0099-2399/94/2002-0090/$03.00/0
JOURNAL OF ENDODONTICS

Printed in U.S.A.
VOL. 20, NO. 2, FEBRUARY 1994

Retreatment Efficacy 3 Months after Obturation Using Glass Ionomer Cement, Zinc Oxide-Eugenol, and Epoxy Resin Sealers

Joshua Moshonov, DMD, Martin Trope, DMD, and Shimon Friedman, DMD

The efficacy of ultrasonic retreatment, 3 months after obturation, in conjunction with Ketac-Endo, Roth's 801, and AH26 sealers was evaluated. Seventy-two root canals were prepared and obturated with gutta-percha and one of the sealers mentioned above. After 90 days, the canals were retreated by an ultrasonic technique and the retreatment time was recorded. The roots were split and the amount of debris that remained on the canal walls in three separate levels was scored. Compared by one-way and two-way analysis of variance, the mean scores of remaining debris at the different canal levels for the three sealer groups, as well as for each group, were not significantly different. The only significant difference was found in retreatment time for which Ketac-Endo was significantly slower to retreat than the other two sealers ($p < 0.002$). Thus, the results of this study showed that the amount of debris remaining on the root canal walls following retreatment 3 months after obturation is similar for Ketac-Endo, Roth's 801, and AH26 sealers, but the retreatment time for Ketac-Endo is significantly longer.

The demand for retreatment of endodontic failures has become very common in endodontic practice. Therefore, the ability to effectively remove the root canal filling materials to enable a new attempt at canal sterilization is of great clinical importance. Gutta-percha is the most widely used endodontic obturation material in conjunction with various sealers (1). There are several techniques for removing the obturating material from the root canal using endodontic instruments worked either by hand, rotary, or ultrasonic devices (2). These procedures may be facilitated by softening the gutta-percha with heated instruments or solvents (2). However, the sealers used in conjunction with gutta-percha have different properties and thus may result in different amounts of remaining debris on the canal walls after retreatment (3–5).

Recently, a new experimental glass ionomer cement sealer commercially named Ketac-Endo has been developed (ESPE GMBH & Co., KG Seefeld/Oberbay, Germany) (6). Initial studies have demonstrated certain advantages of this new sealer including a chemical bonding to dentin (6) and an increased resistance to fracture of the obturated root (7). However, these characteristics may interfere with the removal of this sealer from the canal walls (5).

In a previous study (5) the efficacy of removing Ketac-Endo from retreated root canals was compared with that of Roth's 801 and AH26 sealers. The parameters compared were the amount of debris remaining on the canal walls and the time required for retreatment. Both hand and ultrasonic instrumentation were used. With hand retreatment the total amount of remaining debris was higher for Ketac-Endo than the other two sealers and the retreatment time was longer. Use of ultrasonic instrumentation facilitated the retreatment of all three sealers, resulting in comparable amounts of remaining debris. Retreatment with Roth's 801 sealer was significantly faster than with the other two sealers even with ultrasonic instrumentation.

In clinical practice, retreatments are generally performed after periods far exceeding the 2-wk period used in the previous study. Also, the ease and effectiveness of retreatment may be different when sealers have been in place for longer time periods (3, 4). Thus, the purpose of this study was to evaluate the efficacy of ultrasonic retreatment 3 months after obturation with either Ketac-Endo, Roth's 801, or AH26 sealers and gutta-percha.

MATERIALS AND METHODS

Seventy-two straight, freshly extracted, single-rooted teeth were used in the study. The crowns of all teeth were removed at the cementoenamel junction with a diamond disc. Soft tissue and calculus were removed mechanically, followed by immersion in 2.5% sodium hypochlorite for several hours to dissolve any remaining pulpal tissue and periodontal ligament.

A #15 K file was passed once beyond the apex of each root to confirm patency, and a measurement was made with the file at the apex. One millimeter was subtracted from the measurement to establish the working length. The canals were instrumented according to a modified step back technique to size #40 at the apex, using 0.5% sodium hypochlorite as the

irrigant. The coronal portion of the canals was flared with #2 and #3 Gates Glidden burs and Hedstrom files. A #40 master gutta-percha cone was adjusted to each canal so that "tug back" was attained at the working length.

