Nonsurgically retreated root-filled teeth – radiographic findings after 20–27 years

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Abstract

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Aim To identify periapical changes in nonsurgically retreated root-filled teeth 20–27 years after root canal treatment.

Methodology From an original material of 429 roots, retreated by undergraduate students in a teaching clinic, 112 roots in 70 individuals could be evaluated radiographically 20–27 years after treatment. The same roots had been studied 10–17 years earlier. The periapical condition was registered and compared by three observers in two series of intraoral radiographs taken 10–17 and 20–27 years after treatment. A retrospective analysis was performed to gain information about probable endodontic and nonendodontic reasons for extractions of lost roots, by evaluating their periapical status immediately after retreatment and at the 10–17-year follow-up.

Results Favourable outcomes were observed in 11 roots that had radiolucencies at the 10–17-year follow-up. Eight of these roots had periapical pathosis preoperatively, five of them filled with surplus root filling material. The percentage of cases recorded as normal condition at the final follow-up was 95.5%, including five cases initially recorded with increased width of the apical periodontal space. Delayed healing as a result of surplus root filling material explained most of the cases with favourable outcome assessed many years after treatment. Twenty-eight roots were lost because of extraction during the observation period, 17 during the last 10 years. Based on status at previous follow-ups, endodontic failure seems to represent a minor reason for extraction in the material.

Conclusion Late periapical changes, with more successful cases, were recorded when a 10–17-year follow-up after root canal treatment was extended for another 10 years. Persistent asymptomatic periapical radiolucencies, especially those with overfill, should generally not be classified as failures, as many of them will heal after an extended observation period.

Keywords: retreatment, root canal treatment, prognosis.

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Introduction

Nonsurgical root canal retreatment, frequently done in connection with prosthetic treatment, aims at improving the technical standard of the root filling, thus protecting against infection or re-infection from coronal leakage. In other cases, periapical pathoses are disclosed and infection must be eliminated for healing to occur.

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Follow-up studies indicate that the success frequency is different for the two groups of cases, the technical and pathology groups, with a 10–20% lower success rate for the latter (Friedman 1998). In addition to the preoperative status (Bergenholtz *et al.* 1979a), the success rate of nonsurgical retreatment in teeth with periapical pathosis also depends on the technical-standard of the root filling, with the lowest success rate when the root filling extends beyond the root apex (Sjögren *et al.* 1990).

The prognosis of nonsurgical retreatments made in the School of Dentistry, University of Bergen, has been studied earlier in 203 roots followed for 3.5 years

(Molven 1974), and later in 226 roots evaluated 10–17 years after retreatment (Molven & Halse 1988). The success rate in the first study was approximately 64%, whilst 81% of the roots were classified as successes 10–17 years after retreatment. Thus, these studies indicate an increased number of successful cases with an extended follow-up period.

The aim of the present study was primarily to determine if further changes occurred in the healing for nonsurgical retreatments, now available with a 20–27-year follow-up period.

Furthermore, tooth loss in the retreatment group was analysed to disclose possible endodontic reasons for extractions.

Materials and methods

Details regarding the original material and later follow-ups are presented elsewhere (Molven 1974, Halse & Molven 1987, Molven *et al.* 2002b).

The present follow-up group, 112 roots in 70 individuals, retreated by undergraduate students in a teaching clinic could be evaluated in radiographs taken after 20–27 years. The same roots had been studied 10 years earlier (Molven & Halse 1988), and 68 of them also at a 3.5-year follow-up (Molven 1974). The present material thus comprises about one-half of the retreatments (53%) available at the 10–17-year follow-up (Molven & Halse 1988), and one-fourth (26%) of the total number of retreatments (429 roots) originally made by the students (Molven 1974).

Loss of material

Nonattendants

Loss of patients includes: (i) patients contacted but not attending for various reasons, and (ii) those who had passed away, those not contacted because of age and those who had moved and were untraceable. To evaluate any effect of patient loss at the last follow-up, attendants and nonattendants were compared based on findings at the 10–17-year follow-up.

