Retreatment Efficacy of Propoint and Guttapercha - A Cone Beam Computed Tomography Analysis

**Chandrasekhar Veeramachaneni[1], Mohini Ratakonda[1*], Vijetha Badami[1]
and S. Anitha Rao[1]**

[1]*Department of Conservative Denntistry and Endodontics, Mamata Dental College, Khammam, Telangana, India.*

Authors' contributions

This work was carried out in collaboration between all authors. Author CV designed the study, wrote the protocol and wrote the first draft of the manuscript. Author MR managed the literature searches, performed CBCT analysis. Author VB analyzed the study and author SAR managed the experimental process. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Introduction: The present study aimed to evaluate the amount of residual material after retreatment of propoint (DRFP Ltd. Stamford, UK) and gutta-percha obturated using smart paste bio sealer (DRFP Ltd. Stamford, UK), considering gutta-percha and AH Plus (Dentsply Maillefer, Ballaigues, Switzerland) as the standard for comparison.
Methods: Forty five single rooted teeth were instrumented using rotary files (F3, Protaper, Dentsply Maillefer, Ballaigues, Switzerland). Obturation was done with three different materials (n=15); group 1, Propoint with smart paste bio, group 2, gutta-percha with smart paste bio and group 3, gutta-percha with AH Plus. Teeth were scanned by cone beam computed tomography to measure the volume of obturation material. After three months of storage, retreatment was performed (Protaper universal rotary retreatment files, Dentsply Maillefer, Ballaigues, Switzerland). Second scan of cone beam computed tomography was taken to evaluate the residual filling

Corresponding author: E-mail: mohiniratakonda@gmail.com;

material. Group comparisons were performed using one way ANOVA and Post-Hoc Tukey test HSD test (P=0.05).

Results: There was no statistically significant difference between the three groups (*P*<.05), in the residual filling material.

Conclusions: In conclusion, the results of this study indicate that the obturation material could not be removed completely in all the three groups. There was no significant difference in the retreatment efficacy between propoint and gutta-percha.

1. INTRODUCTION

Successful root canal therapy (RCT) relies on complete and accurate biomechanical preparation followed by a three dimensional obturation of the root canal systems in the absence of injury to periapical tissues. The root filling is thought to be critical for the long-term outcome of root canal treatment. A root filling may entomb the surviving bacteria, and prevent apical and coronal leakage, that is, stop influx of periapical tissue-derived fluid from nourishing the remaining microbiota and prevent re-infection of the root canal system. Animal and human outcome studies have shown that the root filling materials and techniques used currently are not optimal, and fail to fulfill the desired requirements. Therefore, the development and maintenance of a seal is desirable and considered a major prerequisite to improve the outcome of root canal treatment. One relatively recent approach to enhance the sealing ability of root fillings has been to apply adhesive concepts to endodontics. Moreover, both apical and coronal leakage can occur following seemingly successful root canal treatment. The intricate nature of root canal morphology complicates the instrumentation procedure. Fins, anastomoses, isthmuses and other irregularities within the root canal system harbor tissue, microorganisms, and microbial by products that may lead to failure of root canal therapy. Endodontically failed teeth can be treated by either surgical or non-surgical retreatment. In most of the situations, non-surgical endodontic retreatment has been the treatment of choice [1], since persistent infection is recognized as the main cause of failure [2]. Complete removal of previous filling material, re-cleaning and re-shaping followed by proper filling of the root canal system is the key to success of non-surgical retreatment [3,4].

Gutta-percha in combination with different sealers is the most commonly used obturating material. One of the recent advancements in endodontic obturating materials is the Smart seal system which consists of Propoints (also known as C Points) (DRFP Ltd. Stamford, UK) as the obturating points and Smart paste Bio (DRFP Ltd. Stamford, UK) as the sealer. The propoint consists of an inner core and an outer polymer layer. Inner core consists of two proprietary nylon polymers Trogamid T and Trogamid CX; and outer layer consists of cross-linked copolymer of acrylonitrile and vinylpyrrolidone cross-linked using allyl methacrylate and a thermal initiator [5]. Smart paste Bio (DRFP Ltd. Stamford, UK) is a resin based sealant with added bioceramics and ground polymer designed to swell. Both the sealer and point are hydrophillic, absorb water from root canal and expand to gently adapt to any irregularities in the root canal. It is claimed that this lateral expansion occurs nonuniformly, with the expandability depending on the extent to which the hydrophilic polymer is pre-stressed [6]. The in vitro biocompatibility of propoint is comparable to gutta-percha with minimal adverse effects on osteogenesis after elution of potentially toxic components [7]. In addition to other properties, an ideal obturating material should have the ability to be easily removed from root canals if necessary. Till date, there is no study concerning the retreatment of teeth filled with Propoint. Hence, the aim of the present study was to evaluate the amount of residual material after retreatment of propoint and gutta-percha obturated using smart paste bio sealer, considering gutta-percha and AH Plus (Dentsply Maillefer, Ballaigues, Switzerland) as the standard for comparison. The null hypothesis was that there is no significant difference in the retreatability of these materials.

