# Evaluation of the penetration depth of Guttaflow bioseal and Bioceramic sealers using scanning electron microscope (in vitro study)

Razawa Kareem Saeed[(1)]

**Background and objective:** Three- dimensional obturation of the canal is mandatory in root canal treatment to decrease failure rate, the major cause of root canal reinfection after obturation is insufficient obturation of the canal which later leads to a periapical lesion and reinfection.This study aimed to evaluate the penetration depth of Guttaflow bioseal and Bioceramic sealer.
**Methods:** Twenty extracted single-rooted human teeth (mandibular first premolar) were used in this study, teeth were decornated leaving 10 mm root length. The chemico-mechanical preparation of the samples was done by using a protaper universal system till size F1 and then samples were divided into 2 groups (n = 10), according to the filling material in the first group Guttaflow bioseal used while in the second group Onefil bioceramic sealer used the sealers introduced into canals according to manufactures instructions and then obturated with gutta-percha size F1, single condensation technique used and finally samples were cross- sectioned at 3 and 7 mm, sealers penetration depth was measured by using scanning electron microscope.
**Result:** Independent sample t-test shows that the difference between the penetration depth of guttaflow bioseal and bioceramic sealers are non-significant while the ANOVA test shows that the difference between the three sections of the root is highly significant for both sealer, coronal section shows the best result for Guttaflow bioseal while middle section for Bioceramic shows the best result of penetration.
**Conclusion:** There are no difference in sealer penetration of both sealers Guttaflow bioseal and Onefil bioceramic, while regarding sealer penetration in each sections of root for Guttaflow bioseal in coronal section shows a best penetration, for Onefil bioceramic middle section shows a best penetration.
**Keywords:** Penetration depth, Guttaflow bioseal, Bioceramic Sealer, Scanning Electron Microscope

[(1)]Department of Conservative Dentistry, College of Dentistry, Hawler Medical University, Erbil, Iraqi Kurdistan Region.
**Correspondent Name:** Razawa Kareem Saeed
Email: razawakareem@yahoo.com

## INTRODUCTION

Root canal treatment success depends on effective cleaning of canal, irrigation of the canal with agood biomechanical preparation, and achieving an effective apical seal of the canal space with obturating materials.[1] Inadequate obturation of the canal is the main cause of root canal reinfection after obturation of canal which later leads to the periapical lesion and reinfection of canal, about 58% of root canal failure are caused by incomplete obturation of the root canal space. [2]

Insufficient instrumentation of a canal with the wrong technique and incomplete obturation of the canal with inadequate obturating material is the major cause of failure.[3] Different materials had been used for canal obturation like guttapercha, silver points, etc. Gutta percha has been considered as the gold standard for root canal- filling materials.[4] Guttapercha has been considered as the best obturating material for canal obturation however after the setting of the sealer shrinkage of sealer occurs and space is created between canal wall and sealer resulting in the absence of complete seal and microleakage. [5] When Guttapercha is combined with a sealer performs a better sealing ability. [6,7] There are many types of sealer but Guttaflow combines both gutta-percha and sealer one of the advantages of Guttaflow is it is flowability at room temperature and can be used as obturating material and as

asealer instead of a solid master cone. Traditional gutta-percha with sealer did not provide a tight seal for that reason anew obturating material had been developed to overcome this shortage. Guttaflow is composed of sealer with a powder of gutta-percha particles of size less than 30 μm, (polydimethylsiloxane). Guttaflow provides a superior tight seal because of its flowability and with (0.2%) expansion of material during setting providing a better adaptation to root dentin walls.[8] GuttaFlow bioseal is a newly produced silicone-based, cold-filling sealer combining both gutta-percha powder and bioactive glass. The hydroxyapatite crystals are formed by combining bioactive glass with gutta-percha the manufacturer has reinsured this fact.[9]

Bioceramic sealer is one of the most biocompatible materials used as a sealer in root canal treatment one major advantage of this sealer is its biocompatibility it adapts very well with surrounding tissues.[10] Secondly, there is calcium phosphate in the component of bioceramic materials which increases the setting properties of bioceramics and lead to the formation of a structure that resembles to tooth and bone apatite materials , [11] thereby increasing the bond between sealer and root dentine. However, these materials cannot easily have removed from the canal after its set for purpose of retreatment or for post placement is one of major disadvantages of these materials.[12] The success of any endodontic treatment is depend on the three dimensional obturation of the canal a new material had been developed like Guttaflow bioseal and Bioceramic sealer inorder to obtain good and tight seal of canal and to increase success rate of treatment.