The 72 teeth were randomly divided into three groups of equal number. There were obturated by one operator using laterally condensed gutta-percha and the following sealers, each mixed according to the manufacturer's instructions: group 1—Ketac-Endo, group 2—Roth's 801 root canal sealer (Chicago, IL), or group 3—AH26 sealer (De Trey, Zurich, Switzerland). Approximately 1 mm of the coronal gutta-percha was removed with a hot round burnisher and the canal orifices were sealed with Cavit G (ESPE).

The obturated roots were placed on occlusal radiographs and exposed once buccolingually and again mesiodistally. The four roots from each group in which the obturation appeared radiographically the least condensed were discarded, and the remaining 60 roots were stored in 100% humidity for 3 months.

All of the root canals were then retreated by one operator. The Cavit G was removed, and the coronal 1 mm of the gutta-percha was drilled out with a #6 Gates Glidden bur creating space for a drop of chloroform. One minute after placement of the chloroform a #25 ultrasonic file was used to negotiate the canal and was worked until it fit loosely in the canal at the working length. Chloroform was added to the canal whenever additional softening of the gutta-percha was required. Instrumentation was continued with hand K and Hedstrom files to size #50 at the apex, using 0.5% sodium hypochlorite as the irrigant and chloroform if needed as the solvent. Finally, the #25 ultrasonic file with irrigation was worked in the canal for 1 min. The total retreatment time was recorded.

After retreatment, vertical grooves were cut along the buccal and lingual sides of the roots with slow-speed diamond discs, after which the roots were split vertically with a triangular chisel and mallet. The debris covering the canal walls was examined independently by three endodontists, two of whom were not involved in the rest of the study. Both halves of the split roots were viewed in a dissecting microscope at ×1.5 magnification.

All examiners assessed the cleanliness of each root canal in the apical, middle, and coronal levels, using a preset standardized evaluation scale: 0—no debris; 1—minimal debris; 2—considerable amount, but covering less than 50% of the canal wall surface; 3—covering 50% of the walls; 4—more than 50%; and 5—covering the entire wall surface. A mean score at each level was then calculated for the three examiners.

The differences in debris scores at each level within each sealer group and among the groups were statistically analyzed using Friedman two-way analysis of variance, Kruskal-Wallis one-way analysis of variance, and Mann-Whitney *U* test, all with 5% level of significance. Differences among the groups in retreatment time were compared using Kruskal-Wallis one-way analysis of variance.

TABLE 1. Frequency of scores for residual debris following retreatment in root canals obturated with gutta-percha and three endodontic sealers

Sealer	Canal Level	Debris score						
		0	1	2	3	4	5	Unrecorded
Ketac-Endo	Coronal	22	32	19	6	1	0	40
	Middle	59	23	23	8	1	0	6
	Apical	71	14	12	4	3	3	13
Roth's 801	Coronal	4	36	26	6	1	0	47
	Middle	26	40	26	4	2	1	21
	Apical	40	33	10	7	0	2	28
AH26	Coronal	29	39	17	9	0	2	18
	Middle	46	29	8	10	1	2	18
	Apical	42	21	12	2	4	1	32

TABLE 2. Frequency of times required for retreatment of root canals obturated with gutta-percha and three endodontic sealers

Sealer	Retreatment time (min)									
	5	6	7	8	9	10	11	12	13	14
Ketac-Endo	0	0	1	3	5	3	2	1	1	1
Roth's 801	0	4	5	7	1	2	1	0	0	0
AH26	1	4	4	1	3	2	3	1	0	1

TABLE 3. Remaining debris and retreatment time in root canals retreated after obturation with gutta-percha and three sealers

Group	Mean debris score (SD)				Retreatment time (min)
	Coronal	Middle	Apical	Total	
Ketac-Endo	1.15 (1.66)	0.81 (0.77)	0.74 (0.55)	0.87 (0.47)	10.15 (1.90)
Roth's 801	1.50 (0.51)	1.17 (0.71)	0.98 (0.62)	1.19 (0.50)	7.75 (1.40)
AH26	1.16 (0.64)	0.97 (0.84)	0.86 (0.77)	1.03 (0.43)	8.55 (2.44)

RESULTS

The frequencies of scores of debris remaining on the canal walls after retreatment in the three sealer groups are presented in Table 1. The frequencies of retreatment time are presented in Table 2. The mean scores and retreatment time are summarized in Table 3. Within each group, the amount of debris was consistently the highest at the coronal canal level and lowest at the apical level, but these differences were not statistically significant. Among the groups, the amount of debris was the highest in roots obturated in conjunction with Roth's 801 sealer and lowest in roots obturated with Ketac-Endo, at each canal level. However, these differences were not statistically significant also.

