
The effect of root resection on the sealing property of root canal obturations

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Root canal systems of extracted anterior teeth were obturated with sealer and either multiple gutta-percha cones or single silver cones. The effect of root resection on the sealing property of these obturating materials was evaluated by autoradiographic methods. Results indicate that root resection with a rotary instrument in a high-speed handpiece does not adversely affect the sealing property of well-condensed gutta-percha-sealer obturations.

Root resection is an endodontic surgical procedure in which a portion of the root end is removed. The procedure is usually accomplished with a rotary instrument in a high-speed or low-speed handpiece. When root resection is performed on teeth with root canal systems which have previously been obturated, the plane of resection often passes through the obturating materials. The effect of the resection procedure on the sealing property of the obturating materials has not been determined.

In teeth with root canal systems which have well-condensed gutta-percha and sealer obturations, the root-resection procedure is sometimes followed by a clinical dilemma. The practitioner is faced with a decision as to whether or not it is in the best interest of the patient to place a retrofilling. The retrofilling procedure requires additional surgical time for the patient and necessitates an increased flap-retraction period which may lead to untoward postoperative sequelae. In addition, the retrofilling procedure is difficult to accomplish properly on certain roots of molar teeth (for example, lingual roots of maxillary molars, roots of mandibular molars). More important, the findings of Rud and associates¹ showed that the prognosis following endodontic surgery is significantly more favorable in teeth

filled orthograde with gutta-percha and sealer than in those filled retrograde with amalgam.

In teeth with root canal systems obturated with a single silver cone and sealer, Neagley² has shown that contact of a rotary instrument with the silver cone during dowel space preparation causes apical leakage. Extrapolation of these data suggests that contact of a bur with a silver cone during a root-resection procedure would disturb the apical seal. However, Nicholls³ has implied that root resection is less disruptive to the apical seal in a root obturated with a silver cone than in a root obturated with gutta-percha.

Some practitioners assume that the effectiveness of the apical seal is adversely affected by the root-resection procedure and routinely attempt to improve the seal by placing a retrofilling or by heat sealing exposed apical gutta-percha obturations.

The purpose of this investigation was to determine the effect of root resection on the apical seal of roots obturated with gutta-percha and sealer and with a single silver cone and sealer.

MATERIALS AND METHODS

Twenty-four anterior teeth with intact crowns were used in this study. The freshly extracted teeth were stored in 0.9 percent sodium chloride (normal saline) solution* until used experimentally.

In each tooth, a lingual access cavity was prepared, the gross contents of the pulp chamber and canal system were removed with a barbed broach, and the canals were prepared to a size 70 file at the apex. Normal saline solution was used as the irrigant during canal preparation.

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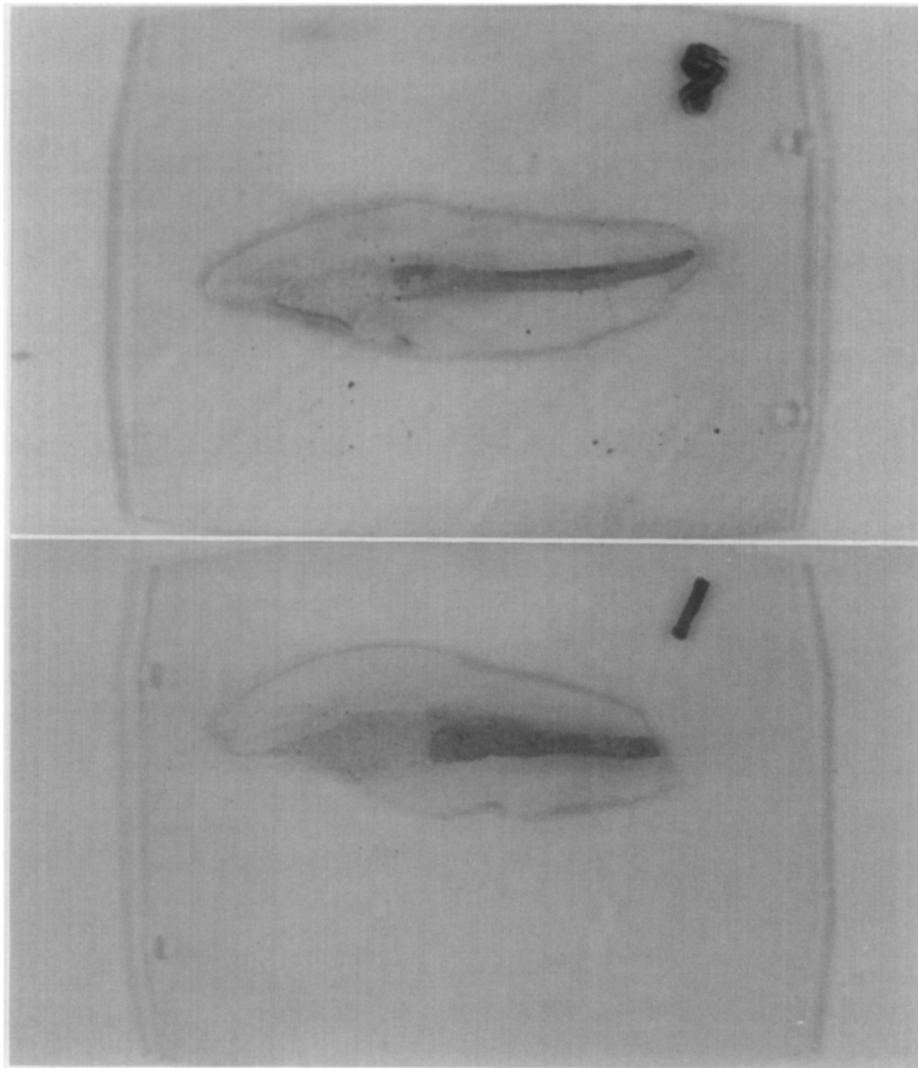