**Aim**

The study aimed to evaluate the penetration depth of Guttaflow bioseal and Bioceramic sealer.

## Methods

Twenty extracted single-rooted human teeth (mandibular first premolar) with full apex, round canals, and straight root no (cracks, root caries, or root resorption) were used in this study and with one apical foramen. At first, the teeth should be put in 5.25% sodium hypochlorite solution for one day and one night to clean the teeth from calculus and surface deposits.

In order to achieve a stander length for all samples all the teeth were cut at 10 mm length by fissure bur with water by using a, high speed hanpiece, after that, a size 10 K-file was inserted in- to canal to establish working length till the file was seen at apical foramen and then minimizing 1mm.

The chemo-mechanical preparation of canals was done by using ProTaper universal system (X-Smart1, Dentsply, Konstanz, Germany), the file was used in continuous rotation motion at a speed 350 rpm according to manufacturer instructions, and each group was shaped with the files reached the WL (SX, S1, S2, F1). irrigation of the canal was done by using 3mL of 5.25% sodium hypochlorite (NaOCl) after each size of the instruments. Then the canal was flushed with 5 ml of 17% of (EDTA) ethylene diaminetetraacetic acid solution to remove smear layer and 5mL of 5.25% NaOCl and lastly with 10mL distilled water. The sterile absorbent paper points were used for drying of the canal.

The samples were randomly sorted into 2 groups (n = 10) depending on the material type used: the 1st group Guttaflow bioseal (roeko, COLTENE) were used and the second group one- fil bioceramic sealer (MEDICLUS CO., LTD) were used in the guttaflow bioseal group after removing of the protective cap a flexible mixing tip was placed. The sealer dispenses on a mixing slab after a slight pressure on the plunger and then introduced into the canal by using stainless steel k- file (#15), then the master cone gutta-percha size F1 was covered with sealer and inserted into a canal after that - a hot instrument was used for cutting of gutta -percha, for the second group the intracanal tip was used for introducing the sealer into the canal, first, the sealer inserted into apical part of the canal and then filling The other parts of the canal with slow withdrawn of the tip until the filling of all other parts of the canal were finished. Guttapercha size F1 was used for obturaion of the canals the technique used for obturaion was single condensation technique. Temporary restoration was used for the seal of coronal access and then to allow sealer to set the samples were stored in 100% humidity at 37˚C for 10 days. [13]

The samples were cut cross-sectionally at three and seven mm from the apex using a diamond disc and continuous water cooling presenting the apical and middle thirds, then the distilled water was used for washing of sections 5 min and scanning electron microscope (SEM) was used. The data were analyzed by using a one-way analysis of variance, t- test and the statistical evaluation was performed using SPSS version 25.

**Results**

In this study, an independent sample t- test was used to compare the penetration depth of guttaflow bioseal and bioceramic sealer. The difference between both groups is non-significant in penetration (P= 0.688> 0.05) (Table 1).

The ANOVA test was used to compare between the three section of roots (coronal, middle and apical) of each group of Guttaflow bioseal and bioceramic. The difference between these three sections of root for both groups is highly significant (P= 0.00 <0,05) as shown in figure 1 and Table 2. In the meantime, T-test was also used to compare between each two of these sections (coronal, middle and apical) within the same groups of the Gutta flow bio sea and Bioceramic. The difference between all compares sections in both groups.

**Table1:** Comparison between Guttaflow bioseal and Bioceramic group

| | | | | | 95% Confidence Interval for mean | | |
|---|---|---|---|---|---|---|---|
| | **N** | **Mean** | **Std.Deviation** | **Std.Error** | **Lower Bound** | **Upper Bound** | **Sig.** |
| **Guttaflow bioseal group** | 30 | 13.980 | 1.035 | 0.189 | -0.891 | 0.192 | 0.688 |
| **Bioceramic group** | 30 | 14.329 | 1.607 | 0.194 | -0.891 | 0.192 | |

