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Evaluation of Filling Quality of Obturation Techniques in Simulated Internal Resorption Cavities Created by Acid Demineralization

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ABSTRACT

Aim and Objectives: Using various gutta-percha obturation techniques, such as cold lateral compaction, thermoplastic injection technique, and Thermafil, to compare and assess the quality of obturation in simulated internal resorptive cavities. Additionally, comparing radiographic and stereomicroscopic methods to assess the quality of obturation.

Materials and Method: Thirty excised single-rooted teeth were divided into mesiodistal sections. After 12 hours of exposure to 5% nitric acid, each tooth segment was treated for 10 minutes with 8% sodium hypochlorite. In between the two treatments, samples were washed with distilled water. The demineralization protocol was in effect for 11 days and was renewed every 24 hours. Following the procedure, the teeth were put back together and split into three groups of ten samples each. The root canal sealer used in each group was AH Plus Bioceramic Sealer. Using a #50 file, the sealer was applied to the canal walls after being blended in accordance with the manufacturer's instructions. Groups 1 and 2 used the Cold Lateral Compaction Technique, Thermafil, and Thermoplastic Injection Technique (Obtura III Max), respectively. To assess the quality of obturation at the Internal Resorptive Cavities (IRC), the teeth were radiographed in both buccolingual and mesiodistal orientations after obturation. To investigate the kind of material that filled the interior resorptive cavities under a stereomicroscope, the incisors were then sliced with a scalpel at the same levels as the preceding portion.

Results: Obtura 3D (thermoplasticized gutta-percha) gave the best result, and in most of the specimens obturated with this technique, the IRC was filled mainly with gutta-percha. Statistical analysis of the data indicated that the difference between Group 3 and the other groups, Group 1 (lateral compaction) and Group 2 (Thermafil), was significant ($p < 0.05$).

Conclusion: Thermoplasticized gutta percha (Obtura 3D) is the best obturating technique for internal resorptive cavities, as compared to the lateral compaction technique and Thermafil. Thermafil is better than the lateral compaction technique for obturating internal resorptive defects. Stereomicroscopic evaluation is a much better and more precise method to evaluate the quality and nature of filling material into the resorptive defect than the radiographic evaluation.

Keywords: Internal resorptive cavities, cold lateral compaction, thermaplastized gutta percha technique, Thermafil

INTRODUCTION

Resorption, according to the American Endodontic Society, is a disorder associated with a pathological or physiological process that causes the loss of bone, cementum, or dentin.1 Resorption is the loss of dental hard tissue as a result of non-infectious damage brought on by osteoclastic cell activity.[2,3] Depending on where they occur on the root surface, root resorptions are classified as internal or external. A clinical disorder known as internal root resorption is defined by the progressive loss of dentin along the root canal walls, usually as a result of trauma or persistent infection.[4,5] Histological investigations have revealed variable incidence rates ranging from 0.01% to 55%, depending on the inflammatory state of the pulp, even though internal root resorption is rarely seen in clinical settings.[6] A dimensionally stable and biologically acceptable substance must completely obliterate the root canal space for root canal treatment to be successful.[7,8] A crucial step in a successful course of treatment for internal resorption is hermetically filling the root canal.[9] However, doctors have a hurdle because of the resorption cavities' uneven form. Therefore, ex vivo study designs have been used to assess the effectiveness of different methods and materials in sealing internal root resorption voids. In order to stop apical and coronal leakage, the main goal of root canal therapy is to create a hermetic seal. Even though there have been many different approaches over the years, each has pros and cons of its own. The cold lateral condensation method is one popular approach that works well for a variety of therapeutic circumstances. Using this method, a master gutta-percha cone that matches the canal preparation is placed first, followed by auxiliary cones to fill in the spaces between the dentin walls and the gutta-percha. However, it could not be as effective as other technologies at filling in the canal's flaws and does not produce a consistent filling.[9] The thermoplastic injection technique was first presented by Michanowicz and Czonstkowsky in 1984. This method involves heating and softening the gutta-percha before inserting it into the root canal with pressure using specific tools. According to reports, injectable gutta-percha can successfully fill anatomical variances like branching foramina, C-shaped canals, lateral canals, internal resorption, and intracanal defects. [10] has shown that when it comes to creating three-dimensional canal filling, the thermoplastic injection method works noticeably better than cold lateral condensation.[11–13]

MATERIALS AND METHOD

A total of 50 single-rooted human teeth, extracted for reasons such as caries or periodontal issues, were selected for the study. The inclusion criteria included teeth with single and straight root canals.