Fig. 1. Sections, 300 μm thick, cut from the center of Group 1 teeth, showing gutta-percha-sealer obturations. **Top:** Control nonresected root end (Specimen 2). **Bottom:** Experimental resected root end (Specimen 7).

The prepared teeth were divided into two groups of twelve teeth each. Group 1 teeth were obturated with multiple gutta-percha cones and sealer* by the lateral condensation technique. Group 2 teeth were obturated with a single size 70 silver cone and sealer.† After obturation, Cavit‡ was used to seal the lingual access cavities and the teeth were then placed in an atmosphere of 100 percent humidity for 1 week to allow the sealer to set.

After the 1-week maturation period, root resection was performed on half of the teeth in each of the two groups. Approximately 3 to 4 mm. of the root end was removed with a tapered fissure bur in a high-speed

handpiece. The plane of resection involved the obturating materials in all resected (experimental) specimens. The six nonresected teeth in each group served as controls.

A radioisotope solution of aqueous sodium sulfate ($\text{Na}_2\text{S}^{35}\text{O}_4$) was prepared with S^{35} in a concentration of 100 microcuries per milliliter.

With the exception of the root ends, all surfaces of the teeth were coated with sticky wax* to prevent surface absorption of the radioisotope. The teeth were then placed into the radioisotope solution.

After exposure to the radioisotope for 48 hours, all teeth were bench dried and the sticky wax was removed. The teeth were embedded in Epon 812† and

*Cutter Laboratories, Berkeley, Calif.

†Proco-Sol, Proco-Sol Chemical Company, Conshohocken, Pa.

‡Premier Dental Products Company, Philadelphia, Pa.

*Kerr Manufacturing Company, Detroit, Mich.

†Polysciences, Inc., Warrington, Pa.