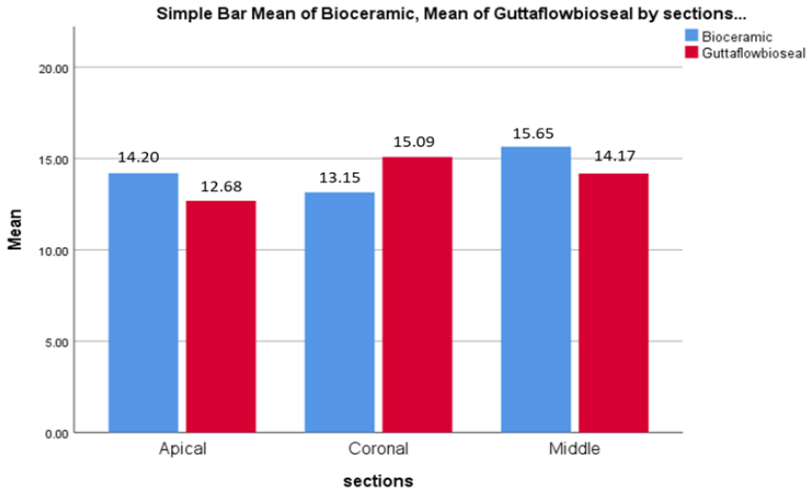


**Figure 1:** Simple Bar of Bioceramic, Men of Guttaflowbioseal by sections

**Table 2:** Comparison between three sections of root regarding sealer depth penetration

| Group | **Compare Sections** | Mean | Sig |
|---|---|---|---|
| Gutta flow bioseal | Coronal-Middle | 15.09-14.17 | .000 |
| | Coronal-Apical | 15.09-12.68 | .000 |
| | Middle-Apical | 14.17-12.68 | .000 |
| Bioceramic | Coronal-Middle | 13.15-15.65 | .000 |
| | Coronal-Apical | 13.15-14.20 | .000 |
| | Middle-Apical | 15.67-14.20 | .000 |

was highly significant (P= 0.00 <0,05) as shown in table 2.

