

Periapical Status and Quality of Root Fillings and Coronal Restorations: An Original Research

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Abstract

Introduction: The quality of the coronal restoration may be of greater importance for the periapical status than the quality of the endodontic treatment. Hence we aim to investigate the quality of endodontic and coronal restorations and the association with periapical status.

Methodology: We selected 614 randomly. The quality of endodontic and coronal restorations and the periapical status of endodontically treated teeth were assessed by radiographic criteria. Root fillings were categorized as 'adequate' or 'inadequate' with regard to root filling length and lateral seal. Coronal restorations were categorized into 'adequate' and 'inadequate', defined by the absence or presence of radiographic signs of overhangs or open margins. Results were analysed statistically using the chi-squared test.

Results: The total number of endodontically treated teeth was 773, and 52.3% had apical periodontitis (AP). Root-filled teeth with an adequate lateral seal had a lower incidence of AP than teeth with an inadequate seal (44.3% vs. 57.8%), and teeth with an adequate root filling length were associated with a better periapical status than teeth with inadequate length of the root filling (42.0% vs. 67.6%). Similarly, adequate coronal restorations were associated with better periapical status than inadequate restorations (48.0% vs. 63.9%). When both root filling and coronal restoration quality were assessed, the incidence of AP ranged from 31.2% (optimal quality) to 78.3% (all parameters scored as inadequate).

Conclusion: Inadequate root canal and coronal restorations were associated with an increased incidence of AP.

Keywords: Apical Periodontitis, Coronal Restoration, Periapical Status, Root Filling.

Introduction

Current information on the quality and prognosis of root canal treatment has mainly been based on clinical studies. Epidemiological population studies of endodontic treatment performed by general practitioners show a different picture. They reveal a high frequency of inadequate root fillings and a high rate of apical periodontitis associated with the endodontically treated teeth.¹⁻⁵ These epidemiological studies point to an association between

the quality of endodontic treatment and the periapical bone status, and they have concluded that there is room for improvement of the endodontic treatment in general dental practice in order to promote periapical health. In addition, focus has recently been set on the quality of the coronal restoration. It has been suggested that the quality of the coronal restoration may be of greater importance for the periapical status than the quality of the endodontic treatment.⁵⁻⁷ The aim of the present study was to relate the quality of endodontic and coronal restorations to the periapical status of the endodontically treated teeth in an adult population based on radiographic examination.

Materials and methods

We selected randomly 614 subjects who had previous treatments. All participants underwent a full-mouth radiographic survey, consisting of 14 periapical and two bite-wing radiographs. The chi-squared test was used for evaluation of differences amongst subgroups of teeth. Fig1

FIGURE 1: PARAMETERS RECORDED ON ENDODONTICALLY TREATED TEETH

Parameters	Registrations and codes
Coronal restorations (filling and crown)	1 = Adequate (radiographically sealed) 2 = Inadequate (radiographic signs of overhangs or with open margins)
Lateral seal of root filling	1 = Adequate in the coronal 1/2 of the root filling + adequate in the apical 1/2 of the root filling 2 = Adequate in the coronal 1/2 of the root filling + inadequate in the apical 1/2 of the root filling 3 = Inadequate in the coronal 1/2 of the root filling + adequate in the apical 1/2 of the root filling 4 = Inadequate in the coronal 1/2 of the root filling + inadequate in the apical 1/2 of the root filling
Length of root filling	1 = Root filling ending ≤ 3 mm from radiographic apex 2 = Root filling ending > 3 mm from radiographic apex 3 = Pulpotomy, material seen only in the pulp chamber 4 = Flush, root filling ending at the radiographic apex 5 = Over-filling, root filling material seen in the periapical area
Periapical index (PAI) (Ørstavik <i>et al.</i> 1986)	1 = Normal periapical structures 2 = Small changes in bone structure 3 = Changes in bone structure with some mineral loss 4 = Periodontitis with well-defined radiolucent area 5 = Severe periodontitis with exacerbating features

Results

The total number of endodontically treated teeth was 773. Approximately half of the teeth had apical periodontitis. Pulpotomies were found in five teeth (0.6%). Table 1 shows the relationship between the lateral seal and periapical status. Apical periodontitis was found in less than half of the adequately root canal-sealed teeth, whereas if voids were detected, disease was present in more than half of the teeth ($P < 0.001$). Coronal restoration, lateral seal, and length were found to be adequate in 154 teeth and less than one-third of these teeth had apical periodontitis. When tested against any other combination of the quality parameters, this was significantly better than any other combination ($P < 0.001$, Table 1). In 69 teeth both the coronal and the endodontic restoration were inadequate, and when they were tested

against any other combination of the quality parameters, these teeth had significantly more apical periodontitis (78.3%, $P < 0.001$).

