Available online at www.giornaleitalianoendodonzia.it

Winner of Riitano Award IV SIE International Congress 2022

ORIGINAL ARTICLE

Hot modified technique: a novel modified obturation technique using biosealers

ABSTRACT

Aim: *This research aimed to test the actual temperature inside the root canal while the obturation phase was ongoing. Specifically, the obturation was done by the proposed heat-based technique with bioselaers.*
Materials and Methods: *This study tested the temperature evaluation. In the experiment, two premolars were utilised, and thermocouples of K-type one for each tooth were used. The Bonferroni method was conducted to compare the data collected from temperature.*
Results: *The experiment results showed that using the new obturation method, the heat did not reach the apical third.*
Conclusions: *Using the proposed modified hot obturation procedure, the temperature will not change the apical area. Consequently, this technique eludes inducing the fast setting for the biosealer.*

Dina Abdellatif[1*]
Alfredo Iandolo[2]
Massimo Calapaj[3]
Alessandra Amato[2]
Massimo Amato[2]

[1]*Department of Endodontics, Faculty of Dentistry, University of Alexandria, Alexandria 21531, Egypt*

[2]*Department of Endodontics, Faculty of Dentistry, University of Salerno, Salerno, Italy*

[3]*Department of Endodontics, Faculty of Dentistry, University of Messina, Italy*

Received 2022, December 11
Accepted 2023, January 17

KEYWORDS *obturation technique, biosealer, endodontic space, cleaning, root canal treatment.*

Corresponding Author
Umberto Gibello | Department of Surgical Sciences, Dental School, Endodontics, University of Turin, via Nizza 230, 10126 Turin | Italy.
Phone: +39 3484369341 | Email umberto.gibello@gmail.com

Peer review under responsibility of Società Italiana di Endodonzia
10.32067/GIE.2023.37.01.08

Introduction

Achieving short and long-term success, the root canal treatment is chiefly founded on good three-dimensional (3D) cleansing of the endodontic system after completing the mechanical shaping. Afterwards, it is crucial to seal the complex endodontic system with complete 3D obturation (1-5).

When the anatomy of the endodontic system is described, it shows anatomical areas that can be accessible for the hand and rotating files (the main root canals) (6, 7). Contrarily, many researchers have shown that the endodontic system contains areas beyond the reach of mechanical tools (lateral canals, loops, ramifications, apical isthmuses, deltas, and dentinal tubules) (8-10). Therefore, more than mechanical shaping is required to reach all zones of the root endodontic system. Moreover, whatever the approach used in shaping the canal, leaving parts of the root canals untreated can occur (11, 12).

Accordingly, it is necessary to perform root canal chemical cleaning to disinfect both the accessible and unreachable spaces) (13, 14). Immediately when the zones mentioned above are cleansed (15-17), they can be obturated with gutta percha and sealer or the recently introduced sealers, the biosealer (18). Certainly, when the biosealers were initially marketed, it was with guidance to be utilised with only the single cone cold technique.

The biosealers can harden immediately when coming in contact with heat, hence, the recommendation mentioned above.

Conversely to the cold technique, the System-B-based approach implies heating to melt the gutta-percha after applying traditional sealer.

Eventually, the melted filling material will flow into the lateral anatomies and fill deeper the complex endodontic space better.

This research aimed to test the actual temperature inside the root canal while the obturation phase was ongoing using a new obturation method: Hot Modified Technique. The technique was developed to avoid causing any risk of chemical alteration of the bioseal. In addition, it aims to show some clinical cases where it is possible to see the difference between the single-cone and the hot-modified techniques.

Materials and Methods

Recently extracted human mandibular premolars (n=2) with intact coronal surfaces were selected for this study.

The selected teeth were extracted for an orthodontic treatment plan and were irrelevant to the current experimentation. The inclusion criteria were patients with age (18-25 years). On the contrary, the exclusion criteria were the existence of any root resorption, incomplete apices, any type of fracture or previous root filling. Before starting the experiment, informed consent was obtained from the patients.

The soft tissues connected to the teeth' exterior surface were pulled utilising a curette. Next, the samples were saved in separate vials containing 5 mL of 10% formalin till usage.