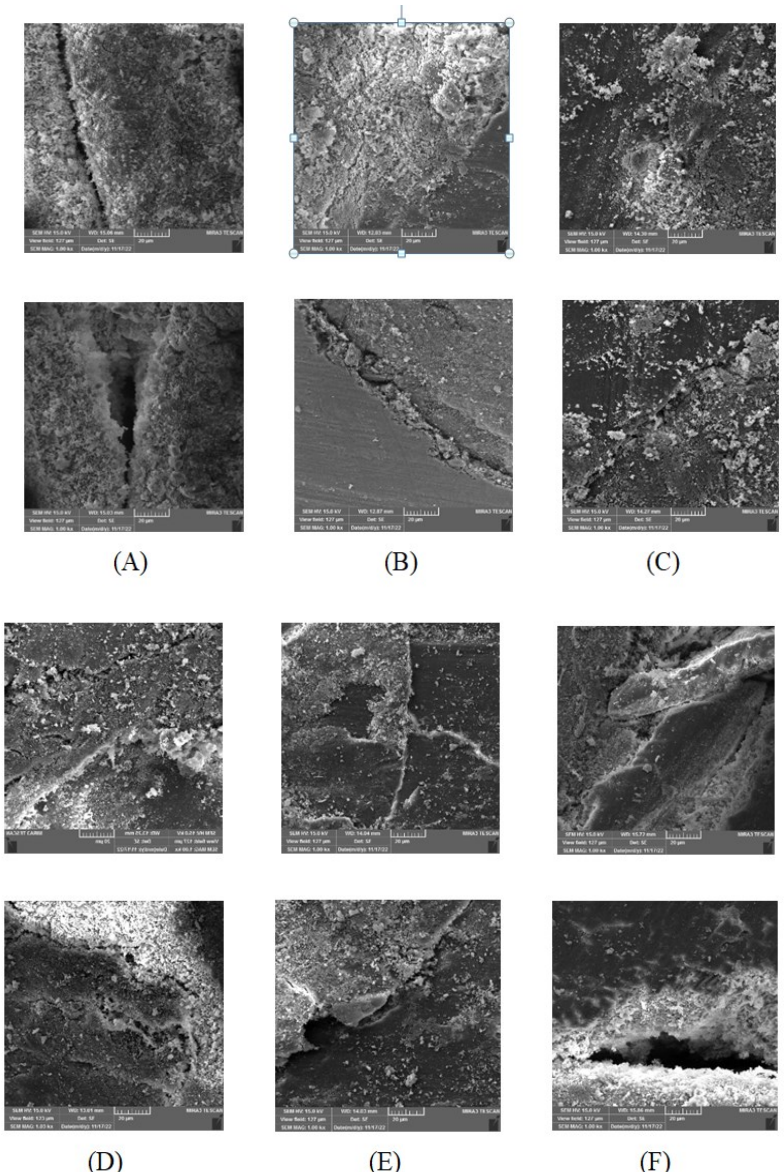


**Figure1:** SEM for sealer penetration for A; Guttaflow bioseal coronal section. B; Guttaflow bioseal apical section. C; Guttaflow bioseal middle section, D; Bioceramic coronal section. E; Bioceramic apical section. F; Bioceramic middle section.

## Discussion

Three-dimensional obturation of canal the play an important role in the success of root canal treatment, so the success rate of endodontic treatment is affected by its complete obturation by gutta-percha and sealer. After chemicomechanical preparation of canal micro-organism sometimes remain alive in the dentinal tubule for that reason three-dimensional obturation of the canal is important to prevent bacteria and their toxin to pass to the periapical area. [14]

Pulpal degeneration and periapical lesions are caused by the bacterial toxin. Thus, a good chemicomechanical preparation of the canal combined with a 3-dimensional obturation method that provides a complete obturation of all canal dimensions is indicated.[15] many materials have been used for the obturation of canals, gutta-percha is one of the best material used for obturation however not the perfect one, but it includes most of Grossman's criteria. [13] However, gutta-percha can be easily displaced under force and have a decreased rigidity and low adhesiveness all of these considerations as a shortage of gattapercha. [16]

In this study a universal protaper system was used for canal preparation because many studies show that the ability of protaper system to preserve the anatomy of the canal to provide sufficient space for a good obturation of canal and to finish the instrumentation in a limited time. [17, 18-20] Sodium hypochlorite is used for the irrigation of canals because sodium hypochlorite is the most effective irrigant used for canal cleaning because of it is antibacterial property removing the dead tissue including the necrotic one and organic part of the smear layer. [21] The Scientific Committee Consensus, [22-24] recommends a concentration of 2.5% to 5.25% of sodium hypochlorite, in order to decrease its toxicity without decreasing its antibacterial effect.

GuttaFlow bioseal combined both Guttapercha and sealer in one product used as a sealer and obturating material. When the guttaflow bioseal comes into contact with body fluid hydroxylapatite crystals are produced. hydroxylapatite crystals enhance the healing process because these materials are natural components of bone and tooth tissue. GuttaFlow possesses good flowability and considers as the first flowable, non -heated gutta-percha with slight expansion and with no shrinkage, guttaflow bioseal was recommended by manufacturer to be used with gutta-percha master cone to achieve better result.

Bioceramic Endodontic Sealer has the advantages of MTA (Mineral Trioxide Aggregate) with aperfect canal obturation, bio - ceramic sealer is biologically biocompatible material as the natural pulp tissue, and had a good sealing ability in the main canal and lateral canal.

The MTA- based sealer has an antibacterial and enhances healing and new tissue formation.; because this sealer is eugenol and bismuth oxide free so there is no tooth stain and discoloration.

In this study, guttaflow bioseal and One-Fil were used One fil which contains a calcium silicate and it is a highly biocompatible material in the root canal environment despite of it is high sealing performance of the canal as a bio-ceramic sealer. And it's a premixed syringe that has the advantages of easy insertion into the canal.

In this study single cone obturation this method has been used because of it is simple and to save time, extra forces and effort are required when compared with using the lateral compaction technique. However, in single cone technique have the disadvantages of poor bond strength and adaptation to root dentine.