TABLE 1 QUALITY OF COMBINED TREATMENTS AND THE RELATION TO THE PERIAPICAL STATUS, PERCENTAGE FOR SOUND/DISEASED

Treatment	Total no. of teeth	Sound (%)	Diseased (%)
Adequate lateral seal + length	205	64.9	35.1
Any other quality combination	568	41.5	58.5
Total	773	47.7	52.3
Inadequate lateral seal + length	198	28.8	71.2
Any other quality combination	575	54.3	45.7
Total	773	47.7	52.3
Adequate lateral seal + length + crown	154	68.8	31.2
Any other quality combination	619	42.5	57.5
Total	773	47.7	52.3
Inadequate lateral seal + length + crown	69	21.7	78.3
Any other quality combination	704	50.3	49.7
Total	773	47.7	52.3

Discussion

In the present study the quality of the lateral seal, the length of the endodontic filling, and the quality of the coronal restoration of endodontically treated teeth were evaluated in relation to the periapical status. A number of epidemiological studies on apical periodontitis have been performed with the PAI scoring system, facilitating comparisons of results.⁷⁻¹² In the present study 52.3% of the endodontically treated teeth had apical periodontitis at the chosen disease threshold. Eckerbom & Magnusson³ demonstrated that the reliability of only one orthoradial intraoral radiograph was poor when evaluating the lateral seal of endodontic treatments. In the present study most of the teeth could be evaluated in more than one projection, thereby increasing the reliability of the quality score of the lateral seal. About 60% of the endodontic treatments had an inadequate lateral seal, and of these, 58% had apical periodontitis. The length of the root filling has been measured in different ways, and few studies have used the same criteria. Some have categorized endodontically treated teeth filled flush with the apex as adequate and some as inadequate. The apical limit of obturation of the root canal has been a topic for discussion amongst endodontists for decades, and numerous studies have been carried out to assess its importance. It has been looked upon from epidemiological, anatomical and micro- biological points of view. Most studies indicate that the apical limit of the root filling should be placed at the apical constriction of the root canal, and that extrusion of root filling material into the periapical tissue should be avoided. Several authors have suggested 'practical limits' of instrumentation and obturation, ranging from 0.5 to 2 mm from the radiographic apex. The position of the apical foramen/foramina has also been investigated and found to be from 0.2 to 3.8 mm from the radiographic apex. It is quite obvious that the differences in measurements and success criteria have consequences when results have been compared.¹³⁻¹⁵ The results from the present study indicate that the length of the root filling is associated with the periapical status. If the length was 0– 3 mm short of apex, 58% of the teeth showed no periapical lesion, whereas for other end-points (shorter or longer) combined, only 32% were judged free of apical periodontitis. In studies of European populations, it has been found that from about 10 to 46% of the teeth with adequate length of the root filling

have apical periodontitis. If the endodontic treatment was too short, 43 to 65% of the teeth had apical periodontitis, and if the endodontic treatment was too long, about 57 to 75% of the teeth showed periapical lesions. In the present study it was shown that despite technically adequate endodontic fillings, 35.1% of the teeth still had apical periodontitis. This indicates that the quality of the root filling is not the only parameter to influence the periapical status. The antiseptic and aseptic efforts during treatment may play an important role for the outcome. The role of bacteria in the pathogenesis of apical periodontitis has been well established, and the microbial activity in relation to the root filling procedures may be of primary concern. In recent years emphasis has been placed also on the quality of the coronal restoration and its relation to the periapical status in root filled teeth. It has been suggested that the coronal restoration as well as the root filling serve as a barrier against fluid and bacterial penetration into the periapical area. In a study of 1010 endodontically treated teeth, Ray & Trope⁵ found that the technical quality of the coronal restoration was even more important for the periapical status than the quality of the endodontic treatment. The results of the present study also showed that the quality of the coronal restoration influenced the periapical status, since as much as 63.9% of the teeth with inadequate coronal restorations had a diseased apical periodontium. When the quality of the coronal restoration and the quality of the endodontic treatment were combined, an even more pronounced pattern was seen. When both were of high quality, almost 70% of the teeth had sound periapical bone, but if both were inadequate, almost 80% of the teeth had apical periodontitis. This strongly indicates that both factors play important roles in obtaining an efficient seal of the root canal. The results of the present study point out that the rate of technically inadequate endodontic treatment and the high frequency of endodontically treated teeth with apical periodontitis in the population is high. Treatment may become more difficult to perform due to age changes of and treatment traumas to the pulp, and because the elderly form a continuously increasing group in the society and tend to keep their natural teeth longer, the problems with obtaining adequate quality of endodontic treatment is presumably becoming more pronounced.^{16,17} To improve the periapical status it is important that each phase of the endodontic treatment is performed according to accepted clinical standards: aseptic working conditions, adequate disinfection, precise canal length measurement, adequate canal preparation, irrigation, complete root canal obturation and a seal- tight coronal restoration.¹⁸⁻²⁰

Conclusion

Results from the present study indicate that the periapical status of endodontically treated teeth depends on both the quality of the endodontic treatment and of the coronal restoration, and efforts should be made to optimize the treatment of teeth with pulpal or periapical infection.

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