The teeth were prepared for the study by de-coronating them at the level of the cementoenamel junction to get the roots of a standardised length (18 mm). Then, a file size 10 K-type (Coltène/Whaledent, Altstätten, Swiss) was introduced in each root canal till it was visible from the apex.

The final working length was set by deducting 0.5 mm from that measurement. The canals were shaped with nickel-titanium rotating Ni-Ti files (Hyflex files EDM, Coltène/Whaledent, Altstätten, Swiss).

The files used in this study to prepare the canals were 10/0.05, 20/0.05, and 25/0.08 rotary files of Hyflex EDM were used till the full working length. After the final apical instrumentation, the size and taper of the apical area were 25/0.08. During canal instrumentation, irrigation

was performed with 5,25% NaOCl solution (Canal pro, Coltène/Whaledent, Altstätten, Swiss). The irrigation was done with a 30G needle in the syringe type (Canal pro irrigating tips, Coltène/Whaledent, Altstätten, Swiss).
The amount of NaOCl used for each tooth was 5 mL and refreshed each minute.
Later, each canal was flushed using sterile saline and then irrigated with 3 mL of chelating agent 17% of ethylenediaminetetraacetic acid (EDTA) (the canal pro EDTA, Coltène/Altstätten, Swiss); this step lasted for 1 min and aimed to get rid of the formed smear layer. Finally, all canals acquired the last rinse of 3 mL of sterile saline.

The temperature evaluation
Regarding the experimentation of temperature evaluation, two-second mandibular premolars were appointed. Then, two K-type thermocouples (ThermoWorks, Salt Lake City, Utah, US) were used for each tooth.
Regarding the thermocouples' fixation in teeth, the examiner drilled cavities utilising a diamond bur Type 196D.644.110 (Komet Dental, Trophagener Weg 25, 32657 Lemgo, Germany), the preparation was done from the external root surfaces until the root canals. The holes were positioned one at the apical foramen (Ta) and the other at 3 mm away from the apex (T3) (8). After the attachment of the thermocouples, the teeth were mounted using Duralay resin (Henry Schein Dental, Melville, New York, United States) in an aluminium tube. The temperature of the tooth environment was controlled and maintained at 37 °C using a thermally controlled heater (Jiu Tu, Baoan District, Shenzhen, China) supplied with an aluminium block.
To register the signals, the thermocouples were attached to the NI DAC interface (MOD National Instruments Corporation, Austin, TX, USA). The LabView system (National Instruments Corporation) registered the signals at a pace of 10 points per second for 300 s.
After fixing the thermocouples in place, the canal was obturated utilizing the System B appliance (Kavo Dental, Orange, California, United States). The master cone gutta-percha was standardized at the same lengths and size for both premolars (25/0.08 Coltène/Whaledent Altstätten, Swiss).
The biosealer chosen for the current experiment was bioseal (Coltène/Whaledent, Altstätten, Swiss), the bioseal syringe tip was placed 10 mm from the working length, and 2 mm of biosealer was injected in each tooth.
A single cone obturation technique was used in the first premolar (experiment A). The procedure included the insertion of the gutta-percha cone till the working length.
In Experiment B, the second premolar was obturated with the proposed hot modified technique, where the heat carrier tip X-Fine (30/04) (Kerr Dental, Orange, California, United States) at 180 °C was inserted 6 mm shorter than the working length. The time of down packing was of 4 s.