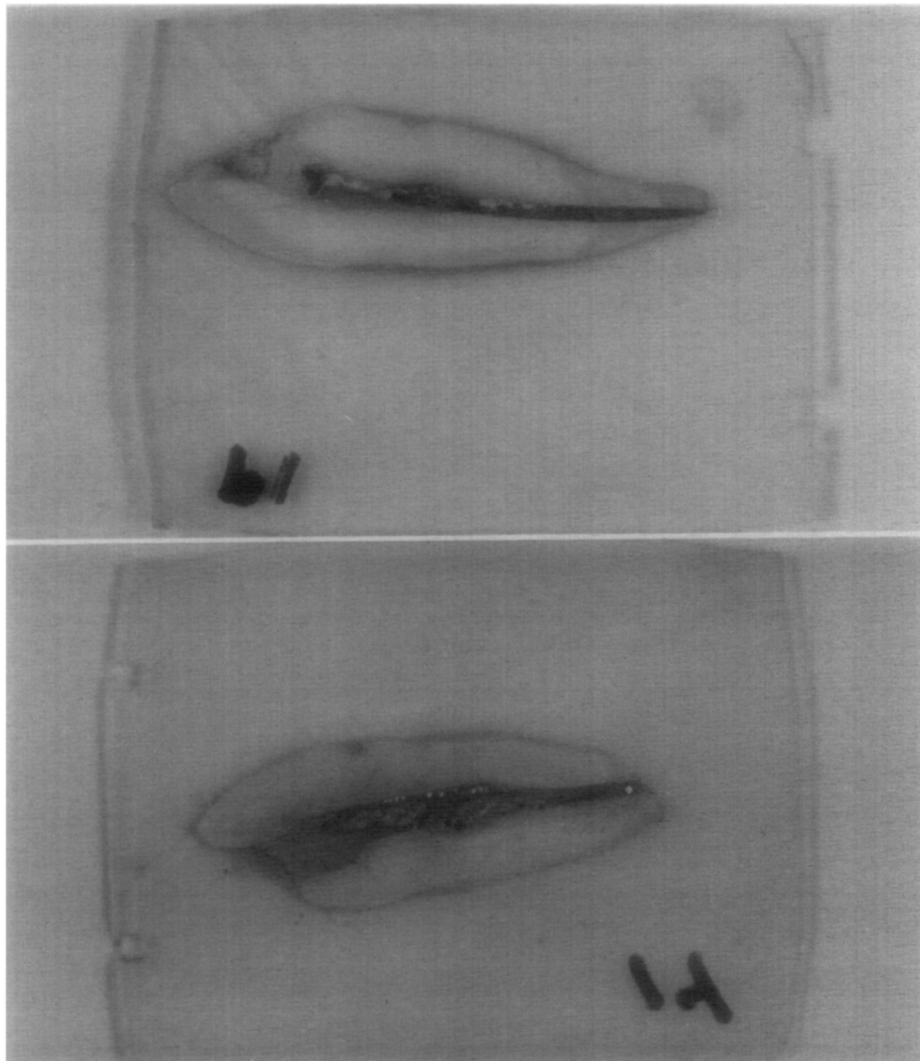


Fig. 2. Sections, 300 μm thick, cut from the center of Group 2 teeth, showing silver cone-sealer obturations. **Top:** Control nonresected root end (Specimen 13). **Bottom:** Experimental resected root end (Specimen 20).

cut longitudinally with a Bronwill TSM-77 thin sectioning machine.* A section 300 μm in thickness was obtained from the approximate center of each tooth (Figs. 1 and 2).

In a dark room, each section was placed between two intraoral ultraspeed x-ray films.† The section and films were enclosed between two plastic blocks and placed in a light-proof lead container. After 24 hours, the films were removed from the lead containers and developed according to the manufacturer's instructions. The resulting autoradiographs were projected onto a viewing screen at a magnification of $\times 20$, and the degree of apical penetration of the isotope was assessed by three evaluators. Penetration was recorded as none, minor

(<2 mm.), or gross (>2 mm.). All autoradiographs were coded to prevent evaluator bias.

RESULTS

In Group 1 teeth there was no apical isotope penetration in the control (nonresected) specimens or in the experimental (resected) specimens (Table I, Figs. 3 and 4).

In Group 2 teeth, the control specimens showed no penetration in three roots, minor penetration in one root, and gross penetration in two roots. The experimental specimens showed gross isotope penetration in all six roots (Table I, Figs. 5 and 6).

DISCUSSION

A retrofilling is placed following a root-resection procedure for the purpose of establishing an apical seal.

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†Eastman Kodak Company, Rochester, N. Y.

Table 1. Degree of apical penetration of S³⁵ in Group 1 and Group 2 control and experimental teeth