2. MATERIALS AND METHODS

2.1 Specimen Preparation

Forty five human mandibular first premolars extracted for orthodontic reasons were collected. Single rooted teeth with single canals and root curvature less than 20° were included in the study. Carious teeth, teeth with incompletely

formed roots, root resorption and severe curvature were excluded. They were stored in 10% formalin solution until use and cleaned to remove any hard and soft deposits on the tooth surface. Presence of a single root canal was confirmed for each specimen by taking angled radiographs (X-Mind™ DC, Acteon Satelec, France). Teeth were decoronated to obtain a standardized length of 17 mm. Working length was established by inserting a # 10 K-file (Mani Inc, Tochigi, Japan) in the canal until its tip became visible from the root apex and subtracting 0.5 mm from that length.

2.2 Preparation and Filling of Root Canals

Apical enlargement was done upto # 25 K-file (Mani Inc, Tochigi, Japan). Root canals were prepared using Protaper Universal rotary files (Dentsply Maillefer, Ballaigues, Switzerland) No. F3 in the sequence of S1, Sx, S2, F1, F2 and F3. During preparation, canals were irrigated with 5 ml of 3% sodium hypochlorite followed by 5ml of 17% EDTA liquid. Final rinse was done with 5ml of distilled water. Specimens were randomly divided into three groups (n = 15). In Group 1 Propoint PT (F3) with smart paste Bio sealer (DRFP Ltd. Stamford, UK) was used for obturation; in Group 2, gutta-percha (Dentsply Maillefer, Ballaigues, Switzerland) (F3) with smart paste bio sealer (DRFP Ltd. Stamford, UK); and in Group 3, gutta-percha (F3) (Dentsply Maillefer, Ballaigues, Switzerland) with AH Plus sealer (Dentsply Maillefer, Ballaigues, Switzerland) were used. After final rinse, excess irrigant was removed in groups 1 and 2 using 2% paper points, but the canals were not completely dried. In group 3, canals were dried until no moisture is absorbed by the paper points. In groups 1 and 2, smart paste Bio sealer was introduced into the canals using sealer delivery tips and obturated with Propoint PT (DRFP Ltd. Stamford, UK) and gutta-percha which were cut flush with the orifice. In group 3, AH Plus sealer was introduced into the canals using lentulo spiral and obturated with gutta-percha. The orifices of root canals were sealed with type II Glass ionomer cement (GC corporation, Tokyo, Japan) to a thickness of 2 mm. Specimens were stored for three months at 37°C and 100% humidity in an incubator.

2.3 Evaluation of Obturation Material Using Cone Beam Computed Tomography (CBCT) Scans

The volume of obturation material of all the specimens was measured by cone beam computed tomography (i-CAT; Imaging Sciences International, LLC, Hatfield, PA) scanning at high resolution. DICOM data sets from the CBCT scans were analyzed on GE Advantage windows software – version 4.6 for volumetric analysis of samples using patented paint on slices technique in segment tool. Area of interest (for volume calculation – root canal obturation material) was selected by sculpting out the unwanted areas on individual slices sequentially for every sample and thus the summation of individual areas on all of the slices of that sample at the end in volume calculation tool of the software. The void area was not included while measuring obturated area.
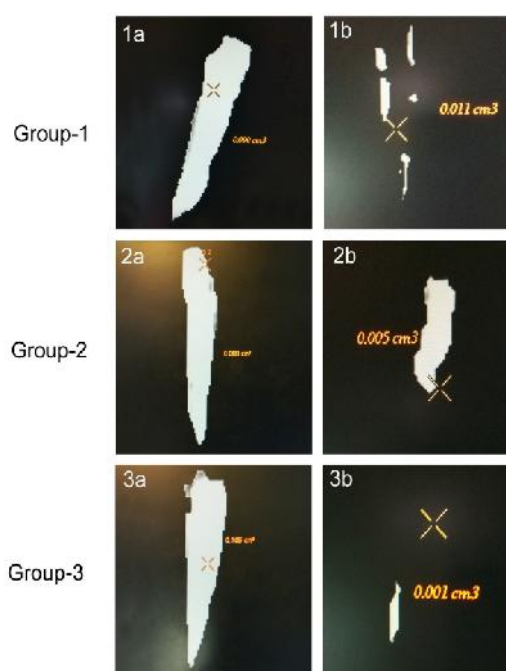