Extracted roots

A retrospective analysis was performed to gain information about probable endodontic and nonendodontic reasons for extractions of 28 retreated roots, lost during the 20–27-year period, by evaluating their endodontic status immediately after retreatment and at the 10–17-year follow-up.

Rejection of radiographs

A final joint evaluation of substandard radiographs rejected either by the two endodontists or by the radiologist alone was performed. Six rejections were maintained.

Radiographic grouping

The evaluation and classification of the periapical conditions have been dealt with in previous papers, with due attention to assessments and use of observers in critical cases (Halse *et al.* 2002, Molven *et al.* 2002a). The periapical findings were grouped as normal conditions, increased width of the periapical periodontal membrane space and roots with rarefactions, originally classified as favourable, uncertain and unfavourable outcomes (Halse & Molven 1986). Seven retreated roots, recorded with uncertain outcomes at the 20–27-year follow-up, were re-evaluated jointly by the observers in order to relate the observations to endodontic or other causative factors. Thereafter, they were classified as favourable (successes) or unfavourable outcomes (failures). Late changes in healing, both successes and failures, were identified by comparing radiographic assessments at the 10–17-year follow-up and earlier with assessments established 20–27 years after retreatment.

Results

Follow-up group

The radiographic findings of the 112 nonsurgically retreated roots, evaluated after 10–17 and 20–27 years, indicated a change towards more successful cases, when the observation period was extended (Table 1). Seven roots initially recorded with increased width of the periodontal space were finally classified as five successful cases and two failures.

The success frequencies related to preoperative status and root filling level are presented in Tables 2 and 3. One case, recorded earlier as successful, now presented as a failure, most likely because of coronal leakage. No cases changed from uncertain to late failure. Radiographs exemplifying the periapical status in three cases after 10–17 and 10 years later are shown in Figs 1–3.

Loss of material

Nonattendants

Table 4 shows the observations at the 10–17-year follow-up, for both attendants and nonattendants 20–27 years

Table 1 Radiographic findings 10–17 years and 20–27 years postoperatively for 112 roots retreated by undergraduate students

	Technical group		Pathosis group		
	Overfill*	No overfill	Overfill*	No overfill	Total
Roots (*n*)	22	24	50	16	112 (100)
Lesions at 10–17 years, *n* (%)	3 (13.6)	3 (12.5)	7 (14)	3 (18.8)	16 (14.3)
No lesions at 10–17 years, *n* (%)	19 (86.4)	21 (87.5)	43 (86)	13 (81.2)	96 (85.7)
Lesions at 20–27 years, *n* (%)	2 (9.1)	1 (4.2)	2 (4)	0 (0)	5 (4.5)
No lesions at 20–27 years, *n* (%)	20 (90.9)	23 (95.8)	48 (96)	16 (100)	107 (95.5)

*Root filling levels recorded according to Strindberg's classification (1956): no overfill = filling at a distance from the radiographic apex (class A); overfill = filling to the radiographic apex without or with surplus material (classes B and C).

Table 2 Success frequencies related to preoperative status at 10–17 and 20–27 years after treatment

	Pathosis group	Technical group
Roots (*n*)	66	46
Success at 10–17 years (%)	84.8	87
Success at 20–27 years (%)	97	93.5

Table 3 Success frequencies and effect of overfilling at 10–17 and 20–27 years after treatment

	Overfill	No overfill
Roots (*n*)	72	40
Success at 10–17 years (%)	86	85
Success at 20–27 years (%)	94.5	97.5

after treatment. The data indicate fewer lesions amongst the attendants.

Extractions

Totally, 28 roots were lost during the 20–27-year period, with 17 roots removed during the last 10 years (Fig. 4). The radiographic status of the roots shortly after retreatment and at their last follow-up revealed that 13 roots (76.5%) of those lost during the last 10 years were categorized as successes at the previous follow-up.