<i>Specimen No.</i>	<i>Root canal obturation</i>	<i>Root end</i>	<i>Apical penetration</i>
<i>Group 1, Control specimens</i>			
1	Gutta-percha and sealer	Not resected	None
2	Gutta-percha and sealer	Not resected	None
3	Gutta-percha and sealer	Not resected	None
4	Gutta-percha and sealer	Not resected	None
5	Gutta-percha and sealer	Not resected	None
6	Gutta-percha and sealer	Not resected	None
<i>Group 1, Experimental specimens</i>			
7	Gutta-percha and sealer	Resected	None
8	Gutta-percha and sealer	Resected	None
9	Gutta-percha and sealer	Resected	None
10	Gutta-percha and sealer	Resected	None
11	Gutta-percha and sealer	Resected	None
12	Gutta-percha and sealer	Resected	None
<i>Group 2, Control specimens</i>			
13	Silver cone and sealer	Not resected	None
14	Silver cone and sealer	Not resected	Minor
15	Silver cone and sealer	Not resected	Gross
16	Silver cone and sealer	Not resected	None
17	Silver cone and sealer	Not resected	None
18	Silver cone and sealer	Not resected	Gross
<i>Group 2, Experimental specimens</i>			
19	Silver cone and sealer	Resected	Gross
20	Silver cone and sealer	Resected	Gross
21	Silver cone and sealer	Resected	Gross
22	Silver cone and sealer	Resected	Gross
23	Silver cone and sealer	Resected	Gross
24	Silver cone and sealer	Resected	Gross

In teeth with poorly condensed root canal obturations which cannot be re-treated by a nonsurgical approach, the retrofilling is believed to be essential for a favorable prognosis.

Teeth with apparently well-condensed root canal obturations may also require surgical intervention because symptoms develop after endodontic treatment. In some of these cases, there is no clinically or radiographically discernible cause for the failure of the initial therapy. In other cases, a possible cause for the patients' symptoms may be discernible. The most frequently encountered examples are teeth with well-condensed root canal obturations which are several millimeters short of the radiographic apex because curvature, canal blockage, ledging, ect. prevented débridement and obturation of the apical portion of the canal system. If the practitioner is convinced that the obturation cannot be improved by re-treatment, endodontic surgery is indicated as an alternative preferable to extraction.

When root resection is performed on teeth with obturated canal systems, the plane of resection often involves the obturating materials. After careful inspection of the exposed obturating materials in the resected root, the practitioner must decide whether or not a retrofilling should be placed. The results of the present study show that the resection procedure, when ac-

complished with a rotary instrument in a high-speed handpiece, does not disturb the sealing property of a well-condensed gutta-percha-sealer obturation. If one accepts the premise that the only purpose of a retrofilling is to establish an apical seal, there is no indication for retrofilling in such teeth. However, the difficulty of determining whether or not a gutta-percha-sealer obturation is, in fact, well condensed is not to be minimized. Radiographic evidence of a well-condensed obturation may be misleading because of the two dimensional limitation of the x-ray. If doubt exists, a retrofilling should be placed.

The evidence that the root-resection procedure does not adversely affect the sealing property of gutta-percha-sealer obturations has several important important clinical applications. Because of difficult access and limited visibility, the retrofilling procedure is extremely difficult to accomplish properly on certain roots of maxillary and mandibular molars. Results of this investigation indicate that resection of a root to the level of a well-condensed gutta-percha-sealer obturation will result in an effective apical seal and obviate the need for a retrofilling. Also, the retrofilling procedure requires increased surgical time. Prolonged flap retraction is believed to result in an increased incidence and degree of untoward postoperative sequelae, such as

