

Retreatment or radiographic monitoring in endodontics

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Summary

The aim of this clinical study was to assess 1032 endodontically treated roots in relation to: (i) the success rate of retreatment (612 roots)—only cases that had recall examinations of 6 months or longer were evaluated; (ii) the influence of various factors on the technical and clinical results of the retreatment; and (iii) the consequences of radiographic monitoring of 420 asymptomatic roots when the root filling was radiographically deficient (short, overextended and/or permeable root fillings).

Technical assessment of the retreatment showed that the root was adequately sealed in 52.3% of cases, the root filling was improved in 33.8%, was identical with the initial treatment in 11.1% and was worse than the first treatment in 2.8% of the canals. Clinical assessment of the retreatment of symptomatic roots showed that 71.8% of the retreatments were judged successful, 18.9% showed some healing and 9.3% had failed. The initial size of the periapical lesion, the use of rubber dam, the root filling technique and the apical level of the root filling had a statistically significant influence on the result of the retreatment.

Monitoring radiographically (median time span 6 years) led to maintenance of the status quo in 94.8% of cases, healing in 2.4% and failure in 2.8% of the canals. Retreatment is clearly indicated when periapical radiolucency, clinical signs and/or symptoms are present with relative success of up to 91%. When no or little radiographic evidence of periapical pathology was present, when clinical signs and symptoms were absent or when the root filling was radiographically deficient, radiographic monitoring led to complications in only a limited number of cases.

Keywords: clinical decision, endodontic retreatment, radiographic evaluation.

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Introduction

Studies have shown that success rates of root canal therapy generally approach 90% (Lewis & Block 1988). When treatment fails, retreatment rather than extraction is usually indicated (Allen *et al.* 1989), but the success rate of retreatment cases is generally poorer (Sjögren *et al.* 1990). Methods of evaluating results of endodontic treatment and retreatment include radiographic examination: the development or persistence of periapical radiolucencies often serves as criteria of clinical failure.

The aim of this clinical study was to analyse two approaches to apparent failure of initial root canal therapy; retreatment or radiographic monitoring only. The answers to three questions were sought: (i) what are the success and failure rates of retreatment; (ii) what influence do various factors affecting the technical and clinical results of retreatment have on its outcome; (iii) how valid is radiographic monitoring alone, when clinical signs and symptoms are not present, when no, or only small, evidence of periapical pathology is visible despite the root filling being radiographically deficient?

Material and methods

This clinical study was based on a retrospective assessment of 1032 root canal therapy cases carried out by a single dentist. Among these roots, 612 were retreated and 420 asymptomatic roots with a radiographically deficient filling (short, overextended and/or permeable endodontic fillings) were not retreated.

Retreatment

Assessment criteria of the initial root filling was based upon the level of the root filling in relation to the root apex, its apparent density and the quality of the apical seal (Table 1). Also recorded were:

Table 1. Criteria for assessment of initial root filling

Previous root filling assessment	Criteria
Bad	Short (>5 mm), or overextended (>3 mm), and/or permeable root filling
Questionable	Short (3 mm < fill ≤ 5 mm), or overextended (1 mm < fill ≤ 3 mm), and/or doubtful apical seal
Satisfactory	Short (1 mm < fill ≤ 3 mm), or overextended (≤ 1 mm), and/or presence of a few small voids
Good	≤ 1 mm from the radiographic apex and an apparently sound apical seal

- The name, sex and age of each patient: the following age categories were used: 20 to 30, 31 to 40, 41 to 50, 51 to 60, 61 to 70, more than 70 years.
- The nature of the initial root filling (empty canal, paste, gutta-percha or silver points), the presence of posts and cores and any previous complications such as broken endodontic instruments, the presence of steps or ledges, furcal or root perforations, and transposition of the apical part of the root canal preparation.
- The reasons for retreatment including radiographic signs and clinical symptoms (Table 2).
- The technique of tooth isolation used: either with cotton-wool rolls or with rubber dam.
- The different root canal treatment procedures that had been used (Table 3).
- The number of appointments required.
- Canal medication: antiseptic medications were used between the appointments (paraformaldehyde was used in the early part of the study, but as this material has been shown to be mutagenic and carcinogenic its use was replaced by calcium hydroxide). Irrigants used were 2.5% sodium hypochlorite and also the chelating agents (EDTA+urea peroxide) followed by irrigation with sodium hypochlorite. Solvents (thymol+isoamyl acetate+trichloroethane or chloroform) were also used for the removal of gutta-percha.
- The root filling techniques used were either a single-cone technique or lateral condensation of gutta-percha. Zinc oxide-eugenol was used as sealer.
- The distance of the root filling from the radiographic apex was recorded as follows: (i) under-

