International Journal of Dentistry and Oral Science (IJDOS)
ISSN: 2377-8075

To Evaluate The Flowability Of Various Root Canal Sealers Under Iso Standardisation - An In Vitro Study

Research Article

Shree Ranjan[1], Dr. Manish Ranjan[2*]

[1] Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.
[2] Associate Professor, Department of Conservative dentistry and Endodontics, Saveetha Dental college and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University , Chennai.

Abstract

Aim : To evaluate the flowability of various root canal sealers under ISO standardisation.
Introduction : Flow is the ability of a sealer cement to penetrate into irregularities and accessory canals of the root canal system, and it is considered to be a very important property. The greater the flow, the greater the ability to penetrate into irregularities. The following study evaluates the flowability of root canal sealer
Materials and methods : The study was carried out by a single operator , the ISO guidelines to evaluate the flowability of the sealer under the ISO standardisation 9002 is followed. In this study 10 samples of each sealer were recorded of the following sealers - AH plus , Bioroot Rcs and Meta fill apex and the data was recorded on the excel sheet and subjected to statistical analysis using the IBM SPSS statistical software version 22.0
Results and discussion : The data was subjected to the Tukey post hoc test. The results obtained were not statistically significant.Within the limitations of this in vitro study, it was concluded that all of the endodontic sealers tested presented greater flow than the minimum recommended in the ADA 57 specification. The recently developed bioroot rcs sealer had better flowability properties as compared to other sealers.

Introduction

The fluid- and bacteria-tight seal of a thoroughly cleaned and shaped root canal system is fundamental for endodontic treatment. An adequate seal of the root canal system cannot be achieved without a root canal sealer because gutta percha cannot bond to the dentinal walls. Moreover, the area that cannot be reached by gutta percha can be penetrated and sealed with a root canal sealer. An ideal root canal sealer should have good biocompatibility, antibacterial activity, good sealing ability and adequate flowability, which is clinically important to allow deep penetration of the narrow and complex anatomical spaces in root canal systems. In this regard, a precise investigation of the flowabilities of root canal sealers is important for evaluating their clinical performance.

However, few studies have examined the viscosity of root canal sealers. The majority of previous studies measuring the flow abilities of root canal sealers used the simple press method that is specified by the International Organization for Standardization (ISO) 6876. Although this method is simple and economical, the information obtained is limited in that this method can determine only the compressed sealer diameter. In contrast, a strain-controlled rheometer provides information regarding the rheological properties of root canal sealers as a function of time and temperature. However, few studies have investigated the rheological properties of root canal sealers using a strain-controlled rheometer. The rheological properties of root canal sealers change with time because all root canal sealers undergo a setting reaction. Not all root canal sealers undergo identical patterns of change because each is affected by a different setting process (development of chemical crosslinks between the polymer chains). The rheological properties of root canal sealers also change with increasing temperature. In modern endodontic treatments, the continuous wave of condensation technique is widely used, in which gutta percha and the root canal sealer are exposed to a temperature of ~200 °C. However, no other study has investigated the changes in the rheological properties of root canal sealers that have been heated

***Corresponding Author:**
Dr. Manish Ranjan,
Associate Professor, Department of Conservative dentistry and Endodontics, Saveetha Dental college and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University , Chennai, India.
Tel : +91- 9543445029
E-mail : manish@saveetha.com

Received: May 05, 2021
Accepted: July 09, 2021
Published: July 17, 2021

Citation: Shree Ranjan, Dr. Manish Ranjan. To Evaluate The Flowability Of Various Root Canal Sealers Under Iso Standardisation - An In Vitro Study. *Int J Dentistry Oral Sci.* 2021;8(7):3263-3267. doi: http://dx.doi.org/10.19070/2377-8075-21000664

to 200 °C. Based on the mineralization potential of tricalcium silicate–based materials, a new calcium silicate–based root canal sealer, BioRoot RCS (Septodont), has been specifically developed for root canal filling[1]. According to the manufacturer, this material is presented as a powder and a liquid. The powder is composed of tricalcium silicate, zirconium oxide (opacifier), and excipients. The aqueous solution is made of calcium chloride and excipients. Although these modifications are aimed at improving the handling properties and avoiding tooth discoloration, they may influence the regeneration potential of the surrounding tissues.