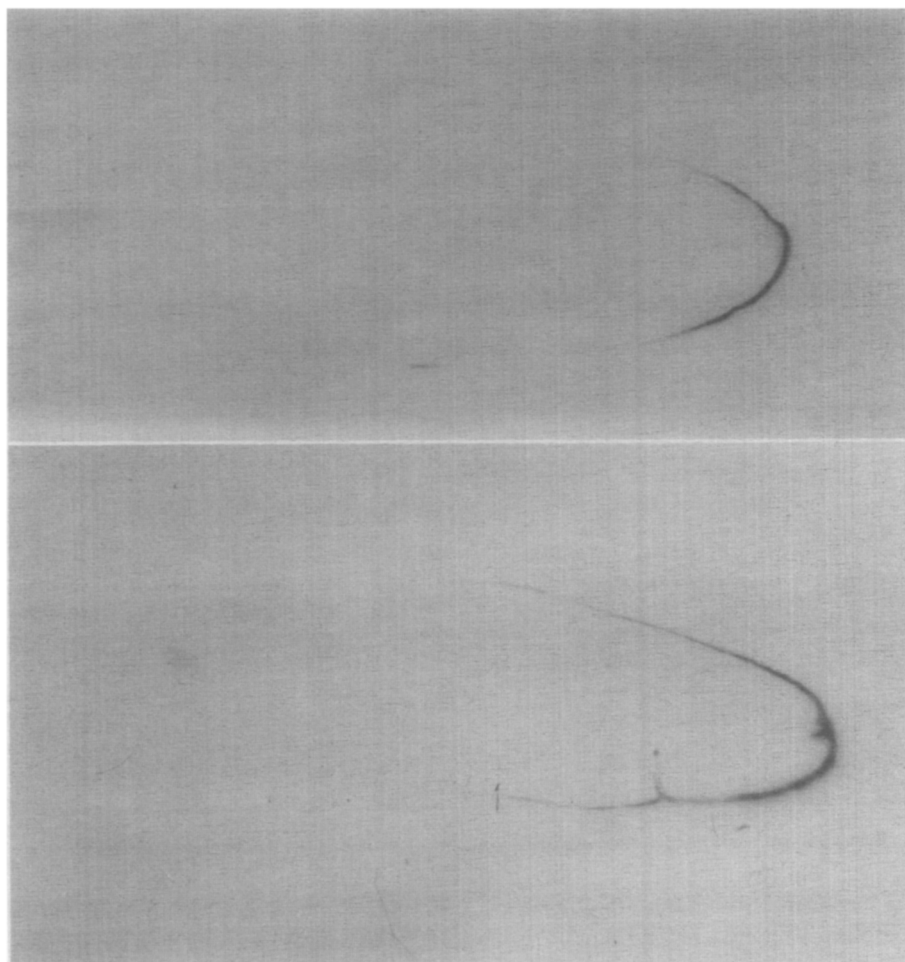


Fig. 3. Group 1 control autoradiographs. No evidence of apical radioisotope penetration. **Top:** Specimen 2. **Bottom:** Specimen 3.

pain, swelling, and delayed healing. In addition, Rud and associates¹ have shown a significantly higher failure rate following endodontic surgery in teeth filled retrograde with amalgam as compared to teeth filled orthograde with gutta-percha and sealer. All of these considerations should be carefully weighed before one decides whether or not to place a retrofilling.

The "heat-sealing" procedure is used by some practitioners in an effort to establish an apical seal following root resection. There is no available evidence to support the contention that heat sealing produces an effective apical seal. Conversely, Barry and co-workers⁴ determined that heat sealing adversely affected the sealing property of gutta-percha-sealer obturations. The effect of heat sealing on the sealing property of completely set sealer has not been determined.

In attempting to extrapolate the results of this laboratory investigation to the clinical situation, certain facts should be kept in mind. This investigation was conducted on teeth with root canal systems obturated with

multiple gutta-percha cones and sealer via the lateral condensation technique and with a single silver cone and sealer. The effect of root resection on the sealing property of other methods of obturation (warm gutta-percha, chloropercha, single gutta-percha cone, etc.) was not investigated and remains unknown. A rotary instrument in a high-speed handpiece was used. The effect of a rotary instrument in a low-speed handpiece was not investigated and remains unknown. The sealer was allowed to set for 1 week prior to the experimental root-resection procedure. The effect of root resection on the sealing property of unset or partially set sealer was not investigated and remains unknown.

The results observed in the control (nonresected) Group 1 teeth confirm the findings of Dow and Ingle,⁵ who reported no evidence of apical radioisotope penetration in teeth with well-condensed gutta-percha-sealer obturations placed by the lateral condensation technique. Marshall and Massler⁶ also concluded that a root canal system could be completely sealed against