Discussion

A classification of radiographic success was seen in 95.5% of endodontically retreated roots at a 20–27-year follow-up. Related to the 85.7% success obtained 10 years previously for the same patients (Table 1), comparable with data presented for retreatment cases (Friedman 1998), the finding indicate late favourable treatment outcomes. Eleven such successes were observed after 20–27 years, eight in the pathosis group, five of them with overfills (Table 1). These findings require additional comments on the reported negative effect of both overfill and preoperative status (Bergenholtz *et al.* 1979b, Sjögren *et al.* 1990, Danin *et al.* 1996).

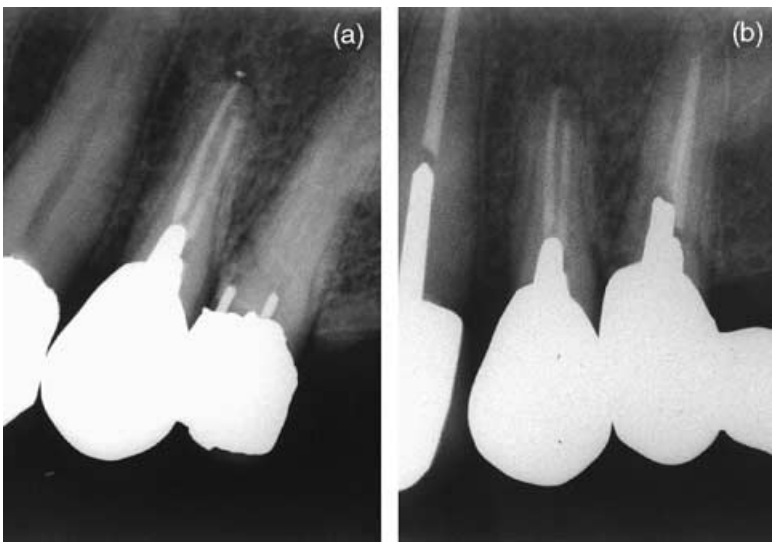

Figure 1 A maxillary first premolar originally treated with surplus root filling material. (a) Apical periodontitis with surplus filling material in the periapical area at 13 years. (b) Normal condition at 23 years.

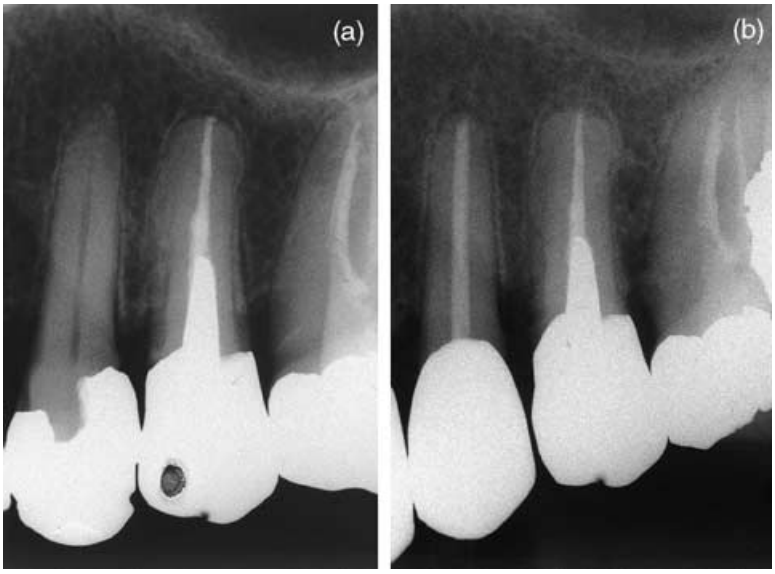

Figure 2 A second maxillary premolar classified with an increased width of the periodontal membrane on two follow-up occasions. (a) Increased width of the periodontal membrane at 16 years. (b) Increased width of the periodontal membrane at 26 years. After joint evaluation, the tooth was finally grouped as successful.

Figure 3 A maxillary lateral incisor classified with a radiolucency on two follow-up occasions. (a) Periapical lesion after 13.5 years. (b) Periapical lesion after 24 years.