BioRoot ™ RCS is the newest endodontic sealer based on tricalcium silicate materials benefiting from both Active Biosilicate Technology and Biodentine™[2]. The first provides medical grade level of purity and, unlike "Portland cement" based materials, it ensures the purity of the calcium silicate content with the absence of any aluminate and BioRoot ™ RCS is a mineral based root canal sealer using tricalcium silicate setting system.

The powder part additionally contains zirconium oxide as a biocompatible radiopacifier and a hydrophilic biocompatible polymer for adhesion enhancing. The liquid part contains mainly water, calcium chloride as a setting modifier and a water reducing agent. BioRoot ™ RCS is bioactive by stimulating bone physiological processes and mineralization of the dentinal structure (Camps 2015, Dimitrova-Nakov 2015,). Therefore it creates a favorable environment for periapical healing and bioactive properties including biocompatibility (Reichl 2015), hydroxyapatite formation, mineralization of dentinal structure, alkaline pH and sealing properties. BioRoot ™ RCS is indicated for the permanent root canal filling in combination with gutta-percha points and is suitable for use in single cone technique or cold lateral condensation (Camilleri, 2015). BioRoot ™ RCS was designed to be used by mixing powder part with the liquid part by simple spatulation: there is no need for a mixing machine. The working time is around 15 minutes and the setting time is less than 4 hours in the root canal. In addition, BioRoot ™ RCS displayed a tight seal with the dentin and the gutta-percha (Xuereb 2014) and an appropriate radiopacity[3]. The paste is of smooth consistency with good flow and adequate adhesion to instruments in order to enable an optimal placement in the root canal. Thanks to the use of Active BioSilicate Technology which is monomer free, there is no shrinkage of BioRoot ™ RCS during setting to allow a tight seal of the root canal. Despite the similar composition in terms of viscosity and texture with a sealer, BioRoot ™ RCS must be considered as an adhesive root filling material. A fitted gutta-percha point is used as a pluggerlike carrier to facilitate the flow of BioRoot ™ RCS into the canal space. Indeed, BioRoot ™ RCS is also recommended for facilitating the obturation removal in case of retreatment.

The purpose of this study was to compare the flow abilities measured using the simple press method and the viscosities of four root canal sealers (AH Plus, Bioroot RCS , MTA Fillapex measured using iso standardisation[4]. The null hypothesis was that there was no statistical significance between the flowabilities measured using the simple press method and there is a correlation between the flowabilities. Previously our team has a rich experience in working on various research projects across multiple disciplines [5-19]Now the growing trend in this area motivated us to pursue this project.

Materials And Methods

The study was carried out by a single operator , the ISO guidelines to evaluate the flowability of the sealer under the iso standardisation 9002 is as follows - all the sealers under the study should have a volume of 0.5ml . The sealer should be dropped on a clean glass slab. Once the sealer is kept on the clean glass slab an additional glass slab should be placed over the sealer which should have a weight of 20 gms . The sealer is allowed to flow and spread for a duration of 3 minutes . This is followed by placement of additional load of 100 gms over the initial glass slab. The sealer is allowed to spread for a time span of 10 minutes once the additional load of 100 gram is kept over the initial glass slab of 20 gms. The process is to be performed by a single operator and the samples should be kept on a flat plane surface. After this the measurement of the internal and the external diameter should be done with the help of the digital vernier callipers The external diameter was denoted by maximum flow of the sealer and the internal diameter was denoted by the minimal flow of the sealer. Any sample having a diameter less than 2cm was excluded from the study .In this study 10 samples of each sealer were recorded of the following sealers - AH plus , Bioroot Rcs and Meta fill apex. And the data was recorded on the excel sheet and subjected to statistical analysis using theIBM SPSS statistical software version 22.0

Results and Discussion

Most previous studies on the flowabilities of root canal sealers used the simple press method, which provides limited information.. The results showed that the flowability of root canal sealers measured using the simple press method were correlated.Thus, the null hypothesis was rejected. Notably, the flow diameters of AH Plus (22.6 mm) and Bioroot Rcs (24 mm),Mta fill apex (21.8mm) were not significantly different.

