filling has been replaced. Patients were examined by the researcher using a dental mirror and a dental probe. The coronal restoration status was scored according to a modification of Ryge's criteria for marginal adaptation (Ryge, 1980) (Table 1). A periapical radiograph was taken of each selected tooth with the paralleling technique using an Endo Ray II film holder (Dentsply, Rinn Corporation, USA) and Kodak Dental Intraoral E-Speed Film (Estman Kodak Company, Rochester, New York, USA). Exposure time was 0.06 seconds and the tube potential was 110 kV. The radiographs were evaluated using an X-ray viewer with 3x magnification (Solar 3 (2"x2"), Photax, United Kingdom). The coronal restoration, the root canal treatment and the periapical condition were scored according to the criteria listed in table 1 (multi-rooted teeth were classified according to the root exhibiting the most severe

periapical condition). The interpretation of radiographs was performed independently by two examiners. The examiner variability was determined by calculating Kappa (*k*) values for detecting a periodical radiolucency and for evaluating the density and periapical extension of the root canal filling. The Kappa values were higher than 0.86 indicating high inter-observer agreement for the selected variables.

Software of Statistical Package for Social Sciences (SPSS Inc, Chicago, IL) was used to analyze the data at a confidence level of 95% by using χ^2 test. Differences were considered significant when the probabilities were equal to or less than 0.5.

Results

Seventy adult patients were included in this study with 121 roots and 141 root canals. The most frequent teeth were found to be the upper left second premolar and the lower right first molar. The mean duration of the root canal treatment was 3.78 years with 1 year being the minimum and 22 years the maximum. On clinical examination the coronal restoration was lost in 25.7 % of the teeth. On the remaining 73.3% the type of the permanent restoration was amalgam in 59.61% of the cases, composite resin in 25%, crowns in 13.46% and 1.92% was restored with an inlay (Fig. 1).

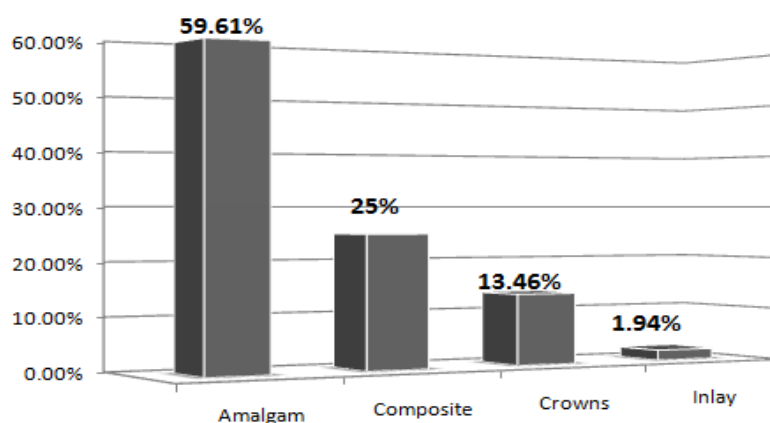
There was no significant correlation between the type of the restoration and the periapical status. In regard, to root canal filling (RCT) no filling material was present in eight roots (5.67%). The length of the root filling was acceptable in 39.1% of the canals terminating 0-2 mm from the radiographic apex, while it was short in 57.89% of the canals and in the remaining 3.01% it was extending beyond the apex (Fig. 2). Regarding the homogeneity of the root filling; almost half of them (49.62%) were homogenous with no voids.

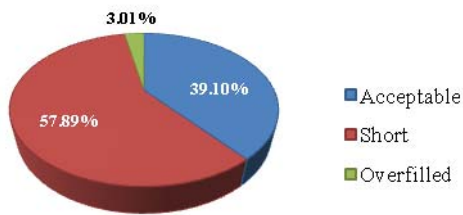
Periapical status of endodontically treated teeth

Thirty-four (48.57%) of the examined teeth showed signs of apical periodontitis (AP). Teeth with adequate coronal restorations and had AP were 33.33%; whereas in the inadequate coronal restoration the incidence of AP was high (65%). There was a statistically significant relation between the quality of the coronal restoration and the periapical status of the teeth (Table 2).

Table 1 Modification of Ryge's criteria for marginal adaptation (Ryge, 1980)

Parameter	Score
Clinical coronal status	1. Good margin (acceptable) 2. Catching of the explorer, no visible crevice (acceptable) 3. Crevice limited to the enamel (acceptable) 4. Crevice penetrating the dentine (unacceptable) 5. Fracture of restoration (unacceptable) 6. Detached restoration (unacceptable) 7. Lost restoration, marginal decay (unacceptable)
Radiographic coronal status	1. Intact restoration without signs of leakage (acceptable) 2. Restoration with open margin (unacceptable) 3. Restoration with recurrent decay (unacceptable)
Length of the root filling	1. Root filling terminating 0-2 mm from the radiographic apex (acceptable) 2. Root filling terminating >2 mm from the radiographic apex (unacceptable) 3. Root filling extending beyond the radiographic apex (unacceptable)
Homogeneity of the root filling	1. Homogeneous root filling, good condensation, no voids visible (acceptable) 2. Inhomogeneous root filling, poor condensation, voids visible (unacceptable)
Periapical status	1. Normal: good periapical condition 2. Widening of the periodontal ligament not exceeding two times the width of the lateral periodontal ligament 3. Periapical radiolucency in connection with the apical part of the root, exceeding at least two times the width of the lateral periodontal ligament

**Figure 1** Types of permanent restorations.

**Figure 2** Length of root canal filling**Table 2** Relationship between the quality of the coronal restoration and the periapical status (according to a modification of Ryge's criteria)

