

Long-Term Evaluation of Surgically Placed Amalgam Fillings

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The coauthors of this article had developed the clinical impression that whereas surgically placed amalgam fillings are successful on a short-term basis, the long-term prognosis for these cases may not be nearly as favorable. In order to test this hypothesis, as many patients as could be contacted, either directly or indirectly, who had been treated before 1981 were evaluated. Excluded from this study were cases for which failure could be attributed to any reason other than failure from the amalgam reverse filling. Therefore, all cases included had to demonstrate periapical healing prior to ultimate breakdown. On this basis, 60 of 104 teeth (57.7%) were considered to be successful and 44 teeth (42.3%) were determined to be failures.

The final objective of endodontic therapy is to seal the apical foramen of the treated tooth at the cemental-dentinal junction (1). Generally, this is accomplished with nonsurgical treatment by going through the crown and root of the tooth and packing the apical third, or more, of the root canal with filling materials. Both theoretically and practically, the apical foramen may be sealed surgically from the apex into the tooth, and this procedure has been referred to as a reverse filling or retrofill (2). In some instances this is the only direction available, because of a large post/core, a sectioned silver point, or an unlocatable extremely narrow canal space being present associated with endodontic failure and/or periapical symptoms (2).

Maxmen (3) wrote several papers in the 1930s and described a veritable atlas of surgery to be used when pulpal and/or periapical problems were present. Indications for surgery included periapical lesions, blunderbuss apices, broken instruments or filling materials, lateral or apical perforations, dilacerated roots, dens-in-dente, and many others (3). However, most surgical treatment at that time involved some type of cutting away of a portion of the root with minimal concern for the quality or even the presence of an existing canal filling. Many of these cases became recalcitrant and lesions returned or extended after surgery. Being aware of the higher chance

of failure caused by improper apical seal, some operators began to use reverse fillings routinely in connection with apicoectomy or curettage to fortify the apical seal (4-6).

A myriad of dental and medical materials were used for this procedure, but silver amalgam has been the most frequently selected for many years. Garvin (4), Luks (5), and Nicholls (6) are credited with early descriptions of such procedures in lectures, presentations, and reports.

However, it was not long before doubts were raised as to the efficacy of amalgam. In 1959, Omnell (7) described a cytotoxic precipitate of zinc carbonate and theorized that the zinc came from the amalgam. This led to the use of zinc-free amalgam as the preferred material, but other papers (8, 9) indicated desirable reactions from the zinc-free fillings, too.

Changes in the usage of amalgam included the use of cavity varnish before its placement to improve the seal (10, 11). Some articles started to suggest that amalgam be replaced for this procedure, as Tanzilli et al. (12) indicated that cold-burnished gutta-percha had less marginal defects.

Despite these negative reports, often based on in vitro studies, the apical amalgam filling has been strongly advocated by many clinicians. On a short-term basis, most cases demonstrated healing radiographically and absence of symptoms which reaffirmed the validity of such treatment. It was comfortable for the amalgam users to anticipate perpetuation of this success, concluding that amalgam reverse filling was the ultimate in surgical therapy. Some practitioners, convinced of its reliability, promiscuously placed reverse fills whenever the apex was available surgically, even if a canal well filled with gutta-percha was present. However, longer term follow-ups were indicating failures not anticipated by the short-term success. Many articles were now questioning the use of amalgam as the surgically placed material of choice, and many articles on alternatives were published (13-16).

The coauthors of this article are four clinicians and educators, with a combined 131 yr of practice limited to endodontics, who at one time or another in their careers lauded the use of apically placed amalgam. However, we had come independently to the conclusion that whereas on a short-term basis (1 to 2 yr) these procedures were effective, we were observing that a significant number were breaking down after a longer time frame. Such a breakdown might include several of the following: tenderness of the tooth, establishment of a chronic sinus tract, development of a periapical radiolucency,

