

Assessment and comparison of the incidence and degree of extrusions with TotalFill®BC and AH Plus™ sealers when using single-matched cone and warm vertical compaction as obturation techniques

Beleva I.

BUPA Dental Care, Newark, United Kingdom

E-mail: dr.beleva@gmail.com

Keywords:

- sealer extrusions
- AH Plus™
- bioceramic sealer
- TotalFill®BC Sealer™
- warm vertical compaction
- single matched cone

Abstract

Extrusions of endodontic materials after root canal treatments are scarcely commented upon in the existing literature. Although they can cause serious complications depending on their size and the area they have occurred.

Literature review: AH Plus™ is a conventional endodontic sealer, which has been established as the "gold standard" for root canal treatments (Roggendorf, 2004). Bioceramic sealers (TotalFill® BC Sealer™) are novel and promising endodontic materials, which have not been comprehensively scrutinised. The limited research available shows comparable success of the treatments with both types of sealers, as well as similar complications.

Method: A laboratory experiment involving 108 plastic teeth was conducted in order to assess and compare the likelihood of extrusions with both types of sealers in combination with two different obturation techniques. The acrylic teeth were instrumented with the same type of endodontic files, according to the same protocol, and divided in four groups. Each group received a different treatment (a combination of one sealer and one obturation method), where an equal amount of sealer was injected in each canal-0.3ml, in order to assess which treatment caused less number and amounts of extrusions.

Results: The percentage of extrusions was higher and statistically significant (with P-value $0.0114 < 0.05$) in the groups obturated with TotalFill®BC Sealer™ - 51.85% and 44.44%, compared to the groups obturated with AH Plus™ - 11.11% and 33.33%. The same was evident regarding the sizes of extrusions. The obturation method did not seem to affect the extrusion occurrences in the TotalFill®BC Sealer™ groups. However, it seemed to have an effect on the frequency of extrusions in AH Plus™ groups as a difference of 22.22% was evident.

Conclusion: Based on the findings of this study and the scientific data from the existing literature, it is recommended that extrusions should be avoided. The choice of obturation technique and sealer should be carefully considered in accordance to the specific case and in order to prevent extrusions.

Introduction

An indication of favourable outcome after a root canal treatment is the absence of pain, swelling or other signs and symptoms of infection [5]. Radiological evidence of a normal periodontal ligament is also of significant importance when assessing the outcome [6].

It is believed that the RC obturation should end at the apical constriction or slightly shorter (0.5mm-2mm), so that an optimal result is achieved Fig. 1 [9, 13].

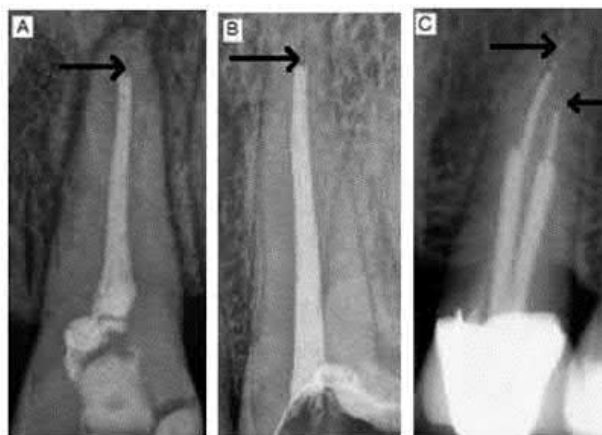


Fig. 1.: Root canal filled short of the apical constriction (underfilled). (source: Mostert, 2015)

During the process of obturation, materials may be unintentionally extruded beyond the limits of the root canal [2]. The obturation materials used should be biocompatible, however, occasionally overextension may cause uncontrolled inflammation, rather than healing [1, 12]. It has been reported that presence of extrusions beyond the apical constriction may cause irritation of the surrounding tissues and lower the success rate of the treatment [4]. Rosen *et al.* [11] confirm the latter statement and advise that potentially contaminated and extruded sealer may cause sensory disturbances and even result in complete failure of the treatment.

Extrusions as a result of the use of different techniques and materials are scarcely commented in the existing literature. Apart from the various case reports, describing complications related to RCs overfilling, the presence of extrusions is rarely followed by investigation of why they have appeared. However, the outcomes could be physiologically detrimental, such as permanent paraesthesia [3].