Teeth exhibiting complete root development without fractures, cracks, resorption, or anatomical variations were chosen after examination under x25 magnification.

To prepare the specimens, the crowns of each tooth were removed using a diamond bur, resulting in a standardized root length of 12 mm. The teeth were mounted on acrylic blocks (Figure 1).

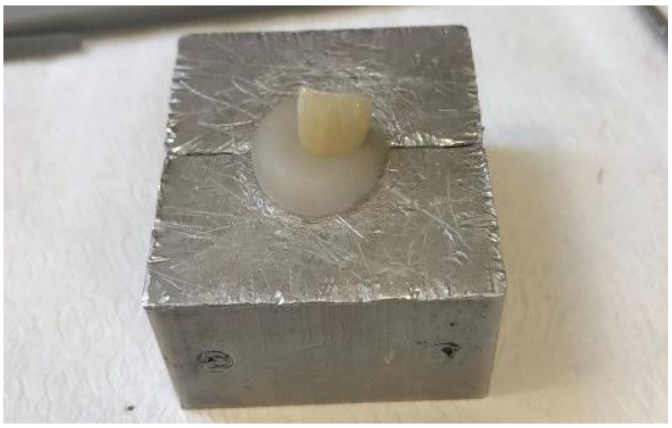


Figure 1. Samples preparation

In the next step, the specimens were bisected in the mesiodistal direction using a diamond disc (Buehler Diamond Cut-Off Wheels 114243; Buehler, Lake Bluff, IL) attached to a chainsaw (IsoMet Low-Speed Saw; Buehler) with water cooling. Metal discs, measuring 2 mm in width and 2 mm in height, were placed in the middle third of the root length in both segments of the tooth. These discs were securely fixed with the aid of a gingival barrier (Opaldam Green Gingival Barrier, Ultradent, India), and tightness was ensured (Figure 2).

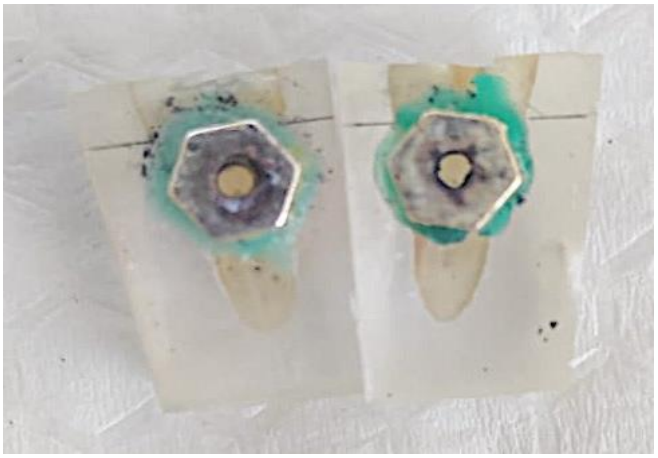


Figure 2. Preparation of resorption cavities

The demineralization protocol for creating the resorption cavity spanned 11 days.

The protocol involved three steps: first, the application of a 5% nitric acid solution for 12 hours; second, the exposure to an 8% sodium hypochlorite (NaOCl) solution for 10 minutes; and finally, another 12-hour application of a 5% nitric acid solution14. Distilled water was used for rinsing between each solution, and throughout the entire duration, the samples were stored at a temperature of -1 °C (+/-3 °C) (Figure 3).

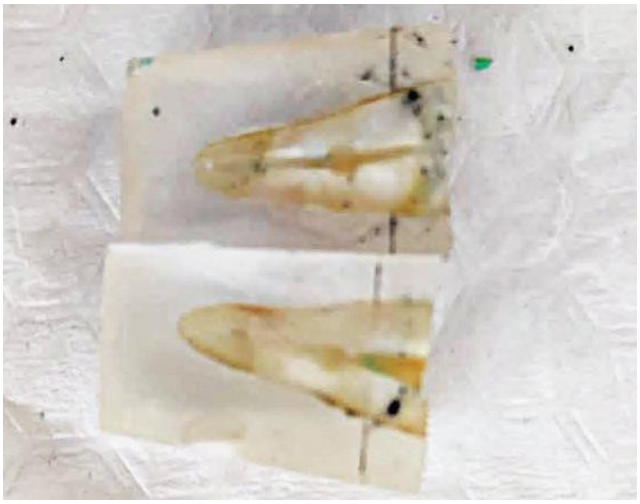


Figure 3. Resorption cavities

After this period, the metal rings were removed from the root surface, and any residues were thoroughly cleaned. Liquid adhesive was applied to the acrylic surfaces, allowing the parts to be assembled in such a way that the resorption areas on both root surfaces were opposite each other. This prepared the samples for root canal preparation.

