

Apical periodontitis in root filled teeth associated with the quality of root fillings

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SUMMARY

The aim of this study was to investigate the technical quality of root fillings in root filled teeth, their association with periapical status and prevalence of apical periodontitis.

Material and methods: The sample consisted of 83 subjects, presenting consecutively as new patients seeking dental care (prosthetic, endodontic and cariologic treatment) in the years 2005/2006. Clinical and radiographic examination on each patient was performed using the scoring system (Periapical index (PAI)) proposed by Ørstavik et al. From the periapical radiographs status of endodontically treated teeth was recorded. For each tooth the following items were surveyed: the presence of a root filling, its quality (lateral seal and length in the root canal) and the periapical status.

Results: Of the 2186 functional teeth, 283 had undergone root canal treatment (13%). Amongst 283 root filled teeth, 122 teeth (43.1 %) had radiological signs of a periapical lesion (PAI>2). Only 28.6% of the root filled teeth fulfilled the criteria of an acceptable root canal filling. Inadequate lateral seal of root filling was observed in 165 (58.3%) of 283 endodontically treated teeth. Inadequate length of endodontic treatment was discovered in 183 (64.7%) out of 283 teeth. Root filled teeth without voids had apical periodontitis in 25 (21.0%) out of 118 of cases, whereas if voids were detected, disease was present in 97 (58.8%) out of 165 teeth ($p<0.001$). Apical periodontitis was found in 23 (23.0%) out of 100 teeth with adequate length of root filling, whereas if the filling was too short or long, periapical lesions were present in 99 (54.0%) out of 183 teeth ($p<0.001$).

Conclusions: Apical periodontitis was present in 43,1% of root filled teeth. Only 28.6% of the root filled teeth fulfilled the criteria of an acceptable root canal filling. The results of this study indicate that inadequate root fillings were more often associated with an increased prevalence of apical periodontitis. On the contrary, adequate root fillings significantly reduced the prevalence of disease. Many root canal treatments were technically unsatisfactory and substantial efforts must be made to improve the standard of endodontic treatment.

Key words: root filled teeth, prevalence of apical periodontitis, lateral seal.

INTRODUCTION

Numerous factors are associated with failing nonsurgical endodontic treatment. The cause of the endodontic failure is often multifactorial and includes such factors as incomplete obturation, root perforation, canals left unfilled, inadvertently removed sil-

ver points, broken instruments. In most cases these procedural errors do not jeopardize the outcome of endodontic treatment unless a concomitant infection is present. It is also evident that procedural accidents often impede appropriate intracanal procedures. When a procedural accident occurs during the treatment of infected teeth the failure of treatment is expected more often.

Follow-up clinical studies have shown that root canal treatment applying modern principles of practice leads to the favourable results, with healing rates above 90% [1]. Such high rates of success reported in these studies were obtained with well trained practitioners under strict operating conditions. That may not reflect the situation found in general practice.

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Epidemiological studies carried out in different population groups report a high prevalence of apical periodontitis (AP) in connection with root filled teeth ranging from 16% to 65% [2, 3, 4], as well as a frequent finding of root fillings of inadequate quality [5, 6]. Reports indicated that the prevalence of root canal treatment varies from 1.3% to 20% and increases with patients age [7]. They also show that when these root canal treatments are evaluated radiographically, they are judged to be insufficient, in a large proportion of cases [8].

The success rate of root canal treatment is a public health problem that has medical, economic and ethical repercussions. The establishment of treatment objectives, the improvement of techniques will enable practitioner to expect a high success rate. Studies which attempt to analyse the quality of root canal treatment and its association with periapical status in Lithuania are rare [5].

The aim of this study was to investigate the technical quality of root fillings in root filled teeth, their association with periapical status and prevalence of apical periodontitis.

MATERIALS AND METHODS

Patient selection

The sample consisted of 83 subjects with a mean age 36.1 ± 13.6 years, presenting consecutively as new patients seeking dental care (prosthetic, endodontic and cariologic treatment) in the years 2005/2006. They were accepted in the order of their attendance to the clinic during a period of 1 year. Females comprised 61.4% of the sample.

The criteria for inclusion in the study were that the patients should be attending for the first time, had no dental treatment during the previous year and had not been referred from colleagues for special endodontic treatment. Patients younger than 18 years and toothless patients were excluded.

The research was carried out at the Institute of Odontology, Faculty of Medicine, Vilnius university.