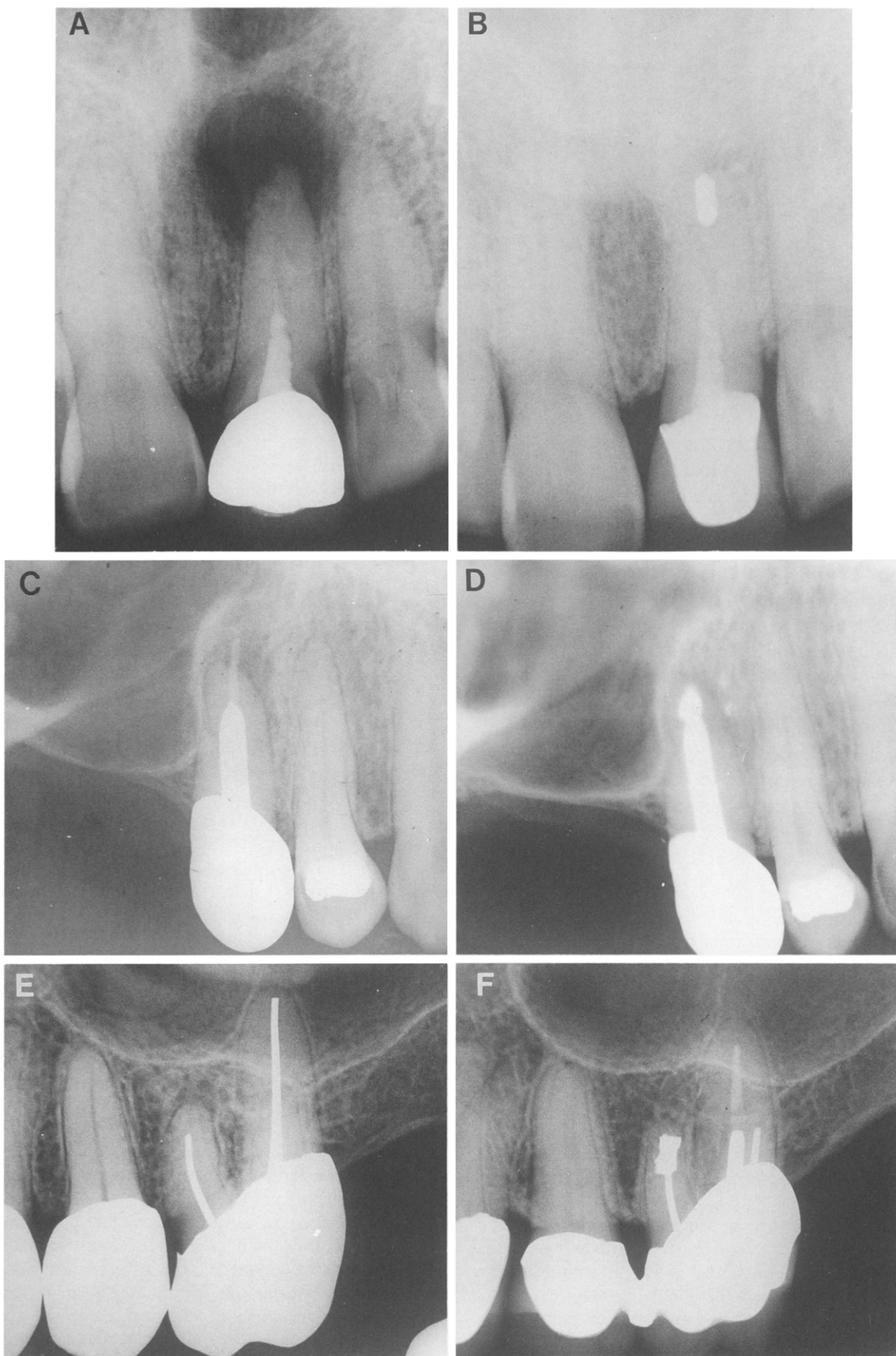


FIG 1. Typical successful cases. *A*, Preoperative film of maxillary central incisor, large periapical lesion, and partial paste filling. *B*, View 16 yr later with complete healing following apical curettage and placement of apical amalgam. *C*, Preoperative view of maxillary second premolar, overextended gutta-percha filling, periapical radiolucency, and apical tenderness. Large post would make removal hazardous for nonsurgical retreatment. *D*, Film taken 12 yr later with excellent healing following curettage and apically placed amalgam. Note, amalgam seems to be in direct contact with metal post. *E*, Preoperative radiograph of maxillary first molar, periapical lesion associated with mesiobuccal root and apical tenderness. *F*, Film taken 18 yr later. At time of surgery, 2 MB canals were located, so figure eight-type preparation was utilized for placement of apical amalgam and excellent healing is seen. A new crown is now present, and the palatal canal was retreated with gutta-percha as filling material in order to provide for a post.