Almeida et al.13 compared the flowabilities of root canal sealers using the simple press method and reported that the flowability was highest AH Plus and lowest for Sealapex. These results agree well with the results of the present study. The high flowability of AH plus Sealer EWT may be due to the resin additives.

The sealer based on tricalcium silicate was MTA Fillapex (Angelus, Londrina, Brazil)[20]. This sealer is mainly composed of a salicylate resin matrix, silica, and mineral trioxide aggregate, with the mineral trioxide aggregate being a minor component. Although the main scope of using a tricalcium silicate–based sealer is the release of calcium hydroxide from the material, hydration MTA Fillapex has been shown to be inert, and no calcium hydroxide was formed when the material set . However, MTA Fillapex complies with ISO 6876 and is also stable when used with warm vertical compaction techniques [21] . In our study it was found that Fillapex has least flowability.

AH Plus showed little change in complex viscosity with time. This result supports a report that the working time for AH Plus is 4 h.BioRoot RCS showed an early increase in complex viscosity, which could be explained by an early setting reaction that occurs between dicalcium silicate dihydrate and tri calcium silicate. These results agree with those of a previous study35 that reported that the setting time of calcium phosphate ranged from 30 to 60 min.36 Mta fill apex showed little change in complex viscosity

during the study. This result agreed with those of previous studies reporting that Mta fillapex sets in 2–3 weeks in 100% relative humidity .

Thus, future studies are necessary to investigate the nature of flowabilities of these materials. Bioroot RCS showed maximum diameter when a simple press method was used to compare the flowability , followed by resin based AH plus Sealer[22] . The least flowability was shown by MTA fillapex.

The clinical significance of the study is that the Bioroot RCS sealer is a part of bioceramic based sealer [23], these sealers not only have antibacterial properties but they also have the ability to heal the periapical region having radiolucency as compared to resin based sealer which have post operative pain as a well known complication . The flowability of the Bioroot RCS sealer was found more than AH plus and mta based fillapex sealers.

Our institution is passionate about high quality evidence based research and has excelled in various fields ([24-38])

Depicting the statistical output of the samples

Tukey HSD							
						95% C Interval	95% C Interval
Dependent Variable	I Groups	J Groups	Mean Difference i-j	Std Error	Sig.	Lower Bound	Upper Bound
Max Flow (cm)	BIO ROOT	AH PLUS	0.7	0.062	0	0.534	0.866
		MTA FILL APEX	1.6	0.062	0	1.434	1.766
	AH PLUS	BIO ROOT RCS	-0.7	0.062	0	0.866	-0.534
		MTA FILLAPEX	0.9	0.062	0	0.734	1.066
	MTA FILL APEX	BIO ROOT RCS	0.28	0.062	0	-1.766	-1.434
		AH PLUS	1.34	0.062	0	-1.066	-0.734
MIN FLOW (cm)	BIO ROOT	AH PLUS	-28	0.048	0	0.153	0.407
		MTA FILL APEX	1.34	0.048	0	1.213	1.467
	AH PLUS	BIO ROOT RCS	-0.28	0.048	0	-0.407	-0.153
		MTA FILL APEX	1.06	0.048	0	0.933	1.187
	MTA FILL APEX	BIO ROOT RCS	-1.34	0.048	0	-1.467	-1.213
		AH PLUS	-1.06	0.048	0	-1.187	-0.933

Figure 1 - representing the electronic weighing scale measuring the weight of the initial glass slab of 20 grams. This was custom made.

Figure 2 - Depicting the demonstration of the additional load of 100 gms kept over the initial glass plate measuring 20 grams . This gave a total load of 120 grams for the assessment of the flowability of the sealer.