In order to provide the 'monoblock concept' by attaching the obturating material to the dentinal walls, [25] thus using sealers that had a good bond to a dentinal wall like bioceramic sealers and comparing it with guttaflow bioseal the result of this study reveals that there is non-significant difference between both type of sealer both of them have a good sealing ability and this might be why it has a good flowability and small particle size for both sealer which range between 20–40 μm with a good biocompatibility of both sealer and when compared between three sections of root for both materials (guttaflow bioseal and bioceramic)there is a significant difference between the three sections of root for both of them in Guttaglow coronal section shows the best penetration and this

because the diameter of coronal section is greater than the other section as we come closer to apical part of the root the diameter become smaller and smaller amount of sealer will reach the apical area and also may be due to complex anatomy with smaller diameter and amount of dentinal tubule at apical area with presence of agreater amount of sclerotic dentine at apical part this result agree with study done by Chiara P,etal they found that penetration of Guttaflow bioseal was significantly decrease from coronal and middle part of root to the apical part of root,[26] while for bioceramic the middle section shows the best penetration and this is may be due to insufficient removal of smear layer in apical area and this result was disagree with Dasari L.etal,they found that the bioceramic root canal sealer(BioRoot RCS) had abetter penetration in coronal area than the middle and apical area.[27] In a study done by Hero M & Niaz H, they found that there is a non -significant difference between the filling ability of three sealers (Guttaflow Bioseal, AH Plus sealer, Endosequence Bioceramic sealer) used for filling lateral canals,[28] while Wang Y Found that the bioceramic sealer (iRoot SP) perform a better penetration and filling ability when compared to AH plus regardless technique used for obturation. [29]

## Conclusion

Within the limitations of this study it concludes that there is no difference in sealer penetration of both sealers Guttaflow bioseal and Onefil bioceramic, while regarding sealer penetration in each sections of root for Guttaflow bioseal in coronal section shows a best penetration, for Onefil bioceramic middle section shows a best penetration.

## Conflicts of interst

The authors reported no conflicts of intersts

### References


1. Daniela M, Gustavo S, Fabio LC, Villela B, Idomeo B. In-vitro assessment of the obturation capacity, adjustment and compaction of gutta-percha in the root channel framework utilizing distinctive filling systems. Acta Odontol Latinoam. 2008; 21:3–9.
2. Ingle JI, Baumgartner JC, 2008. Ingle's endodontics PMPH: USA.
3. Adanir N, Cobankara FK, Belli S. Sealing properties of different resin-based root canal sealers. In Journal of Biomedical Materials Re-Search Part B: Applied Biomaterials: An Official Journal of the Society for Biomaterials, The Japanese Society for Biomaterials, and The Australia Society for Biomaterials and the Korean Society for Biomaterials, 2006;77 (1), pp.1-4.
4. Aptekar A, Ginnan K. Comparative analysis of micro leakage and seal for 2obturation materials: Resilon /Epiphany and gutta-percha. J Can Dent Assoc 2006; 72:245.
5. Ravanshad S, Khayat A. An In-vitro Evaluation of Apical Seal Ability of Thermafil Obturation Versus Lateral Condensation. J Dent TUMS 2004; 1:48-55.
6. Williams C, Loushine RJ, Weller RN, Pashley DH, Tay FR, 2006. A comparison of cohesive strength stiffness of Resilon and gutta-percha. Journal of Endodontics 2006; 32 (6) pp. 553-555.
7. Nikhil V, Singh R. Confocal laser scanning microscopic investigation of ultrasonic, sonic, and rotary sealer placement techniques. Journal of Conservative Dentistry 2013; 16(4), p.294.
8. Robertson D, Leeb IJ, McKee M, Brewer E. A clearing technique for the study of root canal systems. J Endod1980;6: 421-424.7.Coltene,GuttaFlow2,bioseal,https:japan.
9. coltene.com/products/endodontics/obturation-amp- sealing-materials /roeko-sealers/ roeko-guttaflowR-bioseal/
10. Keeneth K and Deenis B. Anew day has dawned: the increased use of bioceramics in endodontics. 2009 the increased use of bioceramics in endodontics Dentaltow vol. 10, pp. 39–43, 2009.
11. Ginebra MP, Fernández E, De Maeyer EA, Verbeeck RM, Boltong MG, Ginebra J. Setting reaction and hardening of an apatitic calcium phosphate cement.1997; J of Dental Research, vol. 76, no. 4, pp. 905–912.
12. Cherng AM, Chow LC, Takagi S. In vitro evaluation of a calcium phosphate cement root canal filler/sealer. Journal of Endodontics.2001; vol. 27, no. 10, pp.613–615.
13. Manu R, Gursandeep Kaur S, Tamanpreet Kaur, Mohd. A, Gayatri G. New Self Curing Root Canal Filling Material: Gutta flow. journal of medical and advanced dental science. 2014; vol2, issue 4.
14. Verissimo DM, do Vale MS. Methodologies for assessment of apical and coronal leakage of endodontic filling materials: A critical review. J Oral Sci 2006; 48:93-8.
15. Cohen S, Burns RC. Pathways of Pulp.8th ed. United States: Mosby; 2002.
16. Punia SK, Nadig P, Punia V. An in vitro assessment of apical micro leakage in root canals obtu-