The working length of the root canals was determined by using a no. 15 K-file (Dentsply Meaillefer), and 0.5 mm was subtracted from the length visible at the apical foramen. For cleaning and shaping the root canals, rotary nickel-titanium instruments (ProTaper, Dentsply Maillefer) were employed, with an X2 file attached to a torque-controlled reduction handpiece (X-Smart, Dentsply Maillefer). Irrigation was performed between each instrument using 2.5 mL of 2.5% NaOCl. Following the completion of the preparation, the root canals were rinsed with 5 mL of 2.5% NaOCl for 1 minute.

The teeth were radiographed in buccolingual and mesiodistal directions to assess the internal resorptive cavities (**Figure 4**).

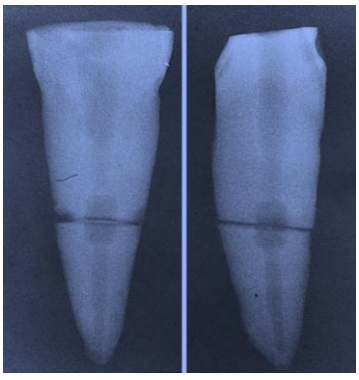


Figure 4. Radiograph showing resorptive cavities

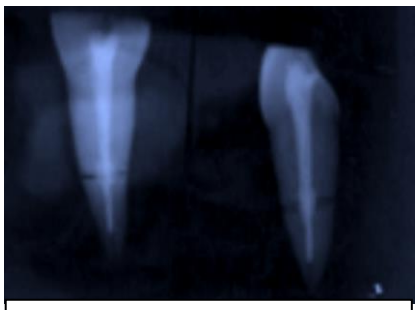
The samples were randomly divided into 3 groups, with 10 samples in each group (Table 1). In all groups, AH Plus Bioceramic was used as the root canal sealer.

Group of the Study	
	Obturation technique
Group 1	Cold Lateral Condensation
Group 2	Thermafil
Group 3	Thermoplastic Injection Technique (Obtura III Max)

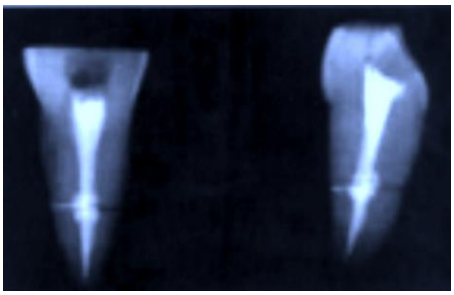
The Obtura III Max System (Obtura Sparton, Fenton, Missouri, USA) was used for the thermoplastic injection technique. All the teeth were kept for 7 days to ensure the setting of the sealer and were then radiographed in buccolingual and mesiodistal directions to evaluate the quality of the obturation obtained at the level of internal resorptive cavities.

Radiographic Evaluation (Fig. 3): Taking into consideration the quality of obturation of internal resorption cavities, the specimens were grouped as follows:

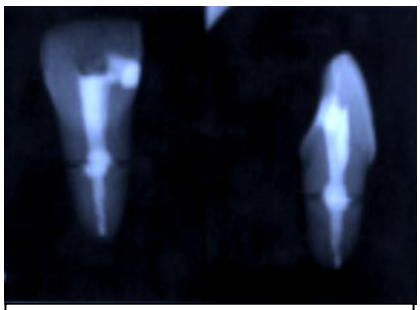
a) Total obturation: The IRC was obturated completely in the buccolingual as well as in the mesiodistal radiographs. Empty spaces were not evident in the filling mass or between the gutta-percha and the dentin walls.



Group 1



Group 2



Group 3

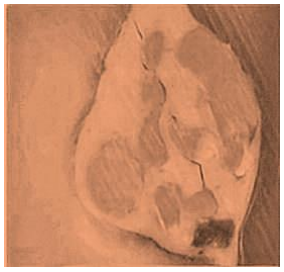
b) Partial Obturation: The obturated IRC showed empty spaces in the mass of the filling material or between the gutta-percha and the dentin walls in buccolingual and/or mesiodistal radiographs. Data were analyzed statistically using Fisher's exact probability test.

