Periapical Status of Endodontically Treated Teeth in Relation to the Quality of the Coronal Restoration

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Summary

The purpose of this study was to evaluate the relationship of the quality of the postendodontic restoration and root canal obturation on the radiographic periapical status of endodontically treated teeth. Panoramic radiographs of randomly selected patients from the Department of Endodontics and Restorative Dentistry and the Department of Periodontology, School of Dental Medicine in Zagreb, were examined. Six hundred and ninety-six endodontically treated teeth from 265 panoramic radiographs were evaluated independently by two examiners. According to a predetermined radiographic set of criteria, the technical quality of the root filling of each tooth was scored as either good or poor, and the quality of the postendodontic restoration similarly good or poor. The apical one-third of the root and surrounding structures were then evaluated radiographically and the periapical status categorized as absence (API) or presence (PPI) of periradicular inflammation. The rate of API for all endodontically treated teeth was 45%. Good endodontic filling (GE) resulted in significantly more API cases than good postendodontic restoration (GR), 89% versus 68%. Poor endodontic filling (PE) resulted in slightly more PPI cases than poor postendodontically restoration (PR), 81% versus 79%. The combination of GE and GR had the highest API rate of 94%, significantly higher than PE and PR, with API rate of 14%. Differences among groups regarding the technical quality of the root filling, and the quality of the postendodontic restoration were statistically significant ($p< 0.05$).

Key words: *periapical status, postendodontic restoration, root canal obturation, periradicular inflammation, endodontically treated teeth, panoramic radiograph.*

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Introduction

Good prognosis for endodontically treated teeth depends on correct performance of all phases of endodontic treatment (1, 2). The success rate of treatment is positively correlated with the criteria of good technical quality of the root canal filling (3-6). Early studies suggested that one of the major reasons for failures in endodontic treatment is microleakage of endodontic space (4, 7, 8). The leakage, both apically and coronally, of obturated root canals has been evaluated using dyes (9), radioisotopes (10, 11), bacterial toxins (12), microorganisms (13), fluid transport technique (14-16). Studies (8, 13, 17) indicate that coronal leakage will be consistent and extensive if the access cavity is left unfilled and thus exposed to oral fluids.

Endodontic space of an unrestored endodontically treated tooth represents a good environment for microorganism colonisation and growth. Bacterial (13,14) and fungal (14) penetration through obturated root canals has been proved, so more emphasis should be placed on early possible completion of the coronal restoration, as a means of securing good results of the endodontic treatment.

The purpose of the post-and-core system is to create the unit from several different materials which has to seal and be able to resist oral fluids (15) and cyclic mastication forces (18, 19). Materials and technical procedures are of great importance in order to use the maximum adhesion properties of materials to tooth structures. There are many different post-and-core systems available on the market, as well as various materials for individual laboratory made posts. Studies (20-24) were performed to evaluate the quality of postendodontic systems regarding retention and resistance characteristics, as well as microleakage of root canal systems.

Recent studies (15, 16, 25-27) proved microleakage of endodontically treated teeth restored with different post-and-core systems cemented with different luting cements. Today, it is well known that the coronal seal achieved by coronal restoration is as important as the apical seal (16, 28). Quality of the coronal restoration can be evaluated clinically and radiographically (4). Radiographical examination is performed to evaluate root canal fillings and for diagnosis of periradicular lesions (5, 29, 30).

Aim

The purpose of this study was to evaluate the relationship of the quality of the postendodontic restoration and the root canal obturation on the radiographic periapical status of endodontically treated teeth.

Materials and methods

Six hundred and ninety-six endodontically treated restored teeth out of two hundred and sixty-five panoramic images were examined. Patients who were not endodontically as well as postendodontically treated for at least one year (4), were randomly selected among patients form the Department of Endodontics and Restorative Dentistry and the Department of Periodontology at the School of Dental Medicine in Zagreb. Images were evaluated independently by two examiners using a Viewscope (Euronda negatoskop, Compact 15, screen 145x340, Italy) and a magnifier. In the case of a different diagnosis for the evaluated teeth, examiners compared their findings, coordinating the results.

Teeth were categorized according to the radiographic quality of the endodontic obturation (1a-good or 1b-poor) and coronal restoration (2a-good or 2b-poor) (4, 5).

1a-Good endodontic filling (GE)- if all canals were obturated, no voids were present and the fill of the main gutta-percha point was within 0 to 2 mm from the radiographic apex (Figure 1).

1b-Poor endodontic filling (PE)- if one or more of the criteria in (1a) were not met (Figure 2).

2a-Good restoration (GR)- any permanent restoration that radiographically appeared sealed (Figure 3).

2b-Poor restoration (PR)-any permanent restoration with radiographic signs of overhangs, open margins or recurrent decay (Figure 4).

The apical one-third of the root and surrounding structures were then radiographically evaluated and categorized as follows:

Absence of periradicular inflammation (API): if the contours, width and structure of the periodontal ligament were normal or slightly widened, if an

excess of filling material was present (Figures 1 and 3).