FIG 2. Case considered to be successful, with radiographic appearance of a fibrous scar. Maxillary lateral incisor, the tooth most commonly seen in association with an apical scar, had been treated 11 yr earlier with apical curettage and apical amalgam. Note that the periodontal ligament space surrounding the tooth is quite regular, and the radiolucency is a few millimeters apical to it. The original periapical lesion was several times larger and in close proximity to the root tip.

and mobility. We decided to undertake a study that would emphasize the longer term evaluation of the reverse filling amalgam surgical method.

DESIGN OF THE STUDY

Most of the studies evaluating surgically placed amalgam fillings have lumped all failures into a single category, regardless of the type of failure demonstrated. However, it is apparent that some failures may result from faulty technique or analysis, such as inability to seal major canal apical openings, perforations, anatomical abnormalities and anomalies, improper preparation or management of the material, and so forth. Other failures may accrue from faulty diagnosis, such as undiscovered root fracture, serious periodontal disease, inability to analyze the prevailing canal configuration, failure to identify restorative limitations, and so forth. And, of course, some failures are inexplicable.

With these factors in mind, and in an effort to evaluate the effectiveness of the apically placed amalgam only, this study was designed to segregate out all other failures. Each case used

in this study had to have a recall radiograph that verified beyond a doubt that postsurgical healing did occur. No failure was accepted without prefailure evidence of success.

We are aware that this demand was most stringent and might represent a reverse bias by our project. However, we believed that only in this way could we establish a clear method by which long-term effectiveness could be measured.

MATERIALS AND METHODS

The authors attempted to recall patients on whom we had performed surgery with apical amalgam fillings 10 or more years earlier. These patients were asked to return to our offices, where one or more radiographs were taken and the clinical conditions of the tooth were evaluated, particularly in regard to mobility, soreness, tenderness to percussion, and the presence of a sinus tract.

If the patient could not be located directly, the referring dentist or a subsequent dentist was contacted. A radiograph, at least 10-yr postoperative, was requested from the dentist for substantiation and, if known, the prevailing clinical condition of the tooth was reported. In cases where the tooth had been extracted, information concerning the reason for extraction was obtained, along with the pertinent radiograph. Other patients were evaluated when they returned for endodontic treatment on another tooth. In these cases, radiographic and clinical examinations were conducted as stated earlier.

A case was declared to be successful if the treated tooth was comfortable and functional, no clinical symptoms were present, and the radiograph indicated that the lesion had healed. In several cases, a radiolucency area that was consistent with being a fibrous scar was noted, and considered to be a success. For a case to be listed as a failure, a previous radiograph had to indicate that healing had previously occurred. An analysis of the failure had to eliminate all possibilities other than the reverse filling. Therefore if root fracture, periodontal failure, restorative failure, or a similar problem was diagnosed, the case was not included in this study.

RESULTS

One hundred four teeth from 96 patients conformed to the requirements for inclusion in this study. Of these, 60 (57.7%) were found to be successful, averaging 15.1 yr after surgery (Fig. 1). Of these, three teeth were considered to be successful, with fibrous scar tissue (Fig. 2). Forty-four teeth (42.3%) were deemed to be unsuccessful, averaging 11.9 yr after surgery (Figs. 3 and 4, Table 1). Several of the failures were retreated, using apically placed filling materials other than amalgam and some of these indicated healing (Fig. 5). Because none were treated for more than 10 yr, no final declaration as to the outcome, as defined in this study, could be made.