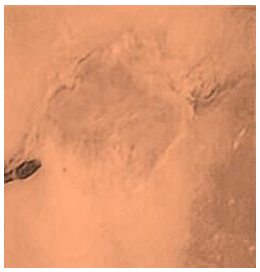
Stereomicroscopic Evaluation (Fig. 4): Following radiographic assessment, the teeth were sectioned with a sharp scalpel blade at the level of the previous cut, 7 mm from the apex. Paired root sections were examined under a stereomicroscope (X20). In both sections, the nature of the filling material predominant at the lRC was recorded, and specimens were grouped as follows:

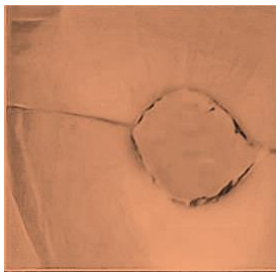
Type I: The predominant filling material was sealer.

Type II: The predominant filling material was gutta-percha.

Type III: The same amount of sealer and gutta-percha was observed.


Group 1


Group 2


Group 3

STATISTICAL ANALYSIS

Statistical analyses were performed using the Kruskal-Wallis ANOVA test. p-value below 0.05 was considered statistically significant.

RESULTS

The radiographic and stereomicroscopic results obtained are summarized in Tables 1 & 2, respectively. The best results were obtained by the injectable thermoplasticized gutta-percha technique, i.e., Group 3. Statistical analysis of the radiographic data indicated that the differences were significant between group 3 and the other groups, i.e., groups 1 and 2 ($p < 0.05$), while no statistically significant differences were observed among groups 1 and 2 ($p > 0.05$).

Statistical analysis of the stereomicroscopic data showed significant differences between all three groups, 1, 2, and 3**.**

Table I: Radiographic evaluation of the quality of obturation of simulated internal resorptive cavities.

Groups	No. of samples	Total Obturations	Partial Obturations
I	10	3	7
II	10	4	6
III	10	8	2

Table II: Stereomicroscopic evaluation of the nature of predominant filling material in the simulated internal resorption cavities.

	No. of samples	Type 1	Type 2	Type 3
Group 1	10	8	0	3
Group 2	10	2	2	5
Group 3	10	0	8	2

DISCUSSION

It is clinically significant to look for a permanent filler material and method to obturate the resorbed area because the full extent of the resorptive defect is not always obvious on radiography.[15]

Being the teeth and regions where internal resorption is most commonly observed, maxillary central incisors with simulated internal resorptive cavities in the middle third of the roots were employed in this study[15, 16]

Under the findings obtained in the present study, the lowest frequency of total obturation of the IRC was observed when the lateral compaction technique was used. Moreover, when total obturation of the IRC was achieved in this group, it consisted mainly of sealer. These results corroborated the findings of previous reports.[17-18]

According to several publications, since some sealers may shrink or dissolve, the root canal obturation should contain less sealer and more gutta-percha.[19, 20] Filling root canals with perforating resorption lacunas is a special case of this.

The current investigation did not confirm Weine's findings that gutta-percha compactors provide a thick fill of the resorptive defect when used clinically. As this study suggests, the filling abnormalities may be more noticeable in the mesiodistal direction, but it is crucial to remember that the radiographic examination in the clinical situation is restricted to the buccolingual direction. The buccolingual view of six of the thirty teeth analyzed in this study revealed radiographically complete obturation of the IRC, whereas voids were seen in the mesiodistal view. Thermafil produced results that were comparable to those of the hybrid approach, which combines thermomechanical and lateral compaction of the gutta-percha.[21] Thermafil's gutta-percha effectively eliminates root canal abnormalities, according to Gutmann et al.[22] Nevertheless, this finding about the obturation of internal resorptive cavities was not validated in our investigation.

The Obtura gun produced the best results. Out of the ten incisors that were obturated in this manner, eight had gutta-percha as the primary filling material and eight had the IRC obturated. In light of these findings, Torabinejad et al. [17] found that gutta-percha that had been injection-moulded and thermoplasticized suited the canal walls precisely.

When the Obtura procedure is used in conjunction with vertical compaction for the obturation of root canals with internal resorption, both Stamos & Stamos[23] and Wilson & Barnes[24] have demonstrated good radiography results.

CONCLUSION

When it came to obturating internal resorption cavities, Obtura III outperformed Thermafil and lateral condensation. As a result, the latter approach is recommended for obturating internal resorption cavity abnormalities in clinical practice.