Table 2. Reasons for retreatment

Reasons for retreatment	
1	Presence of apical radiolucency (0–1 mm, 1–3 mm, 3–5 mm, 5–10 mm and >10 mm)
2	Pain, swelling or fistula, tenderness to apical and gingival pain palpation and percussion
3	Permeable and/or incomplete root filling
4	Further prosthetic or extensive restorative treatment

Table 3. Root canal treatment procedures

Root canal treatment procedures	
1	No initial disinfection
2	Previous disinfection before mechanical debridement and irrigation
3	Initial penetration, measurement of the working length and disinfection of the root canal
4	Initial penetration, measurement of the working length, preparation and disinfection of the root canal

filling: 0 to -1 mm, -1 to -3 mm, -3 to -5 mm, -5 mm or more, canals left empty and (ii) overfilling: 0 to +1 mm, +1 mm to +3 mm, +3 mm to +5 mm, more than +5 mm.

- The complications during retreatment. These included the root canal being blocked by secondary or reparative dentine, impassable ledging in curved canals, furcal or root perforations, transposition during apical preparation, and broken instruments.

Retreatment evaluation

The classification of endodontic retreatment as a success or failure was based on technical and healing assessments (Tables 4 and 5). Success or failure of retreatment was evaluated from recall radiographs (6 months, 1 year, 2 years and more than 2 years) and patient records of clinical examination. Only cases that had recall examinations of 6 months or more were analysed.

Radiographic monitoring only

The details recorded for each patient were; name, sex and age, date of first examination. Radiographic and

Table 4. Technical assessment

Technical assessment	Retreatment/former treatment
Good	The retreatment corresponded to the criteria for a good root canal filling
Improvement	The retreatment improved the former treatment
Unchanged	The retreatment was as good as the former treatment
Worse	The retreatment was worse than the former treatment

Table 5. Healing assessment

Healing assessment	Radiographic appearance, clinical signs and/or symptoms
Complete healing	Complete resolution of periapical radiolucency, no clinical signs and symptoms
Improvement	Decrease in size of periapical radiolucency, no clinical signs and symptoms
Unchanged (A)	No periapical radiolucency, clinical signs and symptoms
Unchanged (B)	Persistence of periapical radiolucency, clinical signs and symptoms
Deterioration	Increase in size of periapical radiolucency or occurrence of periapical radiolucency, exacerbation of clinical signs and symptoms or occurrence of clinical signs and symptoms

Table 6. Distribution of the root canals according to patient age

Age category in years	Number of root canals	%
20<30	150	24.5
31<40	192	31.4
41<50	130	21.2
51<60	110	18.0
61<70	29	4.7
>70	1	0.2
Total	612	100.0

clinical diagnosis was based upon a possible presence of a small periapical radiolucency and/or a permeable or incomplete root canal filling together with absence of clinical signs and symptoms.

The assessment of the root filling, and any complication, in these cases were based on the same criteria as in the retreatment cases (Table 4). Time intervals between the first and the last examination were noted. Assessment of cases left untreated was based upon the

same criteria as those used for the healing assessment of the retreatment cases (Table 5).

Radiographic examination

In evaluating the results of retreatment and monitoring, the radiographs were assessed by two separate observers, who had been trained for calibration. To test intra- and inter-observer agreement the radiographs were examined twice by the two observers at an interval of 1 month. The intra-observer agreement was, respectively, 96% and 93%. Agreement between the two observers was 94% and 90%.