DISCUSSION

On the major question of interest in this investigation, the results indicated that long-term success of the apically placed



FIG 3. Case considered to be a failure. *A*, Preoperative film of maxillary cuspid and lateral incisor. Cuspid has periapical lesion, apical soreness, and short canal filling with post present. Lateral incisor has large proximal restorations involving the pulp. *B*, First lateral incisor was treated nonsurgically and post placed to protect against fracture, then the cuspid was flapped and treated with curettage, apicoectomy, and apical amalgam. This film was taken after surgery. *C*, Film taken 7 months later, indicating excellent healing. Crown preparation had been completed on the lateral. *D*, View 11 yr later, periapical radiolucency is now present on the cuspid and the tooth is very sore at the apex. Lateral incisor has new post, core, and crown.

amalgam procedure was in the vicinity of 60%. This is not as high as many clinicians have believed, because once they noted short-term success, indicated by the initial healing of radiographic lesions, they assumed that no other problems would occur. In this article, the 42.3% of failures had to include at least one film indicating complete healing prior to the time of breakdown (Figs. 3C and 4C). Therefore, at one time or another, *all* of the cases in this report would have been considered to be successful by many observers.

The percentage of success for this article compares favorably with the recent report by Grung et al. (17), who reported 65.2% success of "retrograde fillings." Although their observation periods extended for 2 to 8 yr postoperatively, the average was only 2.3 yr, and recalls ceased on most cases that appeared to be healed after 1 yr. Surely some of these cases would breakdown later, if our study is accurate.

The authors of this report are aware of the potential dangers inherent in retrospective studies. This is particularly true when the investigation includes clinical cases treated by four different operators, across a 15 or more year period, using several different techniques, and with only an unknown percentage of recalls evaluated. However, if such information is ignored, is the endodontic community better off than if it is compiled? We believe that this information has considerable value, despite the limitations of the design. In a very recent article attempting to analyze the various materials available, Friedman (18) stated that clinical evaluations (*in vivo*) were more relevant than any studies performed *in vitro*, and that the most valid evaluations were long-term retrospective clinical studies of many cases. Our study certainly complies with that view.