Fig. 1. Volume of root filling after obturation in group 1 (1a), group 2 (2a) and group 3 (3a). Volume of residual filling after retreatment in group 1 (1b), group 2 (2b) and group 3 (3b)

2.4 Retreatment

Retreatment was performed in each group using Protaper retreatment files (Dentsply International) (D1, D2, D3). D1 and D2 files were used to remove the root canal filling in the coronal and middle third respectively. D3 was used up to the working length. During retreatment, 3 to 4 drops of xylene was used in groups 2 and 3 to soften the gutta-percha. Warm water was used in group 1 to flush out the material, since it cannot be dissolved by solvents

used for gutta-percha. After the working length was reached with D3 Protaper retreatment file, apical preparation was done with F4 Protaper Universal file. Canals were irrigated with 5ml of 17% EDTA followed by 5 ml of 3% sodium hypochlorite. All the treatment and retreatment procedures were performed by a single operator. A second CBCT scan was performed after retreatment for evaluation of residual filling material (Fig. 1).

2.5 Statistical Analysis

Total and residual volumes of the filling material were obtained in cm³. The percentage of filling material removed was calculated by the formula:

% of Volume removed =

$$\frac{\text{Total volume - residual volume}}{\text{Total volume}} \times 100$$

Group comparisons were performed using one way ANOVA and Post-Hoc Tukey test HSD test. The level of significance was set at P = .05.

3. RESULTS

Mean volumes of obturation material and residual material, and percentage volume of material removed are given in Table 1. In regard to comparison of residual material volume and percentage of volume removed (Figs. 2, 3), there was no statistically significant difference between the three groups (P<.05).

4. DISCUSSION

The present study evaluated the volume of residual filling material in the root canals after retreatment in teeth obturated with combination of Propoint and smart paste bio, and gutta-percha and smart paste bio, which were compared to gutta-percha and AH Plus as the standard. Retreatment could not completely remove the obturated material from the root canals, leaving behind some residual material in the canal. Residual filling material was existing in all the groups compared and was not statistically significant. Hence the null hypothesis was accepted.

One of the most commonly used retreatment files are Protaper universal retreatment files. Studies have reported that Protaper retreatment instruments are more efficient in removing gutta-percha from root canals [8,9].

Several methods have been used for evaluating the amount of residual filling material after retreatment. These include dental operating microscope and conventional radiography [10], scanning electron microscopy [11], cone beam computed tomography (CBCT) [12], and micro computed tomography [13]. In the present study, High resolution CBCT imaging (i-CAT; Imaging Sciences International, Hatfield, PA) has been used for obtaining the volume of residual filling material in root canals after retreatment. CBCT provides three dimensional assessment of the root canal system before and after treatments. It is less expensive than computed tomography, with short scan times [14].

The property of sealers to adhere to dentin probably effects their ease of removal [15] signifying the importance of bonding of root canal sealer to dentin. The volume of filling material removed from the control group was greater than other two groups. As the AH Plus sealer does not bind to gutta-percha, it does not form a monoblock [16].

Table 1. Mean volumes of obturation material, residual material and percentage values of filling material removed (±SD)