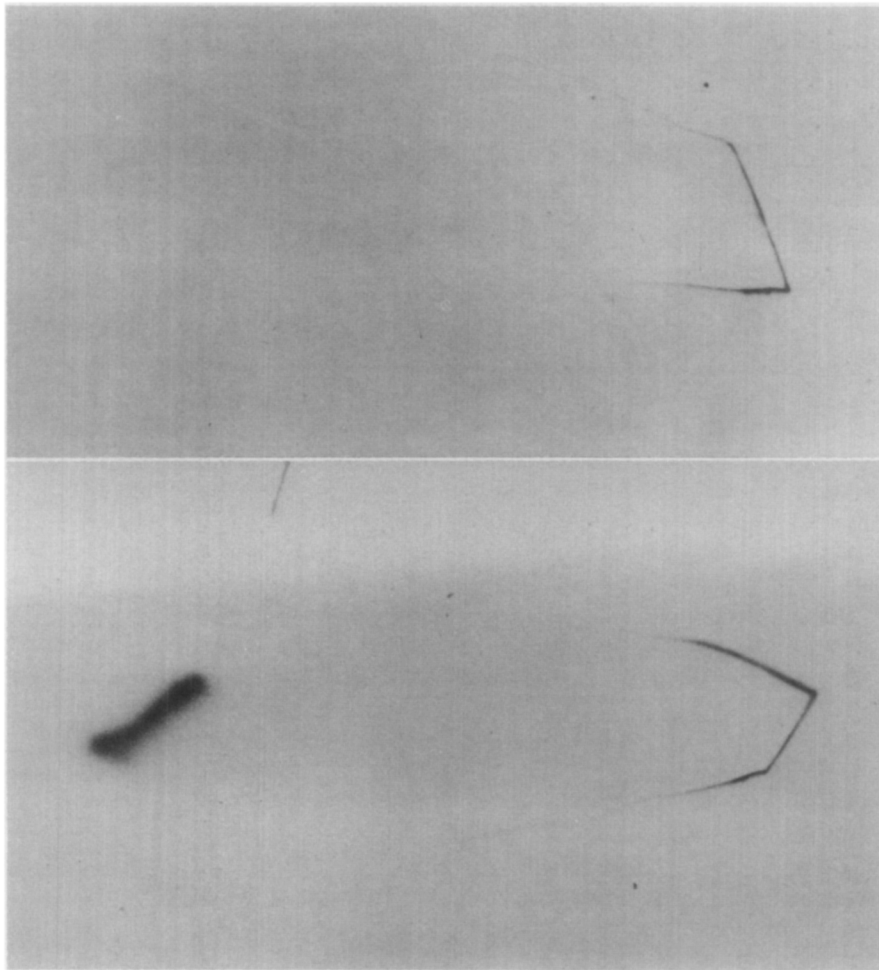


Fig. 4. Group 1 experimental autoradiographs. No evidence of apical radioisotope penetration. **Top:** Specimen 8. **Bottom:** Specimen 10.

the marginal ingress of a radioactive ion by the proper use of gutta-percha and sealer.

All experimental (resected) Group 2 teeth evidenced gross penetration of the radioisotope. Apical penetration ranged from 3 to 14 mm., with a mean penetration of 8.2 mm. for the six specimens. The mean penetration level in the control (nonresected) Group 2 teeth was 2.5 mm., with three of the six specimens showing no apical penetration.

The results of this study indicate that root resection adversely affects the seal in teeth obturated with a single silver cone and sealer. These findings support the findings of Neagley² that contact of a rotary instrument with a silver cone causes a disruption of the apical seal. These results indicate that in cases in which the plane of root resection causes contact with a silver cone, a retrofilling is necessary to establish an apical seal.

Despite evidence^{7, 8} that silver cones are well tolerated by osseous tissue, the use of this obturating material has been challenged^{9, 10} because of the formation of

corrosion products resulting from contact with tissue fluids. Some endodontists argue with emotional zeal that there is no indication for the use of silver cones in endodontic therapy. Failure of endodontic therapy in a tooth obturated with a silver cone and sealer is often considered a "silver cone failure," whereas failure of endodontic therapy in a tooth obturated with gutta-percha and sealer is considered an "operator failure" caused by the inadequate manipulation of these materials during the obturation procedure.

Proponents and opponents of the use of silver cones in endodontics should be cognizant of two fundamental facts. First, gutta-percha and silver cones are two materials with specific but very different physical properties. Both materials can be used improperly, with resultant endodontic failure. Conversely, both materials can be used properly and result in endodontic success.¹¹⁻¹² Second, there is no evidence that a significant difference in prognosis exists between teeth with root canal systems obturated with gutta-percha and sealer and