Clinical and radiographic examination on each patient was performed. Radiographic examination included panoramic radiographic survey and periapical radiographs. Missing and root filled teeth were recorded from the panoramic survey. Third molars were excluded. From the periapical radiographs status of endodontically treated teeth were recorded. For each tooth the following items were surveyed: the presence of a root filling, its quality (lateral seal and length in the root canal) and the periapical status. The scoring system (Periapical index (PAI)) proposed by Ørstavik et al. was used for evaluating

the periapical conditions of each tooth [9]. The parameters which were assessed in the root filled teeth are listed in Table 1.

Periapical radiographs were taken by endodontist using the long-cone paralleling technique with Rinn angulators. Double Kodak Ektaspeed Plus films (Kodak, Rochester, NY, USA) were used, which were developed, fixed and then mounted on black holders. Third molars were excluded.

Radiographic examination

Before clinical examination, all participants underwent panoramic radiographic survey. In regions of maxilla and mandibula where root filled teeth were found periapical radiographs were done. Teeth were categorized as root filled teeth if they had been filled with a radiopaque material in the pulp chamber and/or in the root canal(s). Films were examined in a darkened room using an illuminated viewer box with magnification (3.5x).

Data treatment

For the evaluation of missing and endodontically treated teeth patients were grouped into five age groups (I group: 19-29 y.; II group: 30-39 y.; III group: 40-49 y; IV group: 50-59 y; V group: 60-69 y.).

Diagnostic thresholds for the present study were:

1. Lateral seal of the endodontic treatment: adequate if no voids were present in the root filling: score 1 = adequate and score 2, 3 and 4 = inadequate (Table 1).

2. Length of an endodontic treatment: adequate if ending ≤ 3 mm from, or flush with, the radiographic apex: score 1 and 4 = adequate, and score 2, 3 and 5 = inadequate (Table 1).

3. Periapical bone: score 1 and 2 (according PAI) = healthy, and score 3, 4 and 5 (according to PAI) = diseased (Table 1).

Statistical analysis was performed using the Statistical Package for the Social Sciences for Windows (SPSS v.V8.0). The following values were calculated for every single variable: mean, standard deviation (SD). All values were compared using a chi-squared test (χ^2 -test) for statistical significance. Significance was determined at the 0.001 level of confidence.

RESULTS

Of the 2186 usable teeth, 283 had undergone root canal treatment (13%). The mean number of teeth per subject was 26.3 ± 2.8 . The mean number of endodontically treated teeth per subject was

Table 1. Parameters recorded on endodontically treated teeth.

Parameters	Registrations and codes
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 \leq 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)	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

3.4 \pm 2.2. Number of missing teeth varied from 0 to 15 per person. Statistically significant strong correlation was observed between patient's age and missing teeth ($r=0.722$; $p<0.001$).

In the 19-29 years old group (I) total amount of root filled teeth was 82 teeth. From this group the most frequently root filled teeth were the mandibular first molars 25 (30.5%) and the maxillary first molars 27 (32.9 %) ($p<0.001$).

Amongst total amount of 283 root filled teeth, 122 teeth (43.1 %) had radiological signs of a periapical lesion (PAI $>$ 2). Inadequate lateral seal of root filling was observed in 165 (58.3%) of 283 endodontically treated teeth. Inadequate length of endodontic treatment was discovered in 183 (64.7%) out of 283 teeth. Only 28.6% out of 283 root filled teeth fulfilled the criteria of an acceptable root canal filling.

Table 2 shows the relationship between the adaptation of root filling to canal walls and periapical status. Root filled teeth without voids had apical periodontitis in 25 (21.0%) of 118 cases, whereas if voids were detected, disease was present in 97 (58.8%) out of 165 teeth ($p<0.001$).

The relationship between the length of the root filling and periapical status is shown in Table 3. Apical periodontitis was found in 23 (23.0%) out of 100 teeth with adequate length of root filling, whereas if the filling was too short or long, periapical lesions were present in 99 (54.0%) out of 183 teeth ($p<0.001$).

Both adequate root filling adaptation and length were associated with lower incidence of apical periodontitis ($p<0.001$) (Table 4).

Statistically significant difference was also found between the length of root filling and location of teeth in mandibula and maxilla. More frequently the filling was too short or long in 75% of maxillary molars (53 out of 70 upper molars) and in 82% of mandibular molars (46 out of 56 lower molars) than in other teeth ($p<0.001$).