Presence of periradicular inflammation (PPI)- if one or more of the criteria of success were not fulfilled, i.e. if widening of the periodontal ligament space of twice the width of the lateral periodontal space or radiolucency in connection with the apical part of the root was visible (Figures 2 and 4).

According to these criteria, the periradicular status for each category of treatment quality is shown in Table 1, and combined criteria of treatment in Table 2.

The results were statistically evaluated by χ^2 test.

Results

The rate of API for all examined endodontically treated teeth (696) was 45% (315 teeth) and the rate of PPI was 55% (381 teeth). GE were visible in 37.4% (260 teeth) and PE in 62.6% (436 teeth). GR were noticed in 51.7% (360 teeth), and PR in 48.3 (336 teeth).

The periradicular status for each category of treatment quality is shown in Table 1, and for combination of criteria in Table 2.

For all examined endodontically treated teeth (696), GE and GR were obtained in 30.3%. PE and PR were obtained in 41.3%. GE and PR were noticed in 7%, and PE and GR in 21.4% of the teeth.

Logistic regression was performed to evaluate the effect of GE and GR on the absence of periradicular inflammation (Table 3). GE and GR increases the possibility of absence of periradicular inflammation.

Discussion

This study evaluates periradicular status of the teeth based on analysis of radiographic panoramic images, which are considered an acceptable diagnostic tool for detection of periapical lesions (31). The advantage of the panoramic image compared to full-mouth sets is that all teeth are visible on one convenient, relatively low exposed image (5).

When used for the detection of osteolytic lesions, panoramic images had sensitivity of 76% compared to full-mouth sets in the case of single-rooted teeth and sensitivity of 90% in the case of multirooted teeth (32). Gröndahl et al. (33) showed that interobserver variability was greater when analysing panoramic radiographs than when analysing full-mouth sets., while Muhammed et al. (34) found no statistically significant difference between the panoramic radiograph and full-mouth sets in the detection of periapical lesions. The limits of our study are two dimensional analysis of radiographs and the fact that we do not know the time period passed after endodontic treatment, except that patients were not treated for at least one year.

Lupi-Pegurier et al. (5) when analysing panoramic radiographs found significant relationship of periapical lesions and poor endodontic obturations; quality of postendodontic restorations were not examined.

Bouchner et al. (6) found a high prevalence of root-filled teeth and poor technical quality on full-mouth radiographs. Roots presenting with acceptable root fillings were associated with a lower prevalence of periapical lesions. Endodontically treated but unrestored roots, showed significantly more periapical pathology compared to endodontically treated and restored roots. Posts in roots were associated with periapical pathology significantly more than in roots without posts.

An epidemiological study derived from a random sample of 322 residents of the Porto area (29), indicated the prevalence of apical periodontitis in 27% of this population. The quality of the majority (54%) of the root fillings observed were found to be inadequate, although only 22% of the endodontically treated teeth showed apical periodontitis. The most probable explanation for this may be that extraction is a more commonly accepted treatment for apical periodontitis in Portugal. Thereby, teeth with apical periodontitis and unsuccessfully treated teeth may have been extracted and therefore excluded from observation in the Portuguese study.

Ray and Trope (4) evaluated 1010 endodontically treated teeth on full-mouth radiographs and found absence of periradicular inflammation in 61% of teeth. Teeth with good postendodontically restorations had no radiographic signs of periradicular

lesions in 80% compared to 76% in teeth with good endodontic obturations. PR showed API in 30%, PE in 49%. The combination GR/GE had no periradicular inflammation in 91%. Group GE/PR had lower prevalence of API (44%) compared to the group PE/GR (68%). Results of this study indicate the importance of the coronal seal achieved by coronal restoration, concluding that root canal filling is not an impermeable barrier.

In our study on panoramic radiographs, 696 teeth were evaluated and 45% of them showed no signs of periradicular lesions. Teeth with GR had no periradicular lesions in 68% of cases compared to 89% in teeth with GE. Teeth with PR resulted in 21% of API, while 19% with PE. The combination GR/GE in 94% had no periradicular lesions. The lowest prevalence of API was found in group PE/PR (14%). The combination GE/PR indicated higher percentage of API (65%) compared to group PE/GR (30%). These results for combinations of the examined criteria differ from Ray and Trope's results (4), but many factors implicate the appearance of periradicular lesions. Some of these are: quality of canal instrumentation, residual microorganisms in the endodontic space after instrumentation and obturation, virulence of microorganism, resistance of some microorganisms (*Enterococcus foecalis*) to calcium hydroxide effects, microleakage of root canal fillings, antimicrobial effects of endodontic materials, material contraction characteristics, poor sealing ability of postendodontic restoration, period of time after endodontic treatment as well as postendodontic treatment, patient's imunostatus (35).

Penetration of bacteria to the apex may not be necessary for an apical inflammation response. Endotoxins and other microorganism products could move through the obturated canal to the apex, stimulating the inflammatory response (36).

Based on this and earlier studies (4, 6) it is obvious that the quality of endodontic treatment as well as postendodontic restoration are of great importance to obtain and protect the obturated endodontic space and health of periradicular tissues.