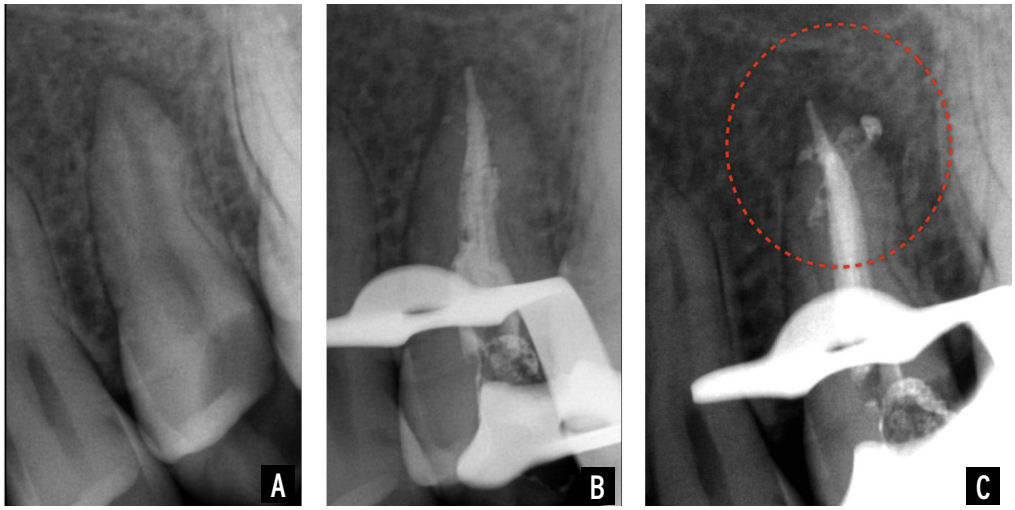
Data were statistically analyzed
Experiment analysis of variants through the OriginLab Pro7 software (Northampton, MA, USA) at a significance level of 0.05 utilizing the Bonferroni method was performed to compare the temperature data.
Some clinical cases done with this new technique are shown in Figures 1, 2 and 3.

Results

Using the novel obturation method, the results demonstrated that no heat reached the final apical 3 mm of the canal. The last apical 3 mm stayed at 37 °C.

Discussion

The current work aimed to compare the impact of the new obturation technique to the single cone method on the existing temperature in the apical region and its penetration in the lateral complexness of the root canal system.
Initially, when the Biosealers were pre-



Cold Singe Cone *Hot Modified Technique*

Figure 1
Endodontic treatment of 2.5 with irreversible pulpitis caused by a distal cavity. **A)** Pre-operative x-ray. **B)** Intra-operative x-ray where the gutta-percha cone was inserted with the biosealer using the single cone technique without heat and pressure. **C)** Hot modified technique, it's possible to see in the apical third, after the new obturation method, how the biosealer reached all the complexity.

sented, they came up with the recommendation to use the single-cone technique (18). Otherwise, the sealer can set faster if it comes in contact with heat.
The newly proposed obturation technique, described as the "hot modified technique", implicates utilising the bioceramics sealers in a 3D manner (19). The purpose was to push the sealer by creating coronal pressure to penetrate deeper than the single cone technique, the lateral anatomies.
Furthermore, the technique was done by first inserting the biosealer and the gutta percha cone inside the root canal. Then, the technique should follow similarly to the system B technique but with some modifications. Specifically, the difference was performing a faster down-packing movement at a decreased temperature of 180° to a maximum penetration depth of 6 mm away from the working length.
Compared to the single cone technique, the proposed hot-modified technique permits a better fill of the biosealer into the lateral anatomies such as lateral canals, isthmuses, loops, or even the dentinal tubules (20, 21). Furthermore, this work established that the heat does not approximate the apical third using the new approach. Thus, no alteration can occur to the biosealer created by the heat.

Conclusions

In conclusion, Bioceramics could lead to greater clinical success thanks to their beneficial characteristics such as

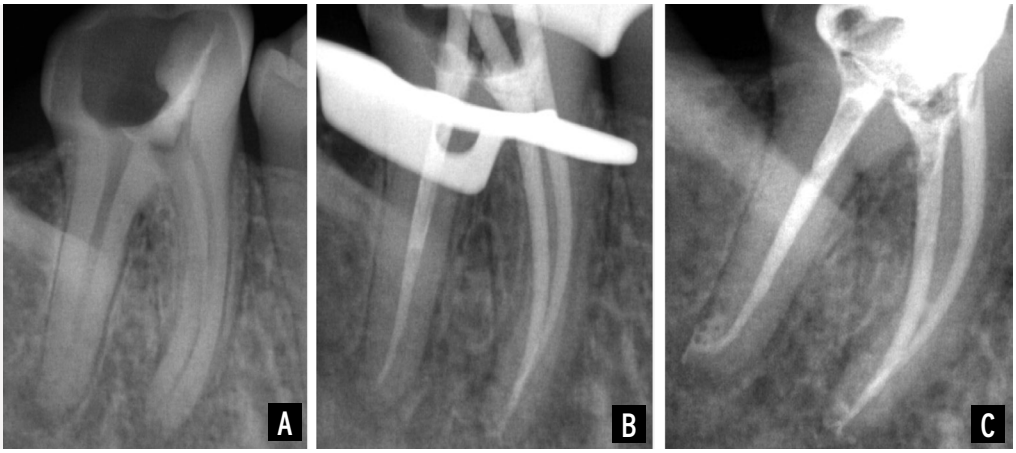


Figure 2
Endodontic treatment of 4.6 with necrosis caused by a deep occlusal cavity. **A)** Pre-operative x-ray. **B)** Intra-operative x-ray where the gutta-percha cone was inserted with the biosealer using the single cone technique without heat and pressure. **C)** Hot modified technique, it's possible to see in the apical thirds, after the new obturation method, how the biosealer reached all the complexity.