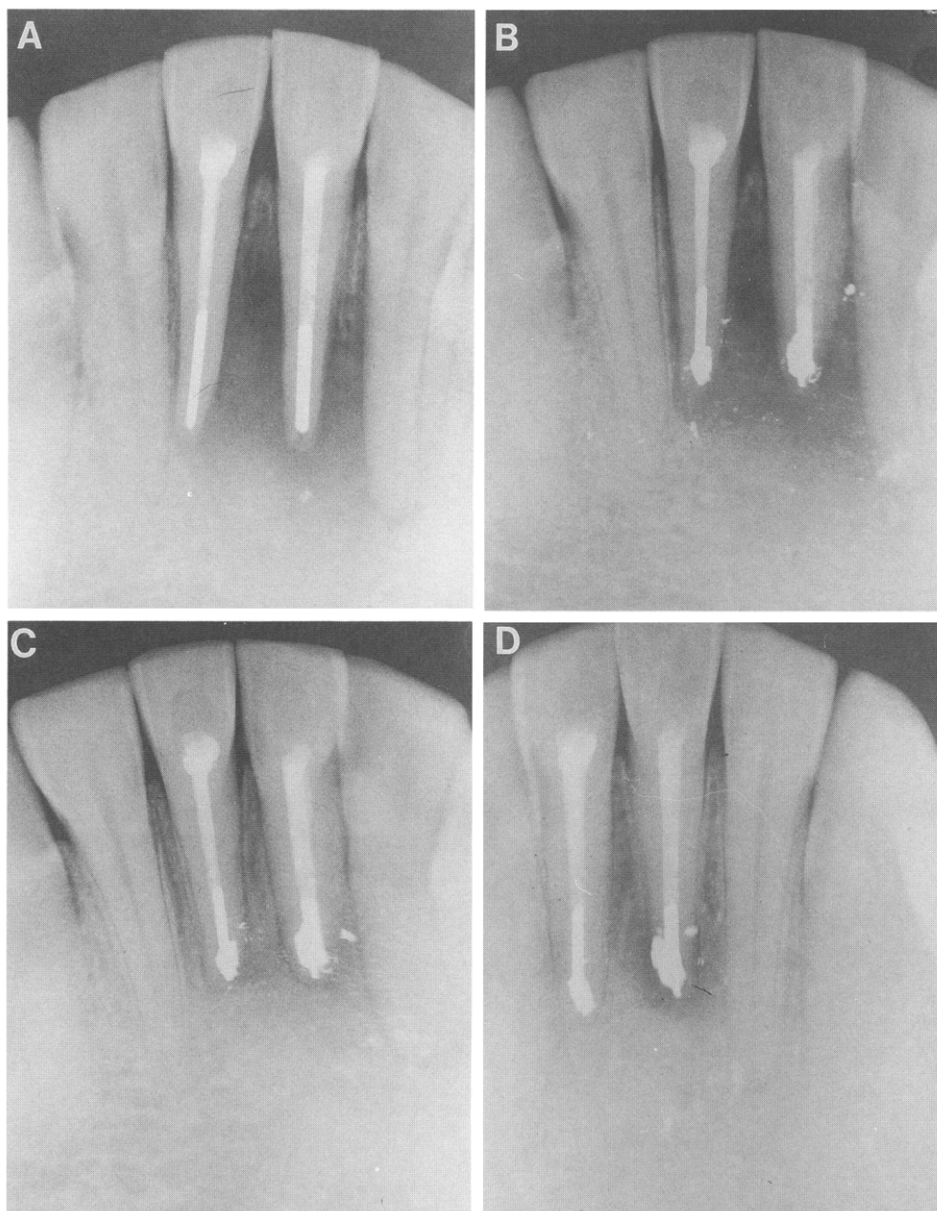


FIG 4. Case typical of this study. *A*, Preoperative view of mandibular central incisors, indicating large periapical lesions associated with teeth filled with sectioned silver points. *B*, Because of the difficulty involved in removing the silver points, apical surgery was performed. This film was taken after apicoectomies, curettage, and placement of apical amalgams. *C*, After 5 yr, periapical healing is complete for both roots. *D*, However, 6 yr later a radiolucency is present surrounding one apex and a sinus tract drains intermittently. The other tooth is still fine.

In addition to the major question answered, this study presented a number of additional questions that should be addressed, but which could not be conclusively answered based on the data obtained.

1. Is a success rate of approximately 60% acceptable for a 10+-yr period? The authors of this article believe that this percentage can be increased by variation of some of the procedures involved in apically placed fillings. Some of the alternative filling materials, as suggested by Oynick and Oynick (13), Dorn and Gartner (16), and, Friedman (18), should be considered to replace amalgam as the filling material of choice. In fact, because of the potentially questionable outlook for reverse filling procedures, we believe that canals should be retreated and refilled from a coronal approach whenever possible. This is still true even if surgery is anticipated, because

then curettage or apicoectomy could be performed into a well-filled canal.

2. Are the failures due to the amalgam as the apically placed material, or would similar results be obtained if alternative materials were used? At this time, we have no way to know the answer. Further studies will be required to evaluate the success/failure situation with these newer materials. When done, these reports should include *in vivo* investigations of long-term observation similar to those in this study. Several of the failures from this study were retreated surgically, effectively at this time (Fig. 5), by using some alternative filling material. However, these cases have not yet withstood the test of long-term observation to confirm success.

3. Are certain conditions more conducive to failure with apical amalgam fillings? Based on the data, no conclusions



FIG 5. A, Preoperative view of maxillary lateral incisor with failure of silver point filling, periapical lesion, and mobility. B, Apicoectomy was performed with surgically placed amalgam and apical curettage. This film was taken 4 yr after surgery and demonstrates excellent healing. C, However, 6 yr later a lesion is present and mobility has returned. D, Another apicoectomy was performed, and the old amalgam was removed and replaced with Super EBA cement. This film was taken 2 yr after the second surgery and demonstrates healing. The tooth is tight again.

could be drawn. Some clinicians are loathe to place apical amalgams directly into metal posts of silver points, fearing electrical activity from the dissimilar metals. Both successes (Fig. 1D) and failures were observed with these combinations. Other problems were predicted when very large amounts of alloy were used, based on the fear that amalgam expansion could lead to root fracture. The largest amount of amalgam

placed in this study yielded a successful case 12 yr postoperatively (Fig. 6). In general, the population of cases in each of these categories was too small to merit statistical inference.