To avoid the risk of inter-observer agreement occurring by chance the kappa coefficient was used. The corrected agreement between the two observers was 0.74.

Statistical analysis

All the data were recorded into a table (EXCEL) and the statistical analysis was performed using SAS (Statistical Analysis System) on an IBM mainframe. The comparison between the categories and the relationships between the factors were evaluated by the Wilcoxon-Mann-Whitney rank sum test (and Kruskal-Wallis test) and the Spearman rank correlation.

Results

Retreatment

Description of the sample. Male and female patients represented 46.6% and 53.4%, respectively of the sample. Table 6 shows the distribution of the root canals according to patient age. Mandibular molars were the most frequently retreated teeth (32.2%), particularly the first molar. Maxillary anterior teeth were retreated 20 times more frequently than mandibular anterior teeth. Among the retreated root canals, 67.8% (415) were sealed initially with paste (zinc oxide-eugenol or unknown) and/or gutta-percha. 9.8% (60) with silver points, 22.4% (137) had been left empty. The reason for the remaining retreatments was either broken instruments or was unspecified. Following qualitative assessment 92.6% of the initial root fillings were unacceptable being judged either bad or questionable. Five per cent of the retreated canals had

Table 7. Distribution of the sample following the root canal treatment procedures

Root canal treatment procedures	Number of root canals	%
No preliminary disinfection	96	15.7
Preliminary disinfection	304	49.7
Initial penetration, measurement of the working length of the root canal and disinfection	132	21.5
Initial penetration, measurement of the working length, endodontic preparation of the root canal and disinfection	80	13.1
Total	612	100.0

previous complications. Retreatment for radiographic and/or clinical reasons involved 42.5% of the sample (260 root canals). Retreatment of asymptomatic root canals for posts and/or defective root fillings involved 57.5% of the sample (352 root canals).

More than 90% of the sample with periapical radiolucency presented with size variations between 0 and 5 mm. Rubber dam isolation was used in 51.1% of cases. The various root canal treatment procedures used are shown in Table 7. Preliminary disinfection before mechanical debridement and irrigation of the root canal was the most frequent procedure. The majority of the root canals required two appointments for the retreatment (45.8%), with 15.7% being completed in one visit, 27.4% in three visits and 11.1% requiring more than three appointments. The antiseptic medications used between the appointments are shown in Table 8. The obturation techniques used are given in Table 9; single-cone and lateral condensation techniques were employed equally. The level of the root filling in relation to the radiographic apex is shown in Table 10. During retreatment, 62 complications, arose (Table 11). Tables 12 and 13 illustrate technical and the healing assessments of retreatment, respectively.

Factors affecting the outcome of retreatment

The patient. The outcome of retreatment according to sex was not statistically significant (Wilcoxon test, $P=0.12$). Spearman coefficient between a failed outcome for retreatment and an increase in age revealed a statistically significant correlation ($r_s=0.136$; $P=0.0012$).

Table 8. Interappointment intracanal medication

Antiseptic medication	Number of root canals	%
Paraformaldehyde (Rockle's 4)	487	79.6
Calcium hydroxide (Reogan Rapid)	29	4.7
No medication	96	15.7
Total	612	100.0

Table 9. Obturation techniques

Obturation techniques	Number of root canals	%
Single-cone	293	47.9
Lateral condensation	284	46.4
Canals left empty	35	5.7
Total	612	100.0

Table 10. Level of the root filling in relation to the radiographic apex

Distance of the root filling from the radiographic apex (mm)	Number of root canals	%
Underfilling		
0<1	328	53.6
1<3	97	15.9
3<5	48	7.8
>5	43	7.0
Canals left empty	35	5.7
Overfilling		
0<1	50	8.2
1<3	10	1.6
3<5	0	0.0
>5	1	0.2
Total	612	100.0

Retreatment procedure. Retreatment outcome was significantly improved when the following pertained: (i) rubber dam isolation (Wilcoxon test, $P=0.0001$); (ii) initial penetration, working length measurement, root canal preparation and disinfection in the first visit ($r_s=-0.106$; $P=0.0119$); (iii) multiple appointments ($r_s=-0.145$; $P=0.006$ and Wilcoxon test, $P=0.0045$); (iv) lateral condensation was performed (Wilcoxon test, $P=0.0001$); (v) root filling to within 1 mm of the radiographic apex (Wilcoxon test, $P=0.0001$).