Materials and Methods

108 Endo-VuTM blocks were instrumented to working length with ProTaper GoldTM files, Dentsply Maillefer, Switzerland files (from S1 to F3). After confirmation of apical size #30, the acrylic teeth were assigned a number from 1 to 108, and were randomly assigned to 4 groups, using a computer program- Research Randomiser. Group A, obturated with AH PlusTM and warm vertical compaction (WVC), was designated as a control group. Group B was obturated with AH PlusTM and single matched cone technique (SC). Group C and D were obturated with TotalFill[®]BC SealerTM and, respectively, WVC and SC. So that the process resembled as much as possible clinical environment, each plastic tooth was securely stabilised and obturated under rubber dam as shown in Fig. 2. This assured lack of bias from the operator as the direct vision to the apical end was obscured and prevented a possible intentional adjustment in the manual operation.

For groups A and C, the GP points used were .08 taper AutoFitTM SybronEndo, Glendora, CA 91740, USA. AutoFitTM GP is manufactured from Alpha phase GP which is preferable in warm obturation techniques. The tips of the master GP points were measured and cut to #30 in a GP point gauge as displayed in Fig. 3. ElementsTM Free, SybronEndo, was the equipment used for WVC technique (downpack and backfill). For groups B and D were used Beta phase GP master points ProTaper GoldTM F3, Dentsply Maillefer, Switzerland, which according to the manufacturer's recommendation "match perfectly" to the canal's final shape created by the last file used – ProTaperGoldTM F3.



Fig. 2.: The acrylic block, isolated under rubber dam. (source: author's own work)



Fig. 3.: GP point gauge measuring if the end of the GP fits the size of the apical constriction accurately. The gauge pictured measures sizes from #20 to #140. (source: author's own work)

It was intended that the amount of sealer introduced into each canal was equal. For this reason, the introduction of sealer to the canals was done by an insulin syringe 0.5ml, prefilled with sealer, which provided precise measurement of up to 0.01ml (seen in Fig. 4). The amount of sealer introduced in the coronal part of the root canal was equal for each canal – 0.03ml. And it was further spread to working length by the master GP point. The GP point itself was not removed from the canal to avoid removal of sealer. Instead, it was used for the obturation of the canal.

After the obturation process was completed, a visual inspection was carried out immediately and if an extrusion was noted, the block was marked. The number of extrusions for each group were recorded in a data collection sheet displaying the treatment and the noted outcomes. The degree of extrusion was later compared to those in the other groups, in order to outline the link between an effect and treatment. The existing extrusions were collected with a scalpel and placed in Eppendorf tubes of 1.5ml (Fig. 5). Prior collection of the extruded material the Eppendorf tube was pre-weighed empty on a milligram scale.



Fig. 4.: Size of insulin syringe compared to TotalFill®BC Sealer™ syringe. Insulin syringe with an applicator tip secured in place. (source: author's own work)

Results and Discussion

The data was analysed with Prism8 GraphPad by parametric one-way analysis of variance (ANOVA) and Tukey's post-hoc test [8], with confidence interval (CI) 95%. The selection of ANOVA test allowed comparison of the findings for more than two groups and acknowledgement of any significant differences between them.

In order to answer the research question about the chance of extrusion incidence, the overall proportion of extrusions- 34.75% and non-extrusions-65.15% was calculated and illustrated in Fig. 6. Additionally, the percentage of extrusion incidences per each group was computed and presented on Fig. 7. Respectively, extrusions were evident 11.11% in Group A, 33.33% in Group B, 51.85% in Group C, and 44.44% in Group D.



Fig. 5.: Measuring of extruded material, collected in Eppendorf tube. (source: author's own work)

