

## Cross-sectional assessment of the periapical status as related to quality of root canal fillings and coronal restorations in a Yemeni population.

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**Abstract:** Aim: The present study aimed to examine the influence of the quality of root canal fillings and coronal restorations on the prevalence of periapical lesions. Materials and Methods: Two hundred digital panoramic radiographs were obtained from the archive of Al-HamziDental Center in Sana'a, Yemen. The final sample consisted of 120 radiographs, and 675 root filled teeth. The quality of root canal fillings was scored according to criteria of length, homogeneity and taper. Coronal status (type of restoration, signs of marginal leakage or decay) was also evaluated. The periapical status was categorized on the basis of presence or absence of radiographical signs of apical periodontitis. Chi-square test was used to determine statistical significance between different parameters. Results: We found that 93.6% of root filled teeth were associated with apical periodontitis. Only 9.2% of root filled teeth were found to have an acceptable standard of root canal fillings, of which 32.3% was also associated to signs of periapical disease. In roots with an unacceptable root canal filling, 95.4% had periapical disease. Teeth with good (14.4%) and poor (32.9%) intra-coronal restorations had apical periodontitis in 93.8% and 97.7% of cases, respectively. Crown restorations were present in 52.7% of root filled teeth, of which 91.0% were associated with periapical lesions. Conclusion: The poor technical quality of root canal fillings and coronal restorations is consistent with a high prevalence of apical periodontitis.

**Keywords:** radiographic evaluation, technical quality, coronal restoration, root canal filling, apical periodontitis, Yemen.

### INTRODUCTION.

Increasing success rate in endodontic therapy has been reported,<sup>1</sup> which may have significantly contributed to the improvement of oral health in recent years. The establishment of treatment objectives, the systematization of procedures and the refinement of techniques allow the modern dental practitioner to achieve a high success rate.<sup>2,3</sup> However, these high success rates were obtained by well-trained dental practitioners under strict operating conditions that may not reflect the situation within the average dental clinic.<sup>4</sup> Therefore, in order to evaluate the endodontic status of populations rather than that of controlled patient groups, several studies have focused on the prevalence and quality of root canal treatment.<sup>5-8</sup>

The outcome of root canal treatment is positively correlated with the technical quality of root canal fillings and coronal restorations.<sup>9,10</sup> Therefore, it has been suggested that the primary contributing factor to the presence or development of periapical lesions is not only root canal filling but also the coronal restoration's sealability.<sup>9-15</sup>

Several studies found that the quality of coronal restorations scored

on radiographs only had a significantly greater impact on periapical health than the quality of root canal fillings.<sup>17</sup> Ray *et al.*,<sup>16</sup> suggested that a favorable endodontic treatment outcome may be achieved even in poorly filled root canals when the quality of the coronal restoration is adequate. Therefore, many authors have encouraged clinicians to reconsider their clinical decision making, in which it is more preferable to place a high-quality permanent restoration immediately after root canal treatment rather than to place a provisional restoration that has a greater chance of leaking.<sup>10,16</sup>

The assessment of the periapical status in different populations is important because it may assist to define the treatment needs of that population and evaluate the effects of various endodontic procedures on treatment outcome. Therefore, various methods and criteria have documented the prevalence of apical periodontitis in various countries.<sup>9-20</sup>

The Yemeni population does not have access to primary dental healthcare and is not being targeted by any dental educational/preventive programs. This is because Yemeni health authorities have been handling major health problems such as tuberculosis and malnutrition, which result in high mortality rates.<sup>21</sup> Therefore, it is important to conduct an evaluation of the prevalence and the technical quality of root canal treatment. In addition, no study in Yemen has yet evaluated the periapical status of endodontically treated teeth in relation to the quality of root canal fillings and coronal restorations. Thus, this study aimed to determine the prevalence of periapical lesions in root canal treated teeth in a Yemeni population and to examine the influence of the quality of root canal fillings and coronal restorations on the prevalence of periapical lesions using radiographic criteria.