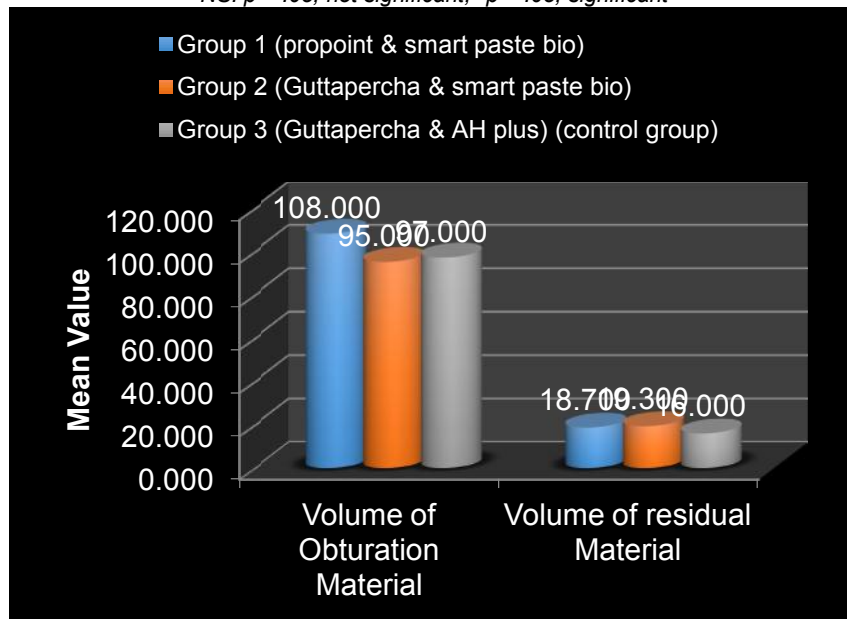| Group	Volume of obturation material (cm³)	Volume of residual material (cm³)	% age volume removed
Group 1 (propoint & smart paste bio) n=15	0.108±0.015	0.0187±0.0099	83.00±9.26
Group 2 (Guttapercha & smart paste bio)	0.095±0.011	0.0193±0.0059	80.14±6.05
Group 3 (Guttapercha & AH plus) (control group)	0.097±0.009	0.0160±0.0091	84.73±11.19
P value[#]	0.008*	0.528[NS]	0.384[NS]
Group 1 vs 2	0.009*	0.975[NS]	0.665[NS]
Group 1 vs 3	0.042*	0.668[NS]	0.861[NS]
Group 2 vs 3	0.806[NS]	0.534[NS]	0.357[NS]

Fig. 2. Mean scores of volume of root filling material after obturation and after retreatment
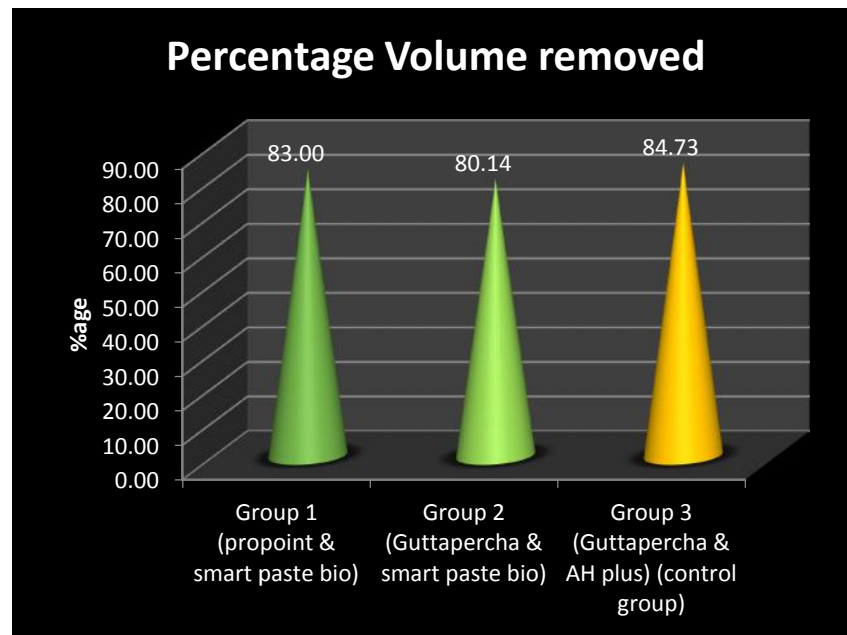

Fig. 3. Percentage volume removed in three groups

Due to polymerization shrinkage, the sealer tends to pull away from gutta-percha and tooth upon setting. These factors might have contributed to the better retrieval of gutta-percha and AH Plus.

Parallel to the control group, the volume of filling material removed from group 1 was greater than group 2. The probable explanation for this is that the rotary file when aimed at the center of Propoint the nylon core will guide the file towards the apex. Which in turn helps the removal of the point. While the outer polymer of Propoint and

smart paste bio which are hydrophilic will adapt with tooth structure to form a better bond there by leaving some residue of the material on the dentin. As claimed by the manufacturer both propoint and smart paste bio sealer are hydrophilic and during the process of retreatment the bonding between the propoint and bio sealer must have disrupted the bond between the dentinal wall and sealer leaving less amount of residual filling material.