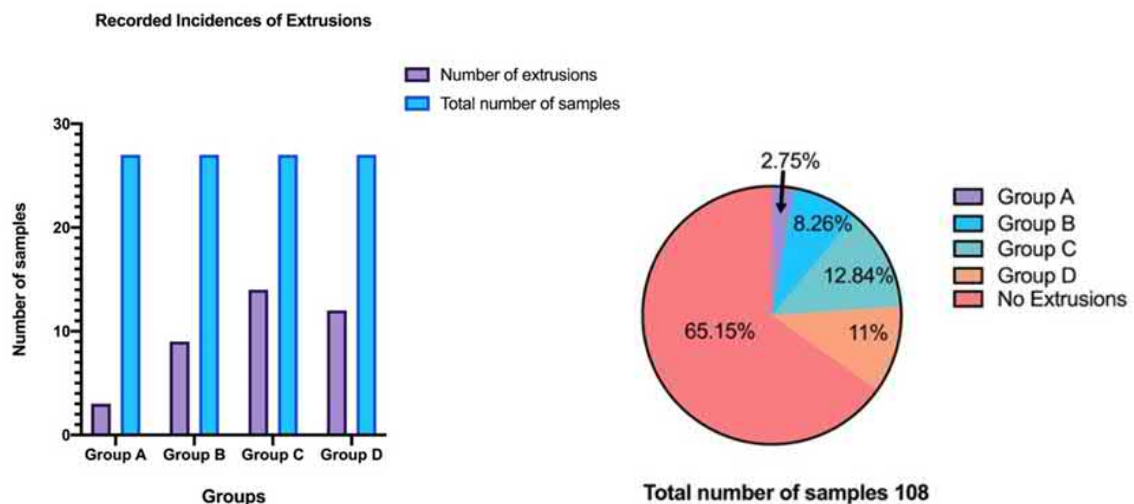


Fig. 6.: Recorded incidences of extrusions and non-extrusions and their percentage per group. (source: author's own work)

From Tukey's post-hoc test (Fig. 8) and the pairwise comparisons of the means (Fig. 9), the presence of significant difference between the means of Groups A compared to Group C – 0.1111 to 0.6296 is evident. The same is noted comparing the means of Groups A to Group D – 0.1111 to 0.6296. Additionally, the 95% confidence intervals for the difference between the means of each pair were analysed. For the pair Groups A/C the lower interval was 0.057 milligrams and the higher interval- 0.9796 milligrams. Therefore, the true value from the difference of the two means to be between 0.057 and 0.9796 milligrams for this study is probable

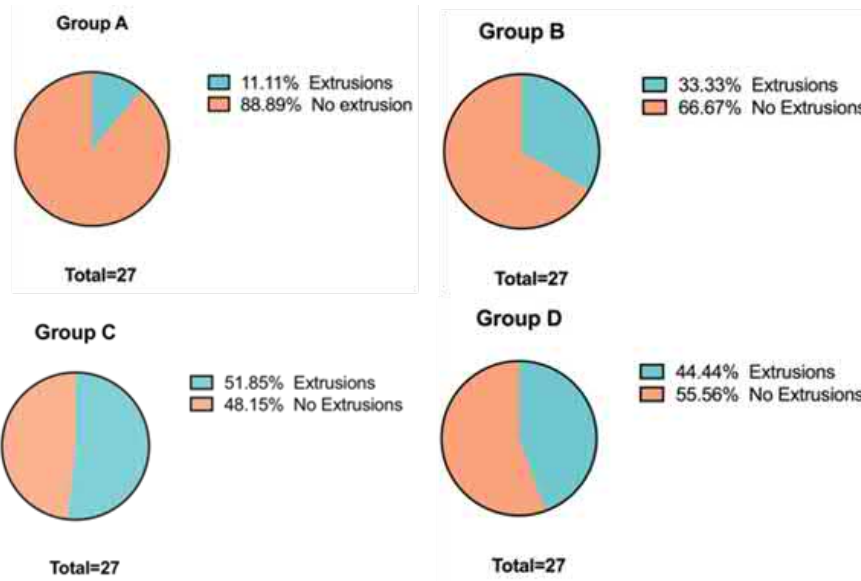


Fig. 7.: Extrusions percentage within each group. (source: author's own work)

up to 95%. Groups A/D had identical values to the latter couple of groups. So, the results were equivalent.