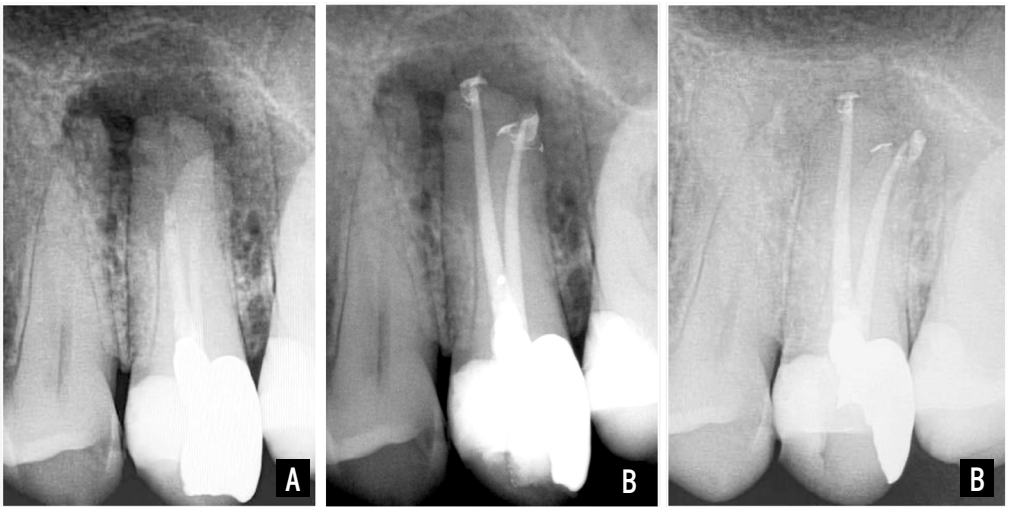


Figure 3
Non-surgical Endodontic Retreatment of 2.5 with periapical lesion.
A) Pre-operative x-ray.
B) Post-operative x-ray where the Hot Modified Technique was used: it's possible to see in the apical thirds, after the new obturation method, how the biosealer reached all the complexity.
C) 2 years follow-up showing good healing.

antibacterial actions, high biocompatibility, and micro-expansion reaching most of the complex endodontic space (18, 19).
Within this study's limits, the three-dimensional penetration of the biosealer in the lateral anatomy was significantly enhanced by employing the new obturation technique compared to the single cone technique.
Furthermore, utilising the heat carrier obturation method, the heat does not reach the apical region, eluding any risk of the immediate setting for the biosealer. Moreover, future investigations with different methods and biosealers can be necessary to verify these results.
Whether the new obturation method provides any significant advantage in improving clinical outcomes is yet to be confirmed.

Clinical Relevance

This technique allows using Bioceramic sealers with heat obturation, creating a three-dimensional seal.

Conflict of Interest

None.

Acknowledgements

None.