## **MATERIALS AND METHODS.**

### **Patient Selection**

The scientific committee of the Dental Faculty at Thamar University approved this study, and patient anonymity was strictly respected. The sample consisted of patients seeking treatment at Al-Hamzi Dental Center. This dental center is located in Sana'a city, Yemen. The majority of this city residents are immigrants from all parts of the country. This dental center attracts a huge number of

dental patients from numerous parts of the city and its surroundings.

The inclusion criteria of this study were patients who attended for the first time and had not previously consulted the dental service for orthodontic reasons. Digital panoramic radiographs of patients who first received treatment at this center, taken between June 2015 and May 2016, were selected from the center's archive. The database of digital panoramic radiographs from 200 patients was evaluated. Radiographic images revealing deformities as well as those who had surgical procedures like cyst enucleation or apicectomy were excluded from the study. The final sample size in this study was reduced to a total of 120 panoramic radiographic images after examination of the 200 images according to the inclusion/exclusion criteria.

### **Radiographic Examination and Observers Agreement**

All radiographs were taken by the same operator using a panoramic digital radiography device (Tomography X-ray System Model Pax-Flex 3D). Two observers evaluated the radiographs. Before evaluation, the observers participated in a calibration training, which consisted of 50 randomly selected panoramic radiographs. The inter-observer agreement was determined by calculation of kappa value (kappa=0.81). In case of disagreement, the radiograph was evaluated and discussed by the three observers together until a final agreement was reached.

### **Radiographic Evaluation**

Table 1 shows the radiographic evaluation parameters and scores used in the present study. For each tooth, root canal fillings (length, density and taper) and their association with the periapical status were assessed. In the case of multirouted teeth, the worst-scored root was considered. The intra-coronal or extra-coronal restorations and their relationship with the periapical health were evaluated. The tooth position (maxilla or mandible), tooth location (anterior or posterior) and tooth type and their relationship with the periapical status were also considered.

### **Statistical Analysis**

The analysis of the data was performed using SPSS 21.0 for Windows (SPSS Inc., Chicago, IL, USA). The chi-squared test was used to determine statistical significance between different parameters. The significance level was set at  $p < 0.05$ .

**Table 1.** Parameters recorded on endodontically treated teeth.

Definition	Criteria	Parameters
<b>Quality of root canal treatment</b>		
Length	Acceptable	Root canal filling 0-2mm short from the radiographic apex.
	Unacceptable	Root canal filling beyond the radiographic apex or root canal filling >2mm from the radiographic apex.
Homogeneity	Acceptable	Homogeneous root canal filling, good condensation, no visible voids.
	Unacceptable	Non-homogeneous root canal filling, poor condensation or voids present.
Taper	Acceptable	Consistent and uniform taper from the coronal to apical area with a reflection of the original shape of the canal.
	Unacceptable	Inconsistent taper.
<b>Coronal status</b>		
Intra-coronal restoration	Acceptable	Any permanent restoration that appeared intact radiographically.
	Unacceptable	Any permanent restoration with detectable radiographic signs of overhangs, open margins, or recurrent caries, or presence of temporary coronal restorations.
Extra-coronal restoration		Crown.
<b>Periapical status<sup>7</sup></b>		
	Healthy periapical Status	If the periodontal ligament was intact with no signs of periapical disease.
	Apical periodontitis	If the widening of the apical part of the periodontal ligament was not exceeding two times the width of the lateral periodontal ligament space, teeth were categorized as having widening of the periodontal ligament.
	Apical periodontitis	If the periapical radiolucency in connection with the apical part of the tooth exceeding at least two times the width of the lateral part of the periodontal ligament, such teeth were categorized as having obvious periapical radiolucency.

