ORAL SURGERY
ORAL MEDICINE
ORAL PATHOLOGY

ENDODONTICS

Editor: Richard E. Walton

Clinical management of nonhealing periradicular pathosis

Surgery versus endodontic retreatment

John Danin, DDS,[a] Torsten Strömberg, DDS, PhD,[b] Hanz Forsgren, DDS,[c]
Lars E. Linder, DDS, PhD,[d] and Lars O. Ramsköld, DDS,[a] Huddinge, Sweden
KAROLINSKA INSTITUTET, HUDDINGE UNIVERSITY HOSPITAL

Nonhealing periradicular pathosis associated with endodontically treated teeth is customarily managed by revision (retreatment). Root-end resection is less often the first choice of treatment.

Objectives. This prospective randomized study compared the outcome of retreatment and surgical intervention in root canal treated teeth with nonhealing periradicular pathosis.

Study design. One such tooth from each of 38 patients was randomly allotted to retreatment or root-end resection and root-end filling. Treatment outcome after 1 year was evaluated and compared clinically and radiographically.

Results. The success rate for surgery was higher than for conventional retreatment, but the difference was not statistically significant.

Conclusions. For management of nonhealing periradicular pathosis associated with root canal treated teeth, surgical intervention should be considered as an alternative to retreatment. In cases with a similar prognosis for both modes of treatment, the choice should be governed by consideration of intrinsic and extrinsic factors.

(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1996;82:213-7)

Bacterial infection of the dental pulp may lead to periradicular pathosis.[1] To eliminate the infection, conventional endodontic treatment requires thorough debridement and mechanical preparation of the root canal followed by filling.[2] The success rate is reported to vary between 54% and 96%.[3, 4] The wide variation is attributable to the type of study, the clinical experience of the surgeons, the evaluation techniques, and the diagnosis and status of the individual teeth. In one recent study,[4] a success rate of up 96% was reported for root canal treatment of teeth with vital or nonvital pulps without periradicular pathosis, and 86% for teeth with pulpal necrosis and periradicular radiolucencies. However, a much lower success rate, 62%, was reported for retreatment of teeth with periradicular pathosis.[4]

Table I. Distribution of cases in relation to the size of the periradicular lesion

Treatment	*≤5mm*	*>5mm*
Retreatment	12	6
Periradicular surgery	13	6

Conventionally, periradicular surgery is less often the first choice of treatment in nonhealing periradicular pathosis. Surgery may be undertaken after unsuccessful retreatment or when retreatment is impossible or has an unfavorable prognosis.[5] The reported success rates for surgery range from less than 50%[6] to as high as 90%.[7]

The aim of the present investigation, a prospective randomized study, was to compare the treatment outcome when nonhealing periradicular pathosis in root canal treated teeth was managed by either retreatment or by surgical intervention. A prospective study enables direct comparison of results and circumvents some of the problems inherent in retrospective studies.

This study has been supported by grants from the Swedish Dental Association and Praktikertjänst AB.
[a]Assistant Professor, Department of Endodontics.
[b]Associate Professor and Head of the Department of Endodontics.
[c]Assistant Professor, Department of Oral Surgery.
[d]Associate Professor, Department of Oral Microbiology.
Received for publication Oct. 3, 1995; returned for revision Nov. 16, 1995 and Feb. 7, 1996; accepted for publication Mar. 11, 1996.

1079-2104/96/$5.00 + 0 **7/15/73825**

Table II. Correlation between the different healing groups and the quality of the previous root canal filling

Healing group	*Group A*	*Group B*	*Group C*	*Group D*
Retreatment				
Complete/incomplete healing	2		3	
Uncertain		3	2	
Failure	1	2	4	2
Total	2	5	9	2
Periradicular surgery				
Complete/incomplete healing	2	4	5	
Uncertain	1	2	2	
Failure	1	1	1	
Total	4	7	8	

Group A (>3mm short of apex), Group B (1-3 mm short of apex), Group C (apex ±1 mm from apex), group D (>1mm beyond apex).

MATERIAL AND METHODS

The participants were 38 patients with periradicular pathoses with root canal filled incisors, canines, and premolars, referred for specialist treatment at the Department of Endodontics, Karolinska Institutet, Stockholm. The distribution of cases in relation to the size of the periradicular lesion is shown in Table I. Only one tooth per patient and only teeth for which both retreatment and periradicular surgery were technically feasible were included. The patients were randomly allotted to retreatment, Group E, or periradicular surgery, Group S.

One patient in Group E was later excluded because of an uncertainty as to whether the periradicular lesion was associated with the tooth in question. The remaining 37 patients were 20 men and 17 women, with a mean age of 52 years, range 24 to 80 years.