Retreatment outcome was significantly worse when: (i) periapical radiolucency size increase ($r_s=0.216$;

Table 11. Complications during retreatment

Complications during retreatment	Number of root canals
Impenetrable canals	35
Curved canals	4
Steps or ledges	7
Furcal perforations	3
Root perforations	1
Apical transpositions	2
Broken instruments	10
Total	62

Table 12. Technical assessment of retreatment

Technical assessment	Number of root canals	%
Worse than previous treatment	17	2.8
Equivalent to previous treatment	68	11.1
Improvement on previous treatment	207	33.8
Correct retreatment	320	52.3
Total	612	100.0

Table 13. Healing assessment of retreatment

Healing assessment	Number of root canals	%
Complete healing	171	27.9
Improvement, but incomplete healing	45	7.4
Status quo without periapical radiolucency clinical signs or symptoms	308	50.3
Persistence of periapical radiolucency, with clinical signs and symptoms	17	2.8
Deterioration	20	3.3
Periapical status unknown	51	8.3
Total	612	100.0

Table 14. Distribution of root canals according to patient age

Age category in years	Number of root canals	%
20<30	87	20.7
31<40	126	30.0
41<50	108	25.7
51<60	66	15.7
61<70	30	7.2
>70	3	0.7
Total	420	100.0

Table 15. Initial size of periapical radiolucency

Initial periapical radiolucency size (mm)	Number of root canals	%
Absence of periapical pathosis	349	83.1
Detectable widening of periodontal space	38	9.0
1<3	33	7.9
Total	420	100.0

Table 16. Level of the root filling in relation to the radiographic apex

Distance of the root filling from the radiographic apex (mm)	Number of root canals	%
Underfilling		
0<1	17	4.1
1<3	32	7.6
3<5	75	17.9
>5	228	54.3
Canals left empty	65	15.5
Overfilling		
0<1	1	0.2
1<3	0	0.0
3<5	1	0.2
>5	1	0.2
Total	420	100.0

Radiographic monitoring only

Sample details

Male and female patients represented 28.1% and 71.9%, respectively. Table 14 illustrates the distribution of the root canals according to age categories. Initial radiographic diagnosis is detailed in Table 15, 98.6% of the root fillings were judged bad or questionable, with only 1.4% being either good or satisfactory. The level of the root filling in relation to the radiographic apex is illustrated in Table 16; in most

$P=0.0014$); (ii) complications arose during retreatment (Wilcoxon test, $P=0.0055$), (iii) when the technical quality of the root filling was in the worst category ($r_s = -0.152$; $P=0.0003$).

The outcome of overfilling was not analysed statistically because of an imbalance in the distribution between groups.

Table 17. Outcome assessment

Outcome assessment	Number of root canals	%
Complete healing	8	1.9
Improvement but incomplete healing	2	0.5
Status quo		
no periapical radiolucency.		
no clinical signs and symptoms	343	81.7
Persistent periapical radiolucency		
no clinical signs and symptoms	55	13.1
Deterioration	6	1.4
Periapical status unknown	6	1.4
Total	420	100.0

instances, short root fillings were observed (95.3%), with overextended fills being rare. Complications, such as broken instruments, were involved in 6.2% of the root canals.

The median time interval between the first and last examination was 6 years. Final radiographic assessment is detailed in Table 17. Radiographic and clinical examinations in these cases showed that the initial situation was stable in 94.8% of cases. Complete and partial healing had occurred in 2.4% of cases. Initiation or increase in size of the initial small periapical radiolucency was observed in 2.8% of canals.

Factors which affected the outcome in those cases receiving only radiographic monitoring. The sex (Wilcoxon test, $P=0.7$) and age ($r_s = -0.044$; $P=0.3$) of the patient were not statistically significant. There was a statistically significantly better outcome when no periapical radiolucency was evident on the initial radiograph (Wilcoxon test, $P=0.0001$). It was not possible to investigate adequately the influence of the quality of the root filling and distance of the root filling from radiographic root apex because of the small number of root canals that had been correctly sealed.