**Table 2.** Periapical status and related criteria.

Variables		Total	Healthy periapical Status		Apical periodontitis		p-values		
			n	%	n	%			
Dental arch	Maxilla	396 (58.7%)	30	7.6%	366	92.4%	0.084		
	Mandible	279 (41.3%)	13	4.7%	266	95.3%			
Tooth region	Anterior	185 (27.4%)	22	11.9%	163	88.1%	0.001		
	Posterior	490 (72.6%)	21	4.3%	469	95.7%			
Tooth type	Upper anterior	157 (23.3%)	20	12.7%	137	87.3%	0.003		
	Lower anterior	28 (4.1%)	2	7.1%	26	92.9%			
	Upper premolar	145 (21.5%)	6	4.1%	139	95.9%			
	Lower premolar	103 (15.3%)	8	7.8%	95	92.2%			
	Upper molar	95 (14.1%)	4	4.2%	91	95.8%			
	Lower molar	147 (21.8%)	3	2.0%	144	98.0%			
	Filling length	Unacceptable	501 (74.2%)	17	2.5%	484		96.6%	<0.001
	Acceptable	174 (25.8%)	26	14.9%	148	85.1%			
Filling density	Unacceptable	508 (75.3%)	17	3.3%	491	96.7%	<0.001		
	Acceptable	167 (24.7%)	26	15.6%	141	84.4%			
Taper	Unacceptable	563 (83.4%)	21	3.7%	542	96.3%	<0.001		
	Acceptable	112 (16.6%)	22	19.6%	90	80.4%			
Type and quality of coronal structure	Unacceptable filling	222 (32.9%)	5	2.3%	217	97.7%	0.005		
	Acceptable filling	97 (14.4%)	6	6.2%	91	93.8%			
	Crowned	356 (52.7%)	32	9.0%	324	91.0%			

## RESULTS.

In this study, 675 root filled teeth obtained from 120 panoramic radiographs were evaluated. Three hundred ninety-six were maxillary teeth (58.7%) and 279 were mandibular teeth (41.3%). Of the 675 root filled teeth, premolars were the most frequently treated teeth (n=248), followed by molars (n=242), and anterior teeth (n=185). Table 2 shows the periapical status and related parameters evaluated in this study.

## DISCUSSION.

The present study is the first to assess the periapical status of root filled teeth in Yemen. Digital panoramic radiographs were used to assess the prevalence of periapical lesions as related to quality of root canal fillings and coronal restorations.

The radiographic measures of length, density and taper of root canal filling can be used as indicators to evaluate root canal treatment to prevent recontamination and it may substitute clinical measures that assess the quality of root canal treatment. Unfortunately, the criteria for judging the quality of root canal treatment have not been well defined. Acceptable root canal treatment was defined with adequate length, density and taper of root canal filling. These subjective assessments have not been standardized or calibrated; however, the results of these subjective assessments showed that an “acceptable root canal treatment” had significantly lower apical periodontitis than those judged “unacceptable”.<sup>22</sup>

Furthermore, it has been contended that periapical diagnosis from panoramic radiographs may result in underestimation of the real prevalence of apical periodontitis as there are certain limitations of the radiographic assessment as a study method.<sup>7,19</sup> One of these limitations involves the evaluation of the quality of root canal filling and coronal restoration based on a two dimensional image of three-dimensional structures. Radiographic images have been used to indicate the presence of periapical infection or coronal leakage, representing an important diagnostic resource. Previous studies have also employed periapical radiographs with the same purpose as in this study.<sup>23</sup> However, some have indicated a good agreement/concordance between panoramic and intraoral radiographs, including in some cases an overestimation of apical health compromise by

panoramic radiographs.<sup>24</sup> It is, therefore, probable that the validity of recording apical periodontitis based on panoramic radiographs is satisfactory.

The current study is a cross-sectional design study. One of the disadvantages of this cross-sectional study is that radiographs were examined at a given point in time, and no information was available once endodontic treatment was concluded. It is therefore, not possible to determine whether a periapical lesion is healing or persists, although some studies have previously reported on the reliability of cross-sectional studies for scoring the long-term success of endodontic treatment.<sup>25</sup>

The prevalence of apical periodontitis in the present study was 93.6%, which is higher than reported in studies elsewhere.<sup>8,9</sup> The discrepancies observed between the results of different studies might be explained by the following aspects:

- (i) Differences between the populations being compared,
- (ii) lack of standardization of the methods used in radiographic assessment,
- (iii) and in reference teeth,
- (iv) variability on the training of professionals conducting the assessment of endodontic treatments, and
- (v) differences in endodontic protocols.