Figure 3 - Depicting the flowability of sealer under the combined load of 120 gms

Figure 4 - The flowability of the gold standard material in the study which was Ah plus sealer. This was the control group

Figure 5- The recent Bioroot Rcs Sealer which depicted the maximal flowability in the study.

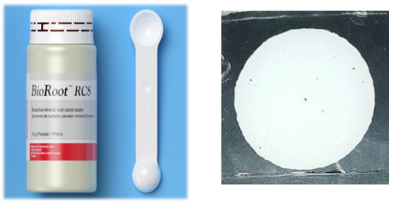

Figure 6- The Mta fill apex sealer by Angelus.

Figure 7- the digital vernier calliper having a measuring range of 0 - 15 cm with a range of 0.01 mm

Conclusion

The maximum flowability is seen for the Bioroot Rcs which is a recently introduced sealer followed by AH plus sealer and mta fill apex.

Acknowledgement

We would like to acknowledge all my teachers of the Department of Conservative dentistry and Endodontics for their constant support and encouragement.

References

[1]. Simon S, Flouriot AC. BioRoot™ RCS a new biomaterial for root canal filling. J Case Studies Collection. 2016;13:4-11.
[2]. Koubi G, Colon P, Franquin JC, Hartmann A, Richard G, Faure MO, et al. Clinical evaluation of the performance and safety of a new dentine substitute, Biodentine, in the restoration of posterior teeth - a prospective study. Clin Oral Investig. 2013 Jan;17(1):243-9. Pubmed PMID: 22411260.
[3]. Ochoa-Rodríguez VM, Tanomaru-Filho M, Rodrigues EM, Guerreiro-Tanomaru JM, Spin-Neto R, Faria G. Addition of zirconium oxide to Biodentine increases radiopacity and does not alter its physicochemical and biological properties. J Appl Oral Sci. 2019 Apr 1;27:e20180429. Pubmed PMID: 30970115.
[4]. Zhou HM, Shen Y, Zheng W, Li L, Zheng YF, Haapasalo M. Physical properties of 5 root canal sealers. J Endod. 2013 Oct;39(10):1281-6. Pubmed PMID: 24041392.
[5]. Govindaraju L, Gurunathan D. Effectiveness of Chewable Tooth Brush in Children-A Prospective Clinical Study. J Clin Diagn Res. 2017 Mar;11(3):ZC31-ZC34. Pubmed PMID: 28511505.
[6]. Christabel A, Anantanarayanan P, Subash P, Soh CL, Ramanathan M, Muthusekhar MR, et al. Comparison of pterygomaxillary dysjunction with tuberosity separation in isolated Le Fort I osteotomies: a prospective, multi-centre, triple-blind, randomized controlled trial. Int J Oral Maxillofac Surg. 2016 Feb;45(2):180-5. Pubmed PMID: 26338075.
[7]. Soh CL, Narayanan V. Quality of life assessment in patients with dentofacial deformity undergoing orthognathic surgery--a systematic review. Int J Oral Maxillofac Surg. 2013 Aug;42(8):974-80. Pubmed PMID: 23702370.