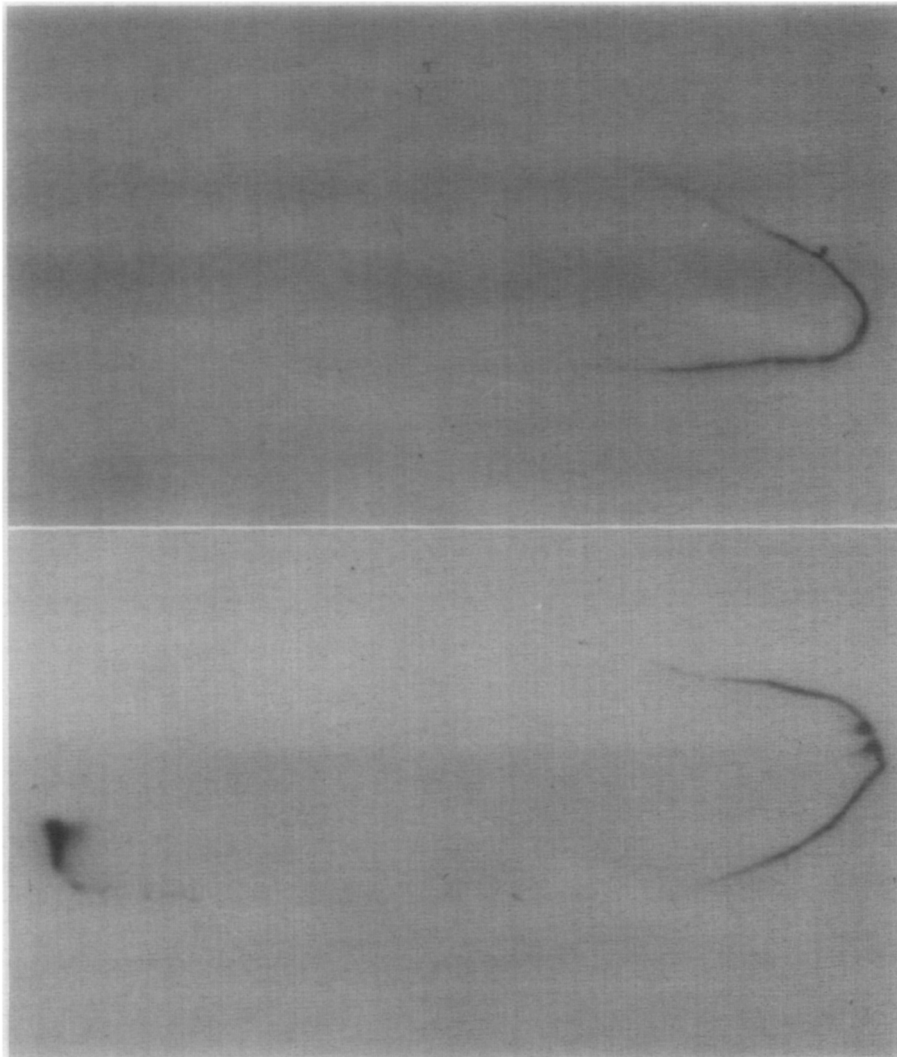


Fig. 5. Group 2 control autoradiographs. **Top:** No evidence of apical radioisotope penetration (Specimen 17). **Bottom:** Minor apical penetration of radioisotope (Specimen 14).

those obturated with silver cones and sealer when both materials are properly used to take advantage of their respective physical properties. There is also no evidence that corrosion of the metal occurs in a canal system with a well-fitted and well-cemented silver cone.¹³

It must be recognized that two different techniques were employed in the obturation of Group 1 and Group 2 teeth. Group 1 teeth were obturated by a multiple-cone lateral condensation technique. Group 2 teeth were obturated by a single-cone technique. It would be erroneous to conclude from this study that the use of a silver cone as a master cone produces a less effective apical seal than the use of a gutta-percha master cone. One can conclude only that a single-cone technique is less effective in sealing the canal system than a multiple-cone technique. Neither silver cones nor

gutta-percha cones are used in endodontic therapy for their sealing property.

In a study involving methylene blue dye penetration, Fogel¹⁴ evaluated five test materials for their ability to seal root canal systems effectively. Controls for this investigation consisted of two types of obturation which were placed by using the multiple-cone technique. One control group consisted of canal systems obturated with a silver master cone and laterally condensed gutta-percha and sealer. The second control group consisted of canal systems obturated with a gutta-percha master cone and laterally condensed gutta-percha and sealer. The silver-cone control group exhibited the least amount of marginal seepage of any test or control group.