References

1 *Shekarchizade, N., Shahpouri, M., Charsooghi, M. A., Spagnuolo, G., & Soltani, P. (2022). Comparative evaluation of the effectiveness of different rotary systems in removal of root canal filling materials. Giornale Italiano Di Endodonzia, 36(1).*
2 *Hülsmann M., Peters O.A., Dummer P.M.H. Mechanical preparation of root canals: Shaping goals, techniques and means. Endod. Top. 2005, 10, 30-76.*
3 *Rengo C., Spagnuolo G., Ametrano G., Juloski J., Rengo S. & Ferrari M. Micro-computerized tomographic analysis of premolars restored with oval and circular posts. Clinical Oral Investigations, 2014. 18(2), 571-578.*
4 *Iandolo A, Pantaleo G, Malvano M, Simeone M, Amato M. Nonsurgical management of complex endodontic cases with several periapical lesions: A case series. G Ital Endod. 2016 30:101-103.*
5 *Iandolo A., Simeone M., Riccitiello F. The preparation of coronal isthmus is a fundamental step for long term success. G. Ital. Di Endod. 2012, 26, 150-154.*
6 *Martina S, Pisano M, Amato A, Abdellatif D, Iandolo A. Modern rotary files in minimally invasive endodontics: a case report. Front Biosci (Elite Ed). 2021 Dec 20;13(2):299-304.*
7 *Rödig T., Hülsmann M., Kahlmeier C. Comparison of root canal preparation with two rotary NiTi instruments: ProFile. 04 and GT Rotary. Int Endod J. 2007, 40, 553-562.*
8 *De Santis R., Iaculli F., Lodato V., Gallicchio V., Simeone M., Spagnuolo G., & Rengo C. The Efficacy of Selected Sodium Hypochlorite Heating Methods for Increasing and Maintaining Its Intracanal Temperature-An Ex Vivo Study. 2022. Applied Sciences, 12(2), 891.*
9 *Violich D.R., Chandler N.P. The smear layer in endodontics-a review. Int. Endod. J. 2010, 43, 2-15.*
10 *Çobankara F.K., Adanır N., Belli S. Evaluation of the influence of smear layer on the apical and coronal sealing ability of two sealers. J. Endod. 2004, 30, 406-409.*

11 Iandolo A., Abdellatif D., Pantaleo G., Sammartino P., Amato A. Conservative shaping combined with three-dimensional cleaning can be a powerful tool: Case series. J Conserv Dent. 2020, 23, 648-652.
12 Iandolo A., Amato A., Martina S., Abdellatif D.A, Pantaleo G. Management of severe curvatures in root canal treatment with the new generation of rotating files using a safe and predictable protocol. Open Dent J. 2020, 14, 421-425.
13 Khandelwal A., Janani K., Teja K., Jose J., Battineni G., Riccitiello F., Valletta A., Palanivelu A., & Spagnuolo G. Periapical Healing following Root Canal Treatment Using Different Endodontic Sealers: A Systematic Review. BioMed Research International, 2022, 1-9.
14 Spagnuolo G. Bioactive Dental Materials: The Current Status. 2022. Materials, 15(6).
15 Patel DV, Sherriff M, Ford TR, Watson TF, Mannocci F. The penetration of RealSeal primer and Tubliseal into root canal dentinal tubules: A confocal microscopic study. Int Endod J. 2007;40:67-71.
16 Plotino G., Cortese T., Grande N.M., Leonardi D.P., Di Giorgio G., Testarelli L., Gambarini G. New Technologies to Improve Root Canal Disinfection. Braz. Dent. J. 2016, 27, 3-8.
17 Gandolfi M.G., Taddei P., Pondrelli A., Zamparini F., Prati C. & Spagnuolo G. Demineralization, collagen modification and remineralization degree of human dentin after EDTA and citric acid treatments. 2019,Materials, 12(1).
18 Raghavendra S.S., Jadhav G.R., Gathani K.M., Kotadia P. Bioceramics in endodontics-A review. J. Istanb. Univ. Fac. Dent. 2017, 51, S128–S137.
19 Abdellatif D., Amato A., Calapaj M., Pisano M., Iandolo A. A novel modified obturation technique using biosealers: An ex vivo study. J Conserv Dent. 2021 Jul-Aug;24(4):369-373.
20 Ghilotti J., Sanz J.L., López-García S., Guerrero-Gironés J., Pecci-Lloret M.P., Lozano A., Llena C., Rodríguez-Lozano F.J., Forner L., & Spagnuolo G. Comparative Surface Morphology, Chemical Composition, and Cytocompatibility of Bio-C Repair, Biodentine, and ProRoot MTA on hDPCs. 2020. Materials, 13(9), 2189.
21 Kharouf N., Pedullà E., La Rosa G.R.M., Bukiet F., Sauro S., Haikel Y., Mancino D. In Vitro Evaluation of Different Irrigation Protocols on Intracanal Smear Layer Removal in Teeth with or without Pre-Endodontic Proximal Wall Restoration. J. Clin. Med. 2020, 9, 3325.