Clinical coronal status	Periapical disease		Total
	Present	Absent	
Acceptable	10	20	30
Not acceptable	26	14	40
Total	36	34	70

Statistics: $\chi^2 = 6.882$, $p = 0.009$ **Table 3** Relationship between the length of the root filling and the periapical status

Length of the root filling	Periapical disease		Total
	Present	Absent	
Acceptable	9	14	23
Not acceptable	27	20	47
Total	36	34	70

Statistics: $\chi^2 = 6.521$, $p = 0.01$ **Table 4** Relationship between the homogeneity of the root filling and the periapical status

Homogeneity of the root filling	Periapical disease		Total
	Present	Absent	
Acceptable	8	20	28
Not acceptable	26	16	42
Total	34	36	70

Statistics: $\chi^2 = 12.236$, $p = 0.001$ **Table 5** Periapical status of teeth related to the quality of the coronal restoration combined with the quality of the root filling

Coronal restoration	Endodontic treatment	AP		AP%
		Present	Absent	
A. Good	Good	1	7	12.5
B. Poor	Poor	13	4	76.47
C. Good	Poor	9	13	40.9
D. Poor	Good	2	3	40

Statistics: A vs. B: $\chi^2 = 39.581$, $p = 0.001$ C vs. D: $\chi^2 = 5.418$, $p = 0.020$

The presence of a base under the restoration or a post in the canal had no influence in the periapical condition. Apical periodontitis was found in 33.13% of the teeth with adequate length of root filling, while if the filling was short or long the disease was present in 57.44% of teeth (Table 3).

Root-filled teeth with a homogenous filling had AP in 26.92% of the cases, whereas if voids were detected, disease was present in 72.72% of teeth. There was a statistically significant relation between the homogeneity of the root filling and the periapical status of the tooth (Table 4).

The combination of adequate coronal restoration and adequate root filling resulted in significantly reduced incidence of AP of 12.5% compared to 76.47% presence of AP when both parameters scored as inadequate. When adequate coronal restoration and poor root filling was combined together AP was present in 40.9% of the teeth, while the combination of poor coronal restoration and good root filling associated with 40% presence of the disease. There's statistically significant relation between the quality of the treatment and the periapical status (Table 5).

Discussion

Apical periodontitis (AP) associated with the quality of the root canal treatment has been given an immense attention in many countries all over the world. In Sudan this is the first study conducted to investigate this problem. Although it was a cross-sectional study and the sample size was relatively small compared to other studies it was important to carry out a preliminary study to point out the extent of the problem. Cross-sectional studies are observational in nature and provide a "snapshot" of a group of participants at one point in time. The misinterpretations and misdiagnoses in cross-sectional studies are known to be fairly equally distributed, so that the results still remain meaningful (Altman, 1991). It has also been assumed that cross-sectional studies are less prone to be biased by the opinion of the investigators when compared with longitudinal studies (Torabnejad *et al.*, 1988).

The current study used the same method as that of Hommez *et al.* (2002), it included radiographic and clinical examination unlike other studies which employed only radiographic evaluation (Segura-Egea *et al.*, 2004; Kirkevang *et al.*, 2006; Siqueira *et al.*, 2005; Kabak and Abbott, 2005; Tavares *et al.*, 2009; Tronstad *et al.*, 2000; Ray and Trope, 1995; Peciulienė *et al.*, 2006; Georgopoulou *et al.*, 2005; Lupi-Pegurier *et al.*, 2002). A number of researchers have used panoramic radiographs for periapical evaluation (Kabak and Abbott 2005; Lupi-Pegurier *et al.*, 2002; Chen *et al.*, 2007), but in this study periapical radiographs were chosen instead of panoramic radiographs which are considered to have lower sensitivity in detecting periapical especially in the anterior region.

In the present study, about 48.57% of the examined root-filled teeth exhibited apical periodontitis lesions. This results comes in agreement within the range reported by several epidemiologic studies from different countries: France (33%) (Tavares *et al.*, 2009), USA (39%) (Ray and Trope, 1995), Lithuania (39%) (Sidaravicius *et al.*, 1999), Japan (40%) (Tsuneishi *et al.*, 2005), Belgium (40%) (De Moor *et al.*, 2000), Turkey (40.5%) (Sunay *et al.*, 2007), Belarus (45%) (Kabak and Abbott, 2005), Canada (44% and 51%) (Dugas *et al.*, 2003), Brazil (51%) (Siqueira *et al.*, 2005), Denmark (52%) (Kirkevang *et al.*, 2000),

Scotland (51%) (Saunders and Saunders, 1998), Germany (61%) (Weiger *et al.*, 1997) and Spain (64.5%) (Segura-Egea *et al.*, 2004).

The quality of the endodontic treatment seemed to exert a greater impact on the outcome than the quality of the coronal restoration. In the present study, there was a statistically significant relation between the homogeneity of the root filling and the periapical status of the tooth. The combination of adequate coronal restoration and adequate root filling resulted in significantly reduced incidence of AP (12.5%) compared to presence of AP (76.47%) when both parameters scored as inadequate. This shows that the quality of the endodontic treatment is the most important determinant of the status of the periradicular tissues. Several cross-sectional studies have been widely used to evaluate the influence of the quality of coronal restoration on the treatment outcome, and conflicting results have been reported. Ray and Trope (1995), suggested that the quality of the restoration had a greater impact on periradicular health than the quality of the root canal filling. Results of the present study agreed with the former group and showed that the quality of the coronal restoration influenced the periapical status, since 65% of the teeth with inadequate coronal restorations had a diseased apical periodontium. The findings of the present investigation come into agreement with other studies which emphasize that a worldwide improvement in the quality of root canal treatment in general dental practice is required to promote periradicular health.

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