The smart paste bio sealer provided by the manufacturer for Propoint contains bioceramic components. Ersahan et al. [17] reported that the dentin bond strength of EndoSequence Bio ceramic sealer was equivalent to that of AH Plus. Hence an attempt has been made to use this sealer in combination with gutta-percha (Group 2).

In present study the smart paste bio sealer and gutta-percha combination could not be removed as easily when compared to other groups as smart paste bio sealer is hydrophilic and bonds to the tooth structure. Whereas gutta-percha does not bond to smart paste bio sealer there by leaving the bonded sealer on the root dentin.

5. CONCLUSION

In conclusion, the results of this study indicate that the obturation material could not be removed completely in all the three groups. There was no significant difference in the retreatment efficacy between propoint and gutta-percha.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Friedman S, Stabholz A. Endodontic retreatment – case selection and technique. Part 1: Criteria for case selection. J Endod. 1986;12(1):28–33.

2. Masiero AV, Barletta FB. Effectiveness of different techniques for removing gutta-percha during retreatment. Int Endod J. 2005;38(1):2–7.

3. Stabholz A, Friedman S. Endodontic retreatment--case selection and technique. Part 2: Treatment planning for retreatment. J Endod. 1988;14(12):607-14.

4. Friedman S, Stabholz A, Tamse A. Endodontic retreatment--case selection and technique. 3. Retreatment techniques. J Endod. 1990;16(11):543-9.

5. Anthony Didato, Ashraf A. Time-based lateral hygroscopic expansion of a water-expandable endodontic obturation point. J Dent. 2013;41(9):796-801.

6. Highgate DJ, Lloyd JA. Expandable / contractable composition for surgical or dental use. United States Patent Number 7,210,935; 2007.

7. Eid AA, Nikonov SY, Looney SW, Didato A, Niu LN, Levin MD, et al. *In vitro* biocompatibility evaluation of a root canal filling material that expands on water sorption. J Endod. 2013;39(7):883-8.

8. Bramante CM, Fidelis NS, Assumpcao TS, et al. Heat release, time required, and cleaning ability of Mtwo R and Protaper Universal retreatment systems in the removal of filling material. J Endod. 2010; 36(11):1870-3.

9. Saad AY, Al-Hadlaq SM, Al-Katheeri NH. Efficacy of two rotary NiTi instruments in the removal of Gutta-Percha during root canal retreatment. J Endod. 2007; 33(1):38-41.

10. Schirrmeister JF, Hermanns P, Meyer KM, Goetz F, Hellwig E. Detectibility of residual Epiphany and gutta-percha after root canal retreatment using a dental operating microscope and radiographs – an *ex vivo* study. Int Endod J. 2006;39(7):558-65.

11. Hess D, Solomon E, Spears R, He J. Retreatability of a Bioceramic root canal sealing material. J Endod. 2011;37(11): 1547-9.

12. Neelakantan P, Grotra D, Sharma S. Retreatability of 2 Mineral trioxide aggregate-based root canal sealers: A cone-beam computed tomography analysis. J Endod. 2013;39(7):893-96.

13. Helvacioglu-Yigit D, Yilmaz A, Kiziltas-Sendur G, Aslan OS, Abbott PV. Efficacy of reciprocating and rotary systems for removing root filling material: A micro-

computed tomography study. Scanning 2014;36(6):576-81.

14. Durack C, Patel S. Cone beam computed tomography in Endodontics. Braz Dent J. 2012;23(3):179-191.

15. Só MVR, Saran C, Magro ML, Vier-pelisser FB, Munhoz M. Efficacy of Protaper retreatment system in root canals filled with gutta-percha and two endodontic sealers. J Endod. 2008;34(10):1223-5.

16. Teixeira FB, Teixeira EC, Thompson JY, Trope M. Fracture resistance of roots endodontically treated with a new resin filling material. J Am Dent Assoc. 2004; 135(5):646-52.

17. Ersahan S, Aydin C. Dislocation resistance of iRoot SP, a calcium silicate-based sealer, from radicular dentine. J Endod. 2010;36(12):2000-2.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/13455