The high percentage of apical periodontitis in the present study was due to the high frequency of inadequate root canal treatment. This is supported by previous studies which stated that the quality of the endodontic treatment strongly influences the status of periradicular tissues.<sup>9,26</sup>

The present findings are in agreement with Kamberi *et al.*,<sup>26</sup> who reported that there were no significant differences between the average rate of apical periodontitis in maxillary (92.4%) and mandibular (95.3%) root filled teeth. On the basis of tooth location, the root filled teeth in anterior region had a lower prevalence of apical periodontitis (88.1%) than those in posterior region (95.7%). Sarıylmaz *et al.*,<sup>19</sup> found that root canal filling quality has a statistically significant effect on root canal treatment outcome. In the present study, quality of root canal fillings was higher in anterior teeth than posterior teeth. This may be explained by the more complex anatomy of posterior teeth (multi-rooted) and more posterior location that may reduce the quality of root canal cleaning and shaping and influence the adequacy of root canal filling. The quality of

root canal filling seems to be the most relevant parameter affecting periapical status in the studied population sample. Obviously, this explains why in this study the prevalence of apical periodontitis associated with root filled teeth in posterior region was higher than those in anterior region.

In this selected population, 85.1% of root filled teeth with adequate length were associated with apical periodontitis, which is higher than that reported in European populations (10-46%).<sup>27</sup> In the present study, non-homogenous root canal fillings were associated with 96.7% apical periodontitis, whereas those homogenous root canal fillings had apical periodontitis in 84.4%. These findings are in concordance with Segura-Egea *et al.*,<sup>28</sup> who revealed that non-homogenous and inadequately compacted root canal fillings had a higher prevalence of apical periodontitis and less survival rate. Another evaluation criterion of root canal fillings is the degree of smoothness and taper continuity. Because taper of root canals is a more subjective criterion, in the literature only a few reports have been published on this matter.<sup>29</sup> In the present study, the minority of root filled teeth (16.6%) had adequate “smooth and continuous” taper with apical periodontitis in 80.4% of them.

A root canal filling was considered adequate only when the length, homogeneity and taper were acceptable. In this study, an acceptable standard of treatment was found in 62 roots (9.2%) with 32.3% of them associated with signs of periapical disease. These findings agreed with Gündüz *et al.*,<sup>8</sup> who found that root canal filling was rated as adequate in 425 teeth (41.9%). In the present study, the same group had a 59.8% success rate.

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The quality of coronal seal is another important factor that influences periapical health.<sup>30</sup> The present study showed 97.7% of teeth with inadequate intra-coronal fillings had apical periodontitis, but only 93.8% of teeth with adequate intra-coronal restorations displayed this condition. The prevalence of periapical lesions was 91.0% when crown restorations were present, this could be explained as a result of inadequate marginal adaptation of crowns or recurrent decay under crown restorations. Furthermore, various iatrogenic factors during the prosthetic procedures, such as excessive preparation and mechanical, thermal, chemical and occlusal trauma can be possible explanations of this outcome.

Within the limitations of this study, the poor technical quality of root canal fillings and coronal restorations is consistent with a high prevalence of apical periodontitis. The probable reasons for treatment failure are multifactorial. Therefore, it is critical that greater attention is given to those factors responsible for the poor quality of root canal treatment. Based on the data reported in this study, there appears to be a need to improve the undergraduate dental curriculum in order to improve the clinical skills of dental practitioners in endodontics and restorative dentistry. Also implementing continuing education programs among practicing dentists can improve the outcomes of treatment provided in public and private dental clinics.

## CONCLUSION.

The prevalence of apical periodontitis was found to be higher in teeth with inadequate root canal fillings and coronal restoration defects or carious lesions.

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