Silver cones, like all obturating materials, possess certain advantages and certain disadvantages and are

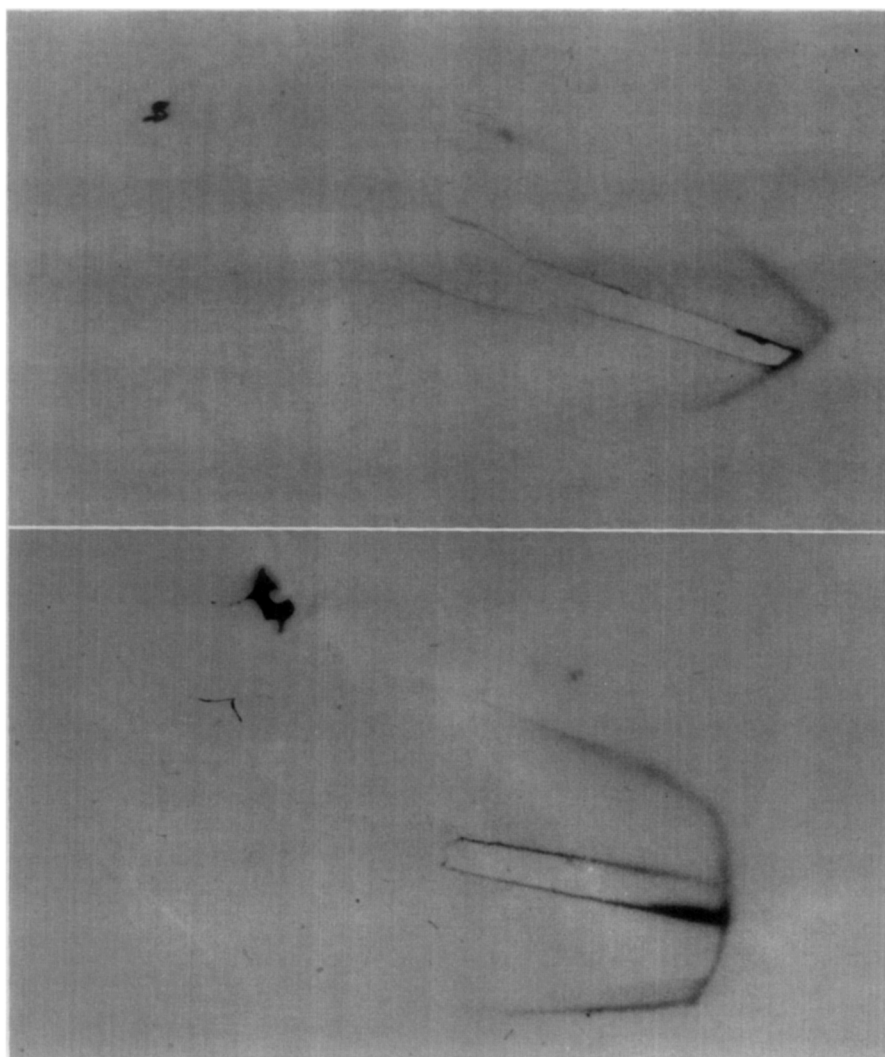


Fig. 6. Group 2 experimental autoradiographs. Gross apical radioisotope penetration resulting from root resection. **Top:** Specimen 21. **Bottom:** Specimen 24.

recommended for use only in certain types of canal systems.^{11, 13, 15} Silver cones are not recommended for use in anterior teeth with large, accessible canal systems, such as those used in this investigation.¹⁵

SUMMARY AND CONCLUSIONS

The root canal systems of extracted anterior teeth were obturated with multiple gutta-percha cones and sealer or with single silver cones and sealer. The effect of root resection on the sealing property of the obturating materials was assessed by autoradiographic methods.

Within the parameters of this study, the following conclusions were drawn:

The obturation of root canal systems with multiple gutta-percha cones and sealer by the lateral condensation technique produces an effective apical seal.

Resection of the root ends of teeth with well-condensed gutta-percha-sealer obturations, with the use of a rotary instrument in a high-speed handpiece, does not adversely affect the seal.

If the plane of root resection causes contact of a rotary instrument with a well-condensed gutta-percha-sealer obturation, a retrofilling or heat-sealing procedure is not necessary to re-establish an apical seal.

The obturation of root canal systems with a single silver cone and sealer does not always produce an effective apical seal.

Resection of the root ends of teeth obturated with single silver cones and sealer adversely affects the seal.

If the plane of root resection causes contact of a rotary instrument with a single silver cone-sealer obturation, a retrofilling is necessary to re-establish an apical seal.

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