Twenty-eight teeth were single-rooted, and 9 were double-rooted. Although not a criterion for inclusion in or exclusion from the material, the quality of the existing root canal filling at baseline was assessed according to the criteria of Kerekes and Tronstad[8] (Table II). This factor has been shown in other studies to influence the long-term results of endodontic treatment.[4]

Conventional retreatment (Group E)

The group comprised 19 patients. All retreatments were performed by an experienced endodontist (T.S.). Procedures were performed under aseptic conditions with a rubber dam. The tooth, the clamp, and the rubber dam were soaked with 30% hydrogen peroxide solution and 0.5% chlorhexidine in ethanol (70%). Pulp chambers and canals were prepared for standard access. The existing root canal fillings were softened with sterile chloroform and removed with S-files (Sjödings, Kista, Sweden). The working length, approximately 1 to 2 mm from the apical foramen, was determined radiographically from two directions. Irrigation was frequent with 0.5% sodium hypochlorite. Canals were enlarged with S-files to at least two sizes greater than the first instrument to engage in the apical dentin. Calcium hydroxide paste (Calasept; Scania Dental AB, Knivsta, Sweden) condensed with paper points was used as an intracanal dressing. The access openings were sealed with zinc oxide-eugenol.

After 3 months the dressing was removed, the root canals were dried with paper points, dehydrated with 95% alcohol, and root filled by lateral condensation with resin chloroform and softened gutta-percha points (Maillefer, Ballaigues, Switzerland). Radiographs were taken from two directions to determine the density of the root canal fillings.

Surgical treatment (Group S)

Nineteen patients were treated under local anesthesia by surgical intervention by the same oral surgeon (H.F.). A standard routine was followed. Access to the apical region of the tooth was achieved by vertical incisions and elevation of a mucoperiosteal flap from the gingival margin. If necessary, a bur was used to removed bone under irrigation with sterile saline solution. Soft tissue was removed with an excavator. A 2- to 3-mm portion of the apex of the tooth was resected at 45 degrees to the axis of the root canal, and an apical cavity approximately 2 mm deep was prepared with a round bur (ISO size 010). No conditioner was used on the resected dentin surface. Under dry conditions, the cavity was filled with glass ionomer cement (Chem-fill II, De Trey, Zurich, Switzerland); the material was mixed to a proper consistency and inserted into the cavity with a smooth instrument. The mucoperiosteal flap was repositioned and sutured. The sutures were removed 1 week postoperatively, and subjective and clinical symptoms were noted. For future evaluation of healing, postoperative radiographs were taken.

Clinical and radiographic evaluation

All patients were examined clinically and radiographically approximately 1 year after treatment. The clinical examination followed routine procedures for subjective and objective findings. Radiographs were taken in both orthogonal and eccentric projections, and examined in a viewer with a magnifying glass. The radiographic findings were analyzed by two different observers (J.D. and L.R.) according to the method described by Halse and Molven.[9] The two observers calibrated their criteria before analysis; only a few cases required subsequent joint evaluation

Table III. Healing 1 year after retreatment and periradicular surgery

	Complete/incomplete healing	*Uncertain*	*Failure*	*Total*
Retreatment	5	5	8	18
Periradicular surgery	11	5	3	19
Total	16	10	11	37

to reach agreement. Treatment outcome was assessed according to the criteria of Rud et al.[10]: category 1, complete healing; category 2, incomplete healing (scar tissue); category 3, uncertain healing; and category 4, unsatisfactory healing (failure). In teeth with two treated canals, the result of the less successfully treated root was recorded.

Category 1: Complete healing: (successful). Reestablishment of a periodontal space has occurred and lamina dura can be followed. The periodontal space in the apical region may be up to twice the normal width. A tiny defect in the lamina dura (maximum 1 × 2 mm) adjacent to the root canal filling was acceptable. As well as cases with complete repair, this group included cases in which the apical periodontal space cannot be discerned.

Category 2. Incomplete healing (scar tissue). The size of the radiolucency has remained stationary or has decreased. Bone structure is often lacking centrally. The lesion has an irregular periphery and may be demarcated by a compact bone border. The rarefaction is often located asymmetrically around the apex. Bone surrounding the rarefaction may show a fine-meshed structure or coarse bone trabeculae interspersed with radiolucent areas. A lamina dura may be formed at the apex.