Tukey's post-hoc test results

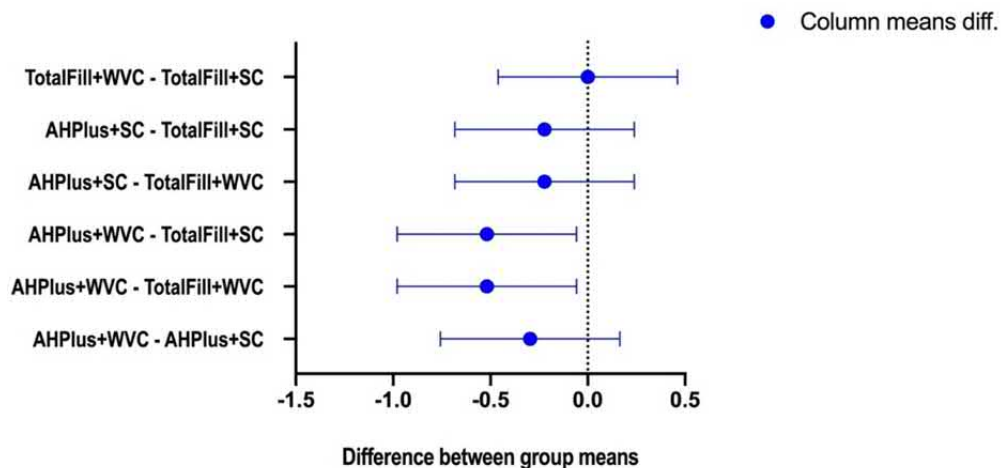


Fig. 8.: Tukey's post-hoc test results. (source: author's own work)

The P-values for the pairwise comparisons were calculated and established to be statistically significant for the pairs Groups A/C and Groups A/D, and equal to 0.021. This meant that the possibility of having similar numbers of incidences and amounts of extrusions was 2.1%.

Conclusion

In conclusion, the highest percentage of extrusion occurrences was evident in both of the groups obturated with TotalFill®BC Sealer™. The obturation technique did not appear to considerably affect the occurrence of extrusions in the groups C and D. However, it was noted that it may be a factor for overfillings when AH Plus™ is used. A further thorough evaluation of the bioceramic sealers with the conduction of randomised controlled trials and systematic reviews is needed for their qualities to be comprehensively appraised.

Due to the standardisation of the acrylic blocks in this in vitro study and a few diverse factors in a

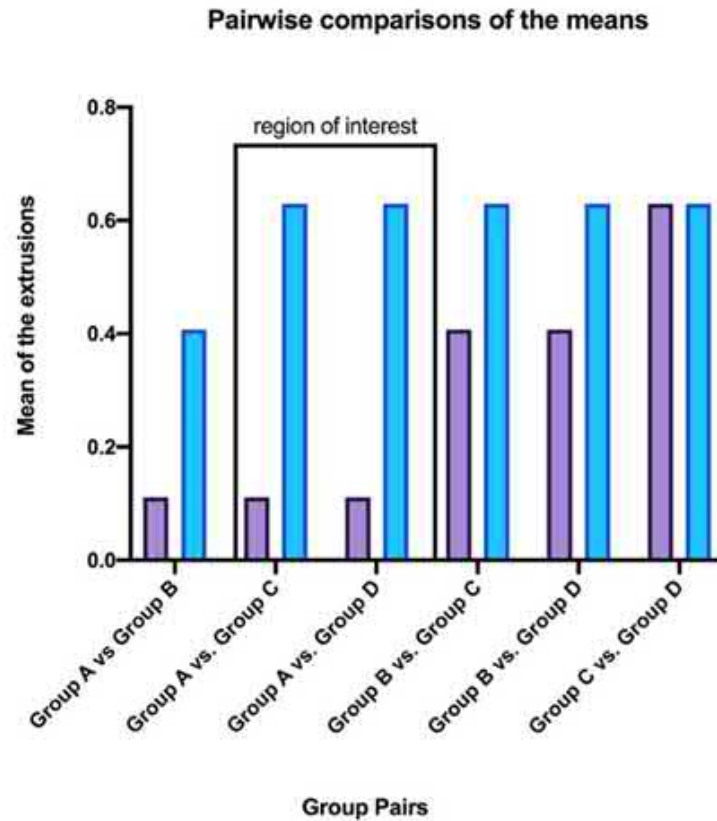


Fig. 9.: Pairwise comparisons of the means. (source: author's own work)

clinical environment, the results potentially may differ if compared to a relevant clinical scenario. A future investigation of extrusions' occurrences and their amounts in clinical environment would be beneficial for more explicit results and categorical deductions.

Within the limitations of this study and based on the existing scientific data regarding extrusions of endodontic materials, the avoidance of overfillings is recommended. The choice of obturation technique and sealer should be carefully considered, dependent upon the RC anatomy and the proximity to main anatomical features such as the inferior alveolar nerve, in order to achieve high-quality obturation with minimal chances of complications.