rated with guttaflow, resilon, thermafil and lateral condensation: A stereomicroscopic study. J Conserv Dent 2011; 14:173-7.
17. Nevares G., Xavier F., Gominho L., et al. Apical extrusion of debris produced during continuous rotating and reciprocating motion. The Scientific World Journal. 2015; 2015:5. doi: 10.1155/2015/267264.267264
18. Bronnec F., Bouillaguet S., Machtou P. Ex vivo assessment of irrigant penetration and renewal during the cleaning and shaping of root canals: a digital subtraction radiographic study. International Endodontic Journal. 2010;43 (4):275–282. doi: 10.1111/j.1365-2591.2009.01677.x. [PubMed] [CrossRef] [Google Scholar]
19. Fleming C. H., Litaker M. S., Alley L. W., Eleazer P. D. Comparison of classic endodontic techniques versus contemporary techniques on endodontic treatment success. JournalofEndodontics. 2010;36(3):414–418. doi: 10.1016/j.joen.2009. [PubMed] [CrossRef] [Google Scholar ]
20. Hwang Y.-H., Bae K.-S., Baek S.-H., et al. Shaping ability of the conventional nickel titanium and reciprocating nickel-titanium file systems: a comparative study using micro-computed tomography. Journal of Endodontics. 2014;40(8):1186–1189. doi: 10.1016/j.joen.2013.12.032
21. Valera M. C., Cardoso F. G. D. R., Chung A., et al. Comparison of different irrigants in the removal of endotoxins and cultivable microorganisms from infected root canals. The Scientific World Journal. 2015;2015: 6.doi:10.1155/2015/125636. 125636 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
22. Juneja N, Hegde M. Comparison of the antifungal efficacy of 1.3% NaOCl/MTAD with other routine irrigants: an ex-vivo study. International Scholarly Research Notices. 2014; 2014:5. doi: 10.1155/2014/575748.]
23. Nevares G, Xavier F, Gominho L, et al. Apical extrusion of debris produced during continuous rotating and reciprocating motion. The Scientific World Journal 2015;2015:5. doi: 10.1155/2015/267264.267264 [PMC free article] [PubMed]
24. Kini S., Shetty S. V., Shetty K. H., Kudva A., Kumar P. The efficiency of 2.5% sodium hypochlorite in preventing inoculation of periapical tissues with contaminated patency files: an ex vivo evaluation. Journal of Pharmacy and Bioallied Sciences. 2015;7(6): S563–S566. doi: 10.4103/0975-7406.163542.
25. Mohamed El-Sayed MA, Aziz Taleb AA, Mubarak Balbahaith MS. Sealing ability of three single-cone obturation systems: An invitro glucose leakage study. J Conserv Dent. 2013;16(6):489–493.doi:10.4103/0972-0707.120936
26. Pirani C, Generali L,Iacono F, Cavani F, Prati C. Evaluation of the root filling quality with experimental carrier-based obturators: A CLSM and FEG -SEM analysis. Aust. Endod. J. 2021, 1–9. [Google Scholar] [CrossRef] [PubMed]
27. Dasari L, Anwarullah A, Mandava J, Konagala RK, Karumuri S, Chellapilla PK. Influence of obturation technique on penetration depth and adaptation of a bioceramic root canal sealer. J Conserv Dent. 2020 Sep-Oct;23(5):505-511. doi: 10.4103/JCD.JCD_450_20. Epub 2021 Feb 10. PMID: 33911361
28. Zahid HM, Ghareeb NH, Evaluation of filling ability of Guttaflow Bioseal sealer to the simulated lateral canal by scanning electron microscope: An in vitro study. EDJ Vol.2 No.2 Dec 2019.
29. Wang Y.Invitro study of dentinal tubule penetration and filling quality of bioceramic sealer. Published online 2018 Feb 1. doi: 10.1371/journal.pone.0192248