DISCUSSION

Previous epidemiological surveys have shown a high prevalence of apical periodontitis in connection with root filled teeth, ranging between 22 and 61% [2, 3, 5, 6, 7, 8]. In the present clinical study the quality of the adaptation of root filling to the root canal walls and its length were evaluated in relation to periapical status. However, from such studies it is impossible to assess the quality of root canal debridement procedures. The radiographic appearance of a filled canal is only a gross sign of its sealing capacity [10]. In the present study 165 (58.3%) out of the 283 root fillings were not adapted to the canal wall, and of these 165 apical periodontitis was found in 97 (58.8%) cases. Similar results have been reported also in previous studies: percentages between 30 and 60% of root filling showing void have been reported and approximately 60-70% of these had apical periodontitis [4, 5]. Results of studies may slightly differ because of the number of missing teeth which were extracted due to an inadequate endodontic treatment and apical pathology.

The results of the present study indicate that the length of the root filling was significantly asso-

Table 2. Adaptation of fillings to the canal walls and the relation to the periapical status, percentage for healthy/diseased

Treatment	Healthy (%)	Diseased (%)	Total no. of teeth
Adequate adaptation	93 (78.8%)	25 (21.2%)	118
Inadequate adaptation	68 (41.2%)	97 (58.8%)	165
Total	161	122	283

$p < 0.001$

Table 3. Length of fillings and the relation to the periapical status, percentage for healthy/diseased.

Treatment	Healthy (%)	Diseased (%)	Total no. of teeth
Adequate length	77 (77.0%)	23 (23.0%)	100
Inadequate length	84 (45.9%)	99 (54.1%)	183
Total	161	122	283

$p < 0.001$

Table 4. Combination of adaptation and length of fillings and the relation to the periapical status, percentage for healthy/diseased.

Treatment	Healthy (%)	Diseased (%)	Total no. of teeth
Adequate adaptation and length	66 (81.5%)	15 (18.5%)	81
Inadequate adaptation and length	95 (47.0%)	107 (53.0%)	202
Total	161	122	283

$p < 0.001$

ciated with periapical status. A total of 100 of the root fillings had an adequate length, only 23% of these had apical periodontitis. On the contrary, when the length was shorter or longer, 99 (54%) out of 183 teeth had periapical lesion. These findings correspond with the results of other studies where 10-46% of the teeth with adequate length of root filling had apical periodontitis [2, 4, 11]. Discrepancies in determination of working length lead to an inadequate debridement and seal of root canal system. Periapical Index (PAI) established by Orstavik et al. based on the histological work of Brynolf allows standardization of the different categories, and thus comparisons between studies [9, 12]. Its reliability was established by further investigations [2, 3, 4]. However, in order to differentiate the normal status from the pathologic, the authors proposed a cut-off at a score of 2, since PAI>2 was considered to be indicative of periapical pathology. Score of 2 corresponds to an image with a localized widening of the ligament and can be associated signs of bone modifications which may be interpreted as an ongoing healing process, an established state of irritation, or an evolution toward a pathological state. Since peak incidence of healing or emerging chronic apical periodontitis is at 1 year, the risks of a questionable image developing a more advanced lesion are increased [1]. Periapical lesions are in general radiographically underestimated, since the cortical bone

must have a 30-50% mineral bone loss to be detectable [13]. Moreover, as the PAI system was established for maxillary anterior incisors, where the cortical bone is thin, the risk of underestimation of lesions with a PAI>2 is increased. Many authors who did not use the PAI scoring system considered a localized increase of the periodontal space as a sign of apical periodontitis if bone changes were present [7, 11]. It is clear that the choice of cut-off is of primary importance because the number of roots classified as pathologic is approximately doubled if one chooses a limit at grade 2 or 3.

This study also poses the problem of root filled teeth in group of age 19-29 years old. The most frequently root filled and missing teeth were mandibular molars. It is reasonable to suppose that some of these teeth were extracted because of periapical pathology, with or without endodontic treatment. Another interesting result of the present study concerns the quality of root canal treatment. The results of this study showed that only 28.6% of the root filled teeth fulfilled the criteria of an acceptable root canal filling, according to the guidelines of European Society of Endodontology (a radiographically dense filling with its end located between 0 and 3 mm from the apex) [14].

The results of this study demonstrate a high prevalence of root filled teeth and poor technical quality of treatment.

CONCLUSIONS

Apical periodontitis was present in 43,1% of root filled teeth. Only 28.6% of the root filled teeth fulfilled the criteria of an acceptable root canal filling. Within the limitations of this study, the results indicate that an adequate root filling had a more substantial impact on the outcome of treatment. Inad-

equate root filling was associated with an increased prevalence of apical periodontitis. Adequate root fillings significantly reduced the prevalence of apical periodontitis. Many root canal treatments were technically unsatisfactory. The data clearly demonstrated the need for improved standards of root filling in order to improve the outcome and benefit associated with endodontic treatment.

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