References

- [1] Chang MC, Lin LD, Chen YJ, Tsai YL, Cheng YA, Kuo CS, et al. Comparative cytotoxicity of five root canal sealers on cultured human periodontal ligament fibroblasts. *Int Endod J* [Internet]. 2010 Mar; 43 (3): 251- 7. DOI: <https://doi.org/10.1111/j.1365-2591.2009.01676.x> [PMid:20158537]
- [2] Chybowski EA, Glickman GN, Patel Y, Fleury A, Solomon E, He J. Clinical Outcome of Non-Surgical Root Canal Treatment Using a Single-cone Technique with Endosequence Bioceramic Sealer: A Retrospective Analysis. *J Endod* [Internet]. 2018 Jun; 44 (6): 941- 5. DOI: <https://doi.org/10.1016/j.joen.2018.02.019> [PMid:29606401]
- [3] Coskunses FM, Sinanoglu A, Helvacioglu-Yigit D, Abbott P V. The extrusion of root canal cement containing paraformaldehyde into the inferior alveolar nerve canal resulting in infection and numbness. *Int Endod J* [Internet]. 2016 Jun; 49 (6): 610- 7. DOI: <https://doi.org/10.1111/iej.12510> [PMid:26193905]
- [4] Suresh Chandra B, Gopikrishna V. *Grossman's Endodontic Practice*. Thirteenth. Wolters Kluwer Health; 2014.

- [5] Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J* [Internet]. 2006 Dec; 39 (12): 921- 30. DOI: <https://doi.org/10.1111/j.1365-2591.2006.01180.x> [PMid:17180780]
- [6] Meirinhos J, Martins JNR, Pereira B, Baruwa A, Gouveia J, Quaresma SA, et al. Prevalence of apical periodontitis and its association with previous root canal treatment, root canal filling length and type of coronal restoration - a cross-sectional study. *Int Endod J* [Internet]. 2020 Apr 15; 53 (4): 573- 84. DOI: <https://doi.org/10.1111/iej.13256> [PMid:31749154]
- [7] Mostert V. Root canal treatment outcomes. School of Dentistry, Faculty of Health Sciences; 2015.
- [8] Han K Do, Park YG. Comments on Statistical Issues in January 2016. *Korean J Fam Med* [Internet]. 2016 Apr 15; 37 (1): 75. DOI: <https://doi.org/10.4082/kjfm.2016.37.1.75> [PMid:26885327 PMCid:PMC4754292]
- [9] Peng L, Ye L, Tan H, Zhou X. Outcome of Root Canal Obturation by Warm Gutta-Percha versus Cold Lateral Condensation: A Meta-analysis. *J Endod* [Internet]. 2007 Feb 15; 33 (2): 106- 9. DOI: <https://doi.org/10.1016/j.joen.2006.09.010> [PMid:17258624]
- [10] Roggendorf M. Wurzelkanalfüllmaterialien up-to-date Klassische und moderne Wurzelkanalsealer im Vergleich. *Bayerisches Zahnärzteblatt*. 2004 (Sept); 32- 34.
- [11] Rosen E, Goldberger T, Taschieri S, Del Fabbro M, Corbella S, Tsesis I. The Prognosis of Altered Sensation after Extrusion of Root Canal Filling Materials: A Systematic Review of the Literature. *J Endod* [Internet]. 2016 Jun 15; 42 (6): 873- 9. DOI: <https://doi.org/10.1016/j.joen.2016.03.018> [PMid:27133502]
- [12] Ruparel NB, Ruparel SB, Chen PB, Ishikawa B, Diogenes A. Direct Effect of Endodontic Sealers on Trigeminal Neuronal Activity. *J Endod* [Internet]. 2014 May 15; 40 (5): 683- 7. DOI: <https://doi.org/10.1016/j.joen.2014.01.030> [PMid:24767564]
- [13] Schaeffer MA, White RR, Walton RE. Determining the Optimal Obturation Length: A Meta-Analysis of Literature. *J Endod* [Internet]. 2005 Apr 15; 31 (4): 271- 4. DOI: <https://doi.org/10.1097/01.don.0000140585.52178.78> [PMid:15793382]