REFERENCES

1. Garg N, Garg A. Textbook of endodontics. 3rd ed. Jaypee Brothers Medical Publishers LTD, New Delhi, 2014.

2. Patel S, Dawood A, Wilson R, Horner K, Mannocci F. The detection and management of root resorption lesions using intraoral radiography and cone beam computed tomography – an in vivo investigation. International Endodontic Journal. 2009 Sep;42(9):831–8.

3. Patel S, Ford TP. Is the Resorption External or Internal? Dental Update. 2007 May 2;34(4):218–29.

4. Patel S, Ricucci D, Durak C, Tay F. Internal Root Resorption: A Review. Journal of Endodontics. 2010 Jul;36(7):1107–21.

5. Wedenberg C, Lindskog S. Experimental internal resorption in monkey teeth. Dental Traumatology. 1985 Dec;1(6):221–7.

6. HAAPASALO M, ENDAL U. Internal inflammatory root resorption: the unknown resorption of the tooth. Endodontic Topics. 2006 Jul;14(1):60–79.

7. Goldberg F, Massone EJ, Esmoris M, Alfie D. Comparison of different techniques for obturating experimental internal resorptive cavities. Dental Traumatology. 2000 Jun;16(3):116–21.

8. Caliskan MK, Turkun M. Prognosis of permanent teeth with internal resorption: a clinical review. Dental Traumatology. 1997 Apr;13(2):75–81.

9. Frank AL, Weine FS. Nonsurgical Therapy for the Perforative Defect of Internal Resorption. Journal of the American Dental Association. 1973 Oct 1;87(4):863–8.

10. Wu M-K, Wesselink PR. A primary observation on the preparation and obturation of oval canals. International Endodontic Journal. 2001 Mar;34(2):137–41.

11. GUTMANN JL. Adaptation of injected thermoplasticized gutta-percha in the absence of the dentinal smear layer. International Endodontic Journal. 1993 Mar;26(2):87–92.

12. Budd CS, Weller RN, Kulild JC. A comparison of thermoplasticized injectable gutta-percha obturation techniques. Journal of Endodontics. 1991 Jun;17(6):260–4.

13. Weller RN, Kimbrough WF, Anderson RW. A comparison of thermoplastic obturation techniques: Adaptation to the canal walls. Journal of Endodontics. 1997 Nov;23(11):703–6.

14. Fernanda P, Vizzotto MB, Montagner F, Dias L, Dias E. Development of a New In Vitro Methodology to Simulate Internal Root Resorption. Journal of Endodontics. 2013 Sep 20;40(2):211–6.

15. Chivian N. Resorption of roots. In: Burns RC, Cohen S. The pulp's pathways. St. Louis: CV Mosby;1987, 4th ed., pp. 511–51.

16. Caliskan MK, Turkun M. Prognosis of permanent teeth with internal resorption: a clinical review. Dental Traumatology. 1997 Apr;13(2):75–81.

17. Torabinejad M, Skobe Z, Trombly PL, Krakow AA, Grøn P, Marlin J. Scanning electron microscopic study of root canal obturation using thermoplasticized gutta-percha. Journal of Endodontics. 1978 Jan;4(8):245–50.

18. Wong M, Peters DD, Lorton L. Comparison of gutta-percha filling techniques, compaction (mechanical), vertical (warm), and lateral condensation techniques, part 1. Journal of Endodontics. 1981 Dec;7(12):551–8.

19. Langeland K. Root Canal Sealants and Pastes. Dental Clinics of North America. 1974 Apr 1;18(2):309–27.

20. Peters DD. Two-year in vitro solubility evaluation of four gutta-percha sealer obturation techniques. Journal of Endodontics. 1986 Jan;12(4):139–45.

21. Tagger M, Tamse A, Katz A, Korzen BH. Evaluation of the apical seal produced by a hybrid root canal filling method, combining lateral condensation and thermatic compaction. Journal of Endodontics. 1984 Jul;10(7):299–303.

22. GUTMANN JL, SAUNDERS WP, SAUNDERSz EM, NGUYEN L. An assessment of the plastic Thermafil obturation technique. International Endodontic Journal. 1993 May;26(3):179–83.

23. Stamos DE, Stamos DG. A new treatment modality for internal resorption. Journal of Endodontics. 1986 Jan;12(7):315–9.

24. WILSON PR, BARNES IE. Treatment of internal root resorption with thermoplasticized gutta-percha. A case report. International Endodontic Journal. 1987 Mar 1;20(2):94–7.

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