The mean time required for retreatment was the longest in canals obturated in conjunction with Ketac-Endo, followed by AH26 and Roth's 801 sealers. Statistically, these differences were significant ($p < 0.002$).

DISCUSSION

In our previous study on retreatment of these same sealers after 14 days it was shown that even though hand and ultrasonic instrumentation resulted in similar amounts of remaining debris, the ultrasonic technique was significantly quicker for all three sealer types (5). In fact, the retreatment time for Ketac-Endo with hand instrumentation was clinically unac-

ceptably long. Therefore, in this study we used only the ultrasonic technique to compare retreatment efficacy.

Retreatment 3 months after obturation appears more clinically relevant since retreatments are seldom performed shortly after the initial obturation. In this study, no difference was found in the remaining debris for all three sealers and each level for the individual sealers. When comparing the remaining debris 3 months after obturation with those canals obturated after 2 wk (5), there was an obvious improvement in retreatment efficacy for both the Ketac-Endo and the AH26 groups. The remaining debris for Roth's 801 sealer did not change with time after obturation but the retreatment time was considerably longer at 3 months compared with 2 wk, in agreement with Wilcox (4). These results suggest that Roth's 801 sealer does not reach its set state by 2 wk and its physical properties change with time. Future studies should be performed to ascertain the clinical significance of the extended setting time of Roth's 801 sealer. The improvement of retreatment efficacy for AH26 as compared with Roth's 801 sealer with increased time after obturation support the results in two studies by Wilcox et al. (3) and Wilcox (4). Their explanation that AH26 sealer becomes more brittle with time might also apply to the results observed with regard to the Ketac-Endo. Although the efficacy of retreatment of Ketac-Endo improved with time after obturation, it still remained significantly slower to retreat than the other two sealers. This might be an indication that the glass ionomer is bound to the dentin walls and thus takes more time to remove. Even though this bond might be disadvantageous in retreating the root canal, the advantages of strengthening the root and possibly a better seal would outweigh this negative factor.

This study, like other retreatment efficacy studies, is based on the assumption that removal of the old obturation material is beneficial to the prognosis of the retreatment. This is a logical but unproven assumption that should be addressed in further studies.

Dr. Moshonov is an instructor, Department of Endodontics, Hebrew University-Hadassah, Faculty of Dental Medicine, Jerusalem, Israel. Dr. Trope is professor and chairman, Department of Endodontology, Temple University School of Dentistry, Philadelphia, PA. Dr. Friedman is associate professor and head, Department of Endodontics, University of Toronto, Faculty of Dentistry, Toronto, Ontario, Canada. Address requests for reprints to Dr. Martin Trope, Department of Endodontology, Temple University, School of Dentistry, 3223 North Broad Street, Philadelphia, PA 19140.

References

1. Nguyen NT. Obturation of the root canal system. In: Cohen S, Burns RC, eds. Pathways of the pulp. St. Louis: Mosby-Year Book, 1991:199–201.
2. Friedman S, Stabholz A, Tamse A. Endodontic retreatment—case selection and technique. Part 3. Retreatment techniques. J Endodon 1990;16:543–9.
3. Wilcox LR, Krell KV, Madison S, Rittman B. Endodontic retreatment: evaluation of gutta-percha and sealer removal and canal reinstrumentation. J Endodon 1987;13:453–7.
4. Wilcox LR. Endodontic retreatment: ultrasonics and chloroform as the final step in reinstrumentation. J Endodon 1989;15:125–8.
5. Friedman S, Moshonov J, Trope M. Efficacy of removing glass inomer cement, zinc oxide eugenol and epoxy resin sealers from retreated root canals. Oral Surg Oral Med Oral Pathol 1992;73:609–12.
6. Ray HL, Seltzer S. A new glass ionomer root canal sealer. J Endodon 1991;17:598–603.
7. Trope M, Ray HL. Resistance to fracture of endodontically treated roots. Oral Surg Oral Med Oral Pathol 1992;73:99–102.