[8]. Mehta M, Deeksha, Tewari D, Gupta G, Awasthi R, Singh H, et al. Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. Chem Biol Interact. 2019 Aug 1;308:206-215. Pubmed PMID: 31136735.
[9]. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115-121. Pubmed PMID: 30451321.
[10]. Campeau PM, Kasperaviciute D, Lu JT, Burrage LC, Kim C, Hori M, et al. The genetic basis of DOORS syndrome: an exome-sequencing study. Lancet Neurol. 2014 Jan;13(1):44-58. Pubmed PMID: 24291220.
[11]. Kumar S, Sneha S. Knowledge and awareness regarding antibiotic prophylaxis for infective endocarditis among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2016;154.
[12]. Christabel SL, Gurunathan D. Prevalence of type of frenal attachment and morphology of frenum in children, Chennai, Tamil Nadu. World J Dent. 2015 Oct;6(4):203-7.
[13]. Kumar S, Rahman RE. Knowledge, awareness, and practices regarding biomedical waste management among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2017;10(8):341.
[14]. Sridharan G, Ramani P, Patankar S. Serum metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Cancer Res Ther. 2017 Jul-Sep;13(3):556-561. Pubmed PMID: 28862226.
[15]. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. J Intercult Ethnopharmacol. 2016 Jan 27;5(1):92-6. Pubmed PMID: 27069730.
[16]. Thamaraiselvan M, Elavarasu S, Thangakumaran S, Gadagi JS, Arthie T. Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession. J Indian Soc Periodontol. 2015 Jan-Feb;19(1):66-71. Pubmed PMID: 25810596.
[17]. Thangaraj SV, Shyamsundar V, Krishnamurthy A, Ramani P, Ganesan K, Muthuswami M, et al. Molecular Portrait of Oral Tongue Squamous Cell Carcinoma Shown by Integrative Meta-Analysis of Expression Profiles with Validations. PLoS One. 2016 Jun 9;11(6):e0156582. Pubmed PMID: 27280700.
[18]. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and in vivo analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019 May;29(4):276-290. Pubmed PMID: 30461321.
[19]. Ramakrishnan M, Bhurki M. Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children-Review. International Journal of Pharmaceutical Research. 2018 Oct 1;10(04):109-14.
[20]. Silva EJ, Accorsi-Mendonça T, Pedrosa AC, Granjeiro JM, Zaia AA. Long-Term Cytotoxicity, pH and Dissolution Rate of AH Plus and MTA Fillapex. Braz Dent J. 2016 Jul-Aug;27(4):419-23. Pubmed PMID: 27652704.
[21]. Vitti RP, Prati C, Silva EJ, Sinhoreti MA, Zanchi CH, de Souza e Silva MG, et al. Physical properties of MTA Fillapex sealer. J Endod. 2013 Jul;39(7):915-8. Pubmed PMID: 23791263.
[22]. Nunes VH, Silva RG, Alfredo E, Sousa-Neto MD, Silva-Sousa YT. Adhesion of Epiphany and AH Plus sealers to human root dentin treated with different solutions. Braz Dent J. 2008;19(1):46-50. Pubmed PMID: 18438559.
[23]. Wang Y, Liu S, Dong Y. In vitro study of dentinal tubule penetration and filling quality of bioceramic sealer. PLoS One. 2018 Feb 1;13(2):e0192248. Pubmed PMID: 29390037.
[24]. Govindaraju L, Gurunathan D. Effectiveness of Chewable Tooth Brush in Children-A Prospective Clinical Study. J Clin Diagn Res. 2017 Mar;11(3):ZC31-ZC34. Pubmed PMID: 28511505.
[25]. Christabel A, Anantanarayanan P, Subash P, Soh CL, Ramanathan M, Muthusekhar MR, et al. Comparison of pterygomaxillary dysjunction with tuberosity separation in isolated Le Fort I osteotomies: a prospective, multi-centre, triple-blind, randomized controlled trial. Int J Oral Maxillofac Surg. 2016 Feb;45(2):180-5. Pubmed PMID: 26338075.
[26]. Soh CL, Narayanan V. Quality of life assessment in patients with dentofacial deformity undergoing orthognathic surgery--a systematic review. Int J Oral Maxillofac Surg. 2013 Aug;42(8):974-80. Pubmed PMID: 23702370.
[27]. Mehta M, Deeksha, Tewari D, Gupta G, Awasthi R, Singh H, et al. Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. Chem Biol Interact. 2019 Aug 1;308:206-215. Pubmed PMID: 31136735.
[28]. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019 Feb;48(2):115-121. Pubmed PMID: 30451321.
[29]. Campeau PM, Kasperaviciute D, Lu JT, Burrage LC, Kim C, Hori M, et al. The genetic basis of DOORS syndrome: an exome-sequencing study. Lancet Neurol. 2014 Jan;