Category 3: Uncertain healing. This group includes cases with some degree of bone regeneration. The initial rarefaction has decreased compared with the posttreatment condition or a subsequent follow-up radiograph. The size of the rarefaction is more than twice the width of the normal periodontal space. The periphery of the rarefaction is nearly always circular or semicircular. The rarefaction is usually located symmetrically around the apex as a funnel-shaped extension of the periodontal space. Teeth remaining in this group after 4 years are failures.

Category 4: Unsatisfactory healing (failures). The rarefaction is either enlarged or unchanged in comparison with a postoperative or previous follow-up radiograph.

Statistical analysis

The differences between the two treatment groups were analyzed statistically by Chi-square test with two degrees of freedom.

Table IV. Healing 1 year after retreatment and periradicular surgery in relation to original size of apical lesion

	Complete/incomplete healing	*Uncertain*	*Failure*	*Total*
Retreatment				
≤5 mm	3	3	6	12
>5 mm	2	2	2	6
Total	5	5	8	18
Periradicular surgery				
≤5 mm	8	3	2	13
>5 mm	3	2	1	6
Total	11	5	3	19

RESULTS

Of 37 teeth, 18 were retreated and 19 had surgery. There were no statistically significant differences as to outcomes between the two treatment groups.

In treatment group E (retreatment), five teeth (28%) showed complete healing or improvement; in five (28%), the results were uncertain; and eight (44%) teeth were assessed as failures (Table III). Four teeth showed symptoms; all these were referred to the failure group on radiographic findings.

In treatment group S (surgery), 11 teeth (58%) showed complete healing or improvement; in five (26%), the results were uncertain; and three teeth (16%) were assessed as failures (Table III). One tooth that had been referred to the failure group on radiographic findings showed symptoms.

No positive correlation was observed between the different healing groups and the size of the apical lesion (Table IV) or the quality of the previous root canal fillings (Table II).

DISCUSSION

An endodontically treated tooth with persistent periradicular pathosis is customarily managed by retreatment; periradicular surgery and a retrograde apical seal is less often considered as the first choice.[5, 11] Retrospective studies that compared the outcomes of these two modes of managing persistent periapical pathosis in endodontically treated teeth have been published. Allen et al.[12] found that the success rate for retreatment was 66%, with an additional 18% uncertain cases, whereas for surgery the success rate was 54%. To our knowledge there are no previously published randomized prospective studies comparing the two treatment modes.

Factors that influence the choice between retreatment or surgical intervention include the risk of complications as a result of proximity of nerves and other structures, the quality of the existing root canal filling, root and root canal anatomy, and the presence of

prosthetic restorations. The inclusion criteria applied to case selection in the present study were intended to minimize the influence of such factors on treatment outcome.

To seal the resected root apex, glass ionomer cement was used in our study. In a prospective long-term clinical study[13] that compared tissue response to amalgam and glass ionomer cement as retrograde fillings after root-end resection, no differences in healing could be shown for the two materials; a success rate of 85% was reported after an observation period of 5 years. Like other materials, glass ionomer cement requires a dry field but offers the advantages of biocompatibility[14] and adhesion to dentin.[15]

Because of the lack of generally accepted criteria for success and failure of treatment of periapical pathosis, the results of different studies are difficult to compare. This applies to studies assessing the outcome of both retreatment and of surgical intervention. For root canal treatment, Strindberg[16] proposed three categories: success, uncertain, or failure.

The most commonly applied description of the outcome of apicectomy (periapical surgery) is by Rud et al.,[10] namely, complete healing, incomplete healing (scar tissue), uncertain, or unsatisfactory. To compare the outcome of the two treatments in the present study, Rud's second category, healing with scar tissue (present only in surgery cases), was included in the group categorized as complete healing.

In our study, treatment outcome was assessed radiographically after 1 year because several studies of periapical surgery have shown this to be a valid interval for follow-up.[13, 17, 18] Teeth that show either complete healing or an unsatisfactory outcome 1 year postoperatively tend to be unchanged over a prolonged observation time.[17] If healing has resulted in reestablishment of normal periapical structure, the risk of subsequent failure is minimal.[17] Prolonged observation is necessary, however, for teeth in which the outcome has been assessed as uncertain; cases that are unchanged after 4 years are failures.[17]

Teeth with periapical pathosis that are retreated and in which the outcome has been assessed as "complete healing" or "unsatisfactory" tend to remain unchanged over time.[16] In a study by Molven and Halse,[19] retreated teeth assessed with uncertain healing (increased width of the periodontal space) were reassessed after 10 to 17 years. At this stage, more were reassessed as successes than as failures.