Discussion

When making an assessment of healing it is necessary to divide the sample of retreated root canals into two groups, one with symptoms, the other without. It was possible to estimate healing only in cases with initial radiographic, clinical signs and/or symptoms. Of cases that had been recalled over more than 6 months, 71.8% were judged successful, 18.9% were considered to be uncertain (on the way to recovery), and 9.3% had

failed. These results are similar to those recorded by Allen *et al.* (1989), which were 65.6% (definitively successful) and 18.3% (uncertain). Sjögren *et al.* (1990) noted less favourable results with only 62% success for retreatment of teeth with initial periapical pathology. Among the original asymptomatic root canals, 95.4% remained asymptomatic and 4.6% failed.

In the present study, the original size of the periapical lesion had an effect on the rate of healing. The observation period was perhaps too short however to observe complete healing of the largest lesions. Sjögren *et al.* (1990) also reported a low rate of healing when root filled teeth with large periapical lesions were retreated. The outcome of retreatment was found to be dependent on the distance of the root filling from the radiographic apex, with the best prognosis being when the filling reached to within 1 mm of the apex. This observation is also in agreement with the results of Sjögren *et al.* (1990).

Complications during the retreatment led to an unfavourable prognosis and confirms the importance of controlling the iatrogenic factors in root canal therapy (Morand 1992).

In the present study, the need for multiple appointments arose mainly from difficulties encountered during the retreatment procedure. The outcome was improved by completing root canal preparation at the first appointment and using a disinfective agent between visits. It may be unwise to make an inference from these two observations because of the very low correlation, but the use of calcium hydroxide, in some instances, may be an explanation for the greater success. The outcome of retreatment was also better with aseptic tooth isolation, perhaps because more effective irrigation of the root canal is possible when a rubber dam is applied.

The decision not to initiate retreatment of the root where a root filling appears deficient but rather to monitor radiographically is a common practice. This study shows that such review leads to complications in only a limited number of cases. It could be considered practical, perhaps, in cases where the coronal restoration does not require replacement, to keep the root filling under review. However, Torabinejad *et al.* (1992) have recently reported that a lack of integrity of coronal seal can result in recontamination of sealed root canals after a short time. If the coronal filling is deficient or lost, the risk of percolation and the possibility of bacterial (re)contamination of a poorly sealed root canal is very high. Retreatment of an inadequately sealed root canal is indicated, therefore, when the canal is to be

retained, as the periapical stability could be upset by bacterial invasion. When replacing coronal restorations, it is essential to ensure a coronal seal of the root canal system.

Conclusions

Technical assessment of retreatment in this study indicated that:

1. The root canal was adequately sealed (the filling extended to within 1 mm of the apex) in 52.3% of cases.
2. The root filling was improved in 33.8% of canals.
3. The root filling appeared identical to the initial treatment in 11.1% of cases.
4. The root filling was worse than the initial treatment in 2.8% of canals.

Clinical assessment of the retreatment of symptomatic roots indicated that:

1. 71.8% of retreatment were judged to be successful.
2. 18.9% showed some healing.
3. 9.3% failed.

The initial size of the periapical lesion, the use of rubber dam, the obturation technique and the apical level of the root filling all had a statistically significant influence on the result of the retreatment.

Avoidance of retreatment with only radiographic monitoring (median time span 6 years) resulted in:

1. no change in 94.8% of canals,
2. healing in 2.4% of canals,
3. failure in 2.8% of cases.

Retreatment is clearly indicated when a periapical radiolucency is accompanied by clinical signs and/or symptoms, and the relative success of such treatment rises to 91%. When no or only small radiographic evidence of periapical pathology is present, and clinical signs and symptoms are absent no treatment appears to result in complications in only a small percentage of cases, despite what appears to be a less than ideal root filling. If radiographic monitoring alone is contemplated there should be no suspicion of more sinister pathology.

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