4. Are certain conditions more conducive for success when placing amalgam surgically? It was the opinion of one of the coauthors (S. S P.), that when surgically placed amalgam were used to seal roots where the apex could not be reached

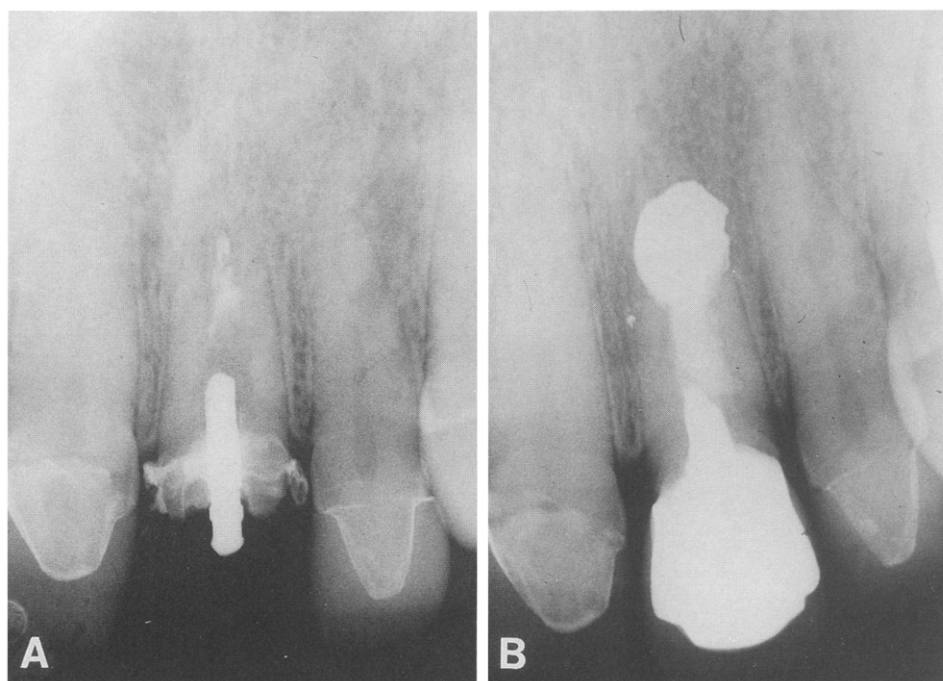


FIG 6. A, Preoperative radiograph of maxillary central incisor, incomplete canal filling, poorly fitting post, and periapical tenderness. B, The canal was prepared, refilled with gutta-percha, and apical surgery performed, including apicoectomy and the placement of an extremely large apical amalgam. This radiograph was taken 12 yr later, demonstrating excellent healing and no observable reaction to the amalgam.

TABLE 1. Successful and unsuccessful cases, listed by clinician

Clinician	Successful Cases	Unsuccessful Cases
Frank	26 (12.6 yr)*	18 (10.4 yr)
Glick	9 (19.9 yr)	11 (16.2 yr)
Patterson	16 (17.3 yr)	5 (10.1 yr)
Weine	9 (13.4 yr)	10 (11 yr)
Total	60 (15.1 yr)	44 (11.9 yr)
%	57.7	42.3

* Average number of years after surgery.

conventionally, usually due to excessive dentin deposition, success was more predictable. Another coauthor (F. S. W.) believed that fresh cases as opposed to retreatment failures, in which the lesion was circumscribed and vascular as opposed to shreddy and fibrous, were more prone to success. Unfortunately, there were too few cases to determine even a trend.

5. What happens to the root tip in the failing cases? There was a strong belief that apical resorption was a frequent finding as the cases began to fail (Figs. 3 and 4). However, it was uncertain whether or not the resorption was a requirement for failure or if it was merely a part of the failure process. If the resorption will occur regardless of the canal filling material used, it may be prognosticated that changing to a material other than amalgam will not be the answer.