Sjögren et al.[4] found the success rate for retreatment of nonhealing teeth to be 62% after 8 to 10 years. Several authors[4, 16] have stressed the importance of a long observation time for treated teeth with periradicular lesions. In our study the success rate of endodontic retreatment was 28%. Our lower figure may be partly attributable to the short observation time; results reported by Molven and Halse[19] from longer observation periods showed gradual improvement. Another contributing factor might be the size of the periradicular lesion at the time of intervention: Sjögren et al.[4] found a lower success rate (38%) for teeth with initially large periradicular lesions (>5 mm). Our material comprised a relatively higher proportion of large lesions.

At the end of the observation period, patients in whom treatment failed underwent additional procedures. During the observation period, four patients from the endodontic retreatment group experienced objective or subjective symptoms and had periapical surgery. At the end of the 1-year observation period, one of these patients showed complete healing, whereas the outcome in the other three was uncertain.

Our findings have important clinical implications: in management of nonhealing periradicular pathosis associated with a root canal treated tooth, the clinician should not routinely undertake conventional retreatment without considering surgical intervention as an alternative. Extrinsic factors such as patient comfort, cost, and healing time may decisively influence the choice of treatment. The study is currently being enlarged, and the observation period prolonged.

CONCLUSIONS

Although not statistically significant, on the basis of a limited number of patients and a relatively short observation period, the results of the present study show a tendency toward a higher success rate for teeth treated by surgery over retreatment.

We thank A. Heimdahl for help and encouragement, Joan Bevenius for linguistic advice, and I. Telme for valuable technical assistance.

REFERENCES

1. Möller ÅJR, Fabricius L, Dahlén G, Öhman AE, Heyden G. Influence on periapical tissues of indigenous oral bacteria and necrotic pulp tissue in monkeys. Scand J Dent Res 1981; 89:475-84.
2. Friedman S. Retrograde approaches in endodontic therapy. Endod Dent Traumatol 1991;7:97-107.
3. Eriksen HM. Endodontology-epidemiologic considerations. Endod Dent Traumatol 1991;7:189-95.
4. Sjögren U, Hägglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. J Endod 1990;16:498-504.
5. Nygaard-Østby B. Introduction to endodontics. Oslo, Norway: Universitetsförlaget, 1971:1-83.
6. Hirsch J-M, Ahlström U, Henrikson P-Å, Heyden G, Peterson L-E. Periapical surgery. Int J Oral Surgery 1979;8:173-85.
7. Harty FJ, Parkins BJ, Wengraf AM. The success rate of api-

cectomy:a retrospective study of 1,016 cases. Br Dent J 1970;129:407-13.
8. Kerekes K, Tronstad L. Long-term results of endodontic treatment performed with a standardized technique. J Endod 1979;5:83-90.
9. Halse A, Molven O. A strategy for the diagnosis of periapical pathosis. J Endod 1986;12:534-8.
10. Rud J, Andreasen JO, Möller Jensen JE. Radiographic criteria for the assessment of healing after endodontic surgery. Int J Oral Surg 1972;1:195-214.
11. Bergenholtz G, Lekholm U, Milthon R, Heden G, Ödesjö B, Engström B. Retreatment of endodontic fillings. Scand J Dent Res 1979;87:217-24.
12. Allen RK, Newton CW, Brown CE Jr. A statistical analysis of surgical and nonsurgical endodontic retreatment cases. J Endod 1989;15:261-6.
13. Jesslén P, Zetterqvist L, Heimdahl A. Long-term results of amalgam versus glass ionomer cement as apical sealant after apicectomy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995;79:101-3.
14. Zetterqvist L, Anneroth G, Nordenram Å. Glass-ionomer cement as retrograde filling material. Int J Oral Maxillofac Surg 1987;16:459-64.
15. Beech DR. Improvement in the adhesion of polyacrylate cements to human dentine. Br Dent J 1973;135:442-5.
16. Strindberg L. The dependence of the results of pulp therapy on certain factors: an analytic study based on radiographic and clinical follow-up examinations. Acta Odontol Scand 1956;14(suppl 21):1-175.
17. Rud J, Andreasen JO, Möller Jensen JE. A follow-up study of 1,000 cases treated by endodontic surgery. Int J Oral Surg 1972;1:215-28.
18. Halse A, Molven O, Grung B. Follow-up after periapical surgery: the value of the one-year control. Endod Dent Traumatol 1991;7:246-50.
19. Molven O, Halse A. Success rates for gutta-percha and Kloroperka N-Ø root fillings made by undergraduate students: radiographic findings after 10-17 years. Int Endod J 1988;21:243-50.

Reprint requests:
John Danin, DDS
Department of Endodontics
School of Dentistry
Karolinska Institutet
Box 4064
S-141 04 Huddinge
Sweden