Table 4 Results obtained at the 10–17-year follow-up, comparing data from attendants and nonattendants at the 20–27-year follow up (n= roots)

	Technical group		Pathosis group		
	Overfill	No overfill	Overfill	No overfill	n (%)
Attendants, lesions at 10–17 years ($n = 112$)	3	3	7	3	16 (14.3)
Nonattendants, lesions at 10–17 years ($n = 110$)	4	6	13	3	26 (23.5)

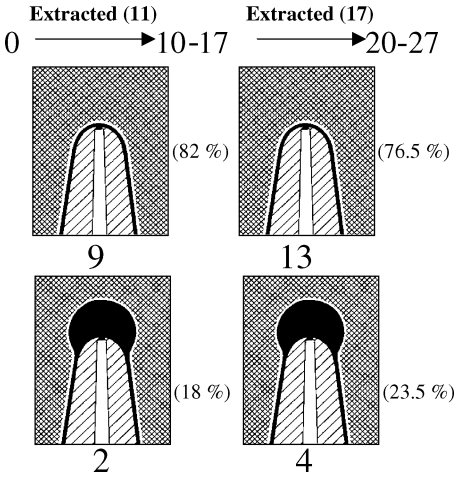

Figure 4 Periapical radiographic status in 28 non-surgically retreated roots in 19 individuals extracted before the 10–17-year follow-up (11 roots), and between the 10–17-year and the final follow-up at 20–27 years (17 roots). The status is based on recordings made shortly after retreatment for roots extracted before the 10–17-year follow-up, and on recordings made on the latter occasion for the 17 roots extracted later.

Methodological considerations

The original material

Nonsurgical retreatments and the final coronal restorations, either by fillings or artificial crowns, had been performed by undergraduate students in a teaching clinic. Root fillings were completed in teeth with and without periapical radiolucencies, originally treated before the patients attended the dental school. The technical quality of the root fillings reflected high-standard endodontic treatment based on a nonstandardized instrumentation technique and a softening gutta-percha/chloro-percha obturation method (Molven 1976, Molven & Halse 1988, Molven *et al.* 2002b). Thus, the original material was characterized by a number of cases with surplus root filling material (64%), a typical finding also in comparable materials with 56 and 74%, respectively, of the roots classified as overfilled (Grahnén & Hansson 1961, Bergenholtz *et al.* 1979b).

The sample

Loss of patients in follow-up studies is common. Within the present study and at the earlier 10–17-year follow-up, the nonattendants were individuals not invited to participate because of age, and individuals refusing or being unable to participate for various reasons. On both occasions, the invitation to participate was presented as a general offer to provide a radiographic overview of the dental health status, serving as a basis for further treatment plans by their private dentists and not solely as an endodontic follow-up. Emphasizing the general dental aspect might increase the value of the radiographic series and thus the number of attendants, and not prevent patients with endodontic mishaps from coming. Furthermore, obvious differences between attendants and nonattendants were not expected with regard to main endodontic variables, similar to that found 10 years earlier (Molven & Halse 1988). However, one finding at the final 20–27-year follow-up requires comment. Seven versus 13 cases with apical pathosis were noted for attendants versus nonattendants within the pathosis group with overfill 10 years earlier (see below).