6. A huge number of treated patients was not contacted in the recall process; would the results have been different if a larger percentage had been evaluated? The so-called "lost tribe" factor is always a problem when analyzing retrospective studies, but in this instance we know that many more teeth were treated than were reported here. Some of the patients who declined to return possibly did so because the treated

tooth had been extracted. All of the practices of the coauthors involve a considerable number of geriatric patients, and the necessity for 10-yr postoperative recall would put many of these individuals into an advanced age where infirmity or death would not be unusual. Therefore, we have no way of knowing the success to failure ratio of these uncounted patients, but we were aware that there were many of them.

Some endodontic clinicians and educators continue to use and extoll the virtues of the surgically placed amalgam filling procedure. Although they are aware of the recently introduced alternatives, or of the need to retreat and refill even if surgery is still necessary, this group questions the need to explore for substitutions. Because they are comfortable using their existing technique, they are dubious about the potential for other materials and methods to offer enough improvement to merit any changes.

It is our hope that this report will be an impetus for further investigations on materials and methods to replace apically placed amalgam fillings to give improved long-term results.

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References

1. Nguyen NT. Obturation of the root canal system. In: Cohen S, Burns RC, eds. *Pathways of the pulp*. 3rd ed. St. Louis, CV Mosby, 1984:205.

2. Luebke RG, Glick DH, Ingle JL. Indications and contraindications for endodontic surgery. *Oral Surg Oral Med Oral Pathol* 1964;18:97-113.
3. Maxmen HA. The expanding scope of endodontics. *J Mich Dent Assoc* 1959;41:125-40.
4. Garvin MH. Foci of infection in relation to non-vital teeth. *Natl Dent Assoc* 1919;6:195-210.
5. Luks S. Root end amalgam technic in the practice of endodontics. *J Am Dent Assoc* 1956;53:424-8.
6. Nicholls ES. Retrograde filling of the root canal. *Oral Surg Oral Med Oral Pathol* 1962;15:463-7.
7. Omnell K. Electrolytic precipitation of zinc carbonate in the jaw. *Oral Surg Oral Med Oral Pathol* 1959;12:846-52.
8. Wilson CJ, Ryge G. Clinical study of dental amalgam. *J Am Dent Assoc* 1963;66:763-71.
9. Watson PA, Phillips RW, Swartz MS, Gilmore HW. A comparison of zinc-containing and zinc-free amalgam restorations. *J Prosthet Dent* 1973;29:563-4.
10. Abdal AK, Retief DH, Jamison HC. The apical seal via the retrosurgical approach. II. An evaluation of retrofilling materials. *Oral Surg Oral Med Oral Pathol* 1982;54:213-8.
11. Tronstad L, Trope M, Doering A, Hasselgren G. Sealing ability of dentz amalgams as retrograde fillings in endodontic therapy. *J Endodon* 1983;9:551-3.
12. Tanzilli JP, Raphael D, Modonick RM. A comparison of the marginz adaptation of retrograde techniques: a scanning electron microscopic study. *Oral Surg Oral Med Oral Pathol* 1980;50:74-80.
13. Oynick J, Oynick T. A study of a new material for retrograde fillings. *J Endodon* 1978;4:203-6.
14. Gutmann JL, Harrison JW. Posterior endodontic surgery: anatomica considerations and clinical techniques. *Int Endod J* 1985;18:8-34.
15. Ruiz de Temino P. Cirugia periapical y radicular. In: Rodriguez MD, ed. *Cirugia bucal. Patologia y tecnica*. Madrid: Africa Azcarte, 1990:541-66.
16. Dorn SO, Gartner AH. Retrograde filling materials: a retrospective success-failure study of amalgam, EBA, and IRM. *J Endodon* 1990;16:391-3.
17. Grung B, Molven O, Halse A. Periapical surgery in a Norwegian county hospital: follow-up of 477 teeth. *J Endodon* 1990;16:411-7.
18. Friedman S. Retrograde approaches in endodontic therapy. *Endor Dent Traumatol* 1991;7:97-107.

You Might Be Interested to Know

The ultimate in recycling has apparently arrived. A purveyor of chocolate candy now markets them in a box made of spun protein, marzipan, biscuit, and rice paper. The box is totally edible (Grocer 1990:28).

Shouldn't do much for the DMF rate though. Perhaps a judicious inclusion of NaF? Nope, that would be "an additive" and not "natural."

Zachariah Yeomans