The loss of endodontically treated teeth during observation periods should be related to the success rate, not only in endodontic follow-up studies but also in retrospective epidemiological investigations. This was done in the present study. Seven teeth, with 11 total roots, were lost during the first 10–17-year observation period, whilst 17 roots (12 teeth) were extracted during the next 10 years, most of them recorded with normal periapical findings, as observed 10 years earlier. What do we generally know then about failures and reasons for removal of endodontically treated teeth? Persistent asymptomatic apical radiolucencies do not *per se* indicate endodontic failures, as healing may progress for years (Strindberg 1956, Molven *et al.* 2002b), and developing lesions may be of temporary or permanent character. Usually, treatment failures leading to extraction appear during or shortly after treatment, whereas structural or other reasons for removal occur later. Thus, proper restoration of root-filled teeth is necessary to prevent subsequent tooth fracture, or failure as a result of coronal leakage (Hansen *et al.* 1990, Ray & Trope 1995, Tronstad *et al.* 2000). The prognosis of root canal treatment is generally good, and the need for careful restorations is reflected in the fact that endodontically treated teeth more often develop problems or are lost because of restorative difficulties rather than unsuccessful root canal treatment (Sjögren *et al.* 1990, Vire 1991, Lazarski *et al.* 2001). The preoperative status of extracted roots, the recordings from previous follow-ups and the general standard of dental treatment indicate that endodontic failures seem to represent a minor reason for tooth loss in the present material.

Loss of material because of substandard radiographs is important for the interpretation of endodontic

follow-up studies. In the present study, such data are presented. Rejections because of inadequate quality of the radiographs were made for six roots (5%), using criteria presented by Molven *et al.* (2002a).

Late periapical changes

Late periapical changes towards normal radiographic periapical conditions was a major finding in the present material. Percentage differences, slightly in favour of the technical group at the 10–17-year control, changed to higher values for the pathosis group at the 20–27-year follow-up (Table 1). This included an obvious favourable trend for roots, both with and without overfills. However, the highest percentage of successful outcomes was found for roots without overfills (Tables 1 and 3).

Microbial infection is the major factor in the prognosis of root canal treatment (Sundqvist & Figdor 1998, Sundqvist *et al.* 1998). But, foreign material extruded beyond the apex during instrumentation and obturation may result in an asymptomatic foreign body reaction, responsible for delayed healing (Nair *et al.* 1990, Ricucci & Langeland 1998, Sundqvist & Figdor 1998). The obturation technique used, with chloroform softening of the gutta-percha material, may have resulted in disintegration of the root filling material with displacement of small gutta-percha particles into the extraradicular tissues, shown to be responsible for macrophage accumulation and foreign body reactions *in vivo* (Sjögren *et al.* 1995; 1998, Sundqvist & Figdor 1998). The delayed healing and the late radiographic periapical changes seen in the present material, with extended observation periods, may be explained by longstanding irritation in the periapical area and a final disappearance over time.

Clinical implications

Endodontic retreatment is generally considered to have a lower prognosis than primary endodontic cases, with the poorest outcome in retreated teeth/roots with apical periodontitis (Friedman 1998). However, the success frequencies disclosed in the present follow-up for the pathosis group (>95%) are higher than observed in previous studies, and the clinical relevance of this finding merits discussion to avoid misinterpretation.

The present study was not designed to be a controlled investigation of prognostic factors, but as part of a search for late periapical changes in teeth available after extended observation periods. The aim of endodontic treatment is primarily to protect against or treat a microbiological problem (Sundqvist & Figdor 1998). Radiographic or clinical signs indicating absence of infection control is a negative prognostic factor. The results support and supplement previous studies that have shown that more successful cases are noted with extended observation periods, and that there seems to be no definite upper limit for late periapical changes to occur in otherwise asymptomatic teeth (Strindberg 1956, Halse & Molven 1987, Molven *et al.* 2002b). Not unexpected, a higher percentage of successful cases was found when increasing the observation period for up to 20–27 years postoperatively, mainly because of an effect on the prognosis from overextended root filling material (Bergenholtz *et al.* 1979b, Sjögren *et al.* 1990). The late favourable outcomes therefore confirm a longstanding irritating effect of surplus material, and underline the importance of reducing tissue irritation to a minimum during the instrumentation and filling procedure. The best short-time results are obtained with root filling material ending short of the radiographic apex. In overfilled cases, an extended observation period is needed to see if delayed healing may be the final outcome.

Conclusions

Asymptomatic endodontically treated teeth with persistent small periapical radiolucencies, in particular those with overfill, should generally not be classified as failures. The long observation periods used, and the results obtained in the present study, indicate that many of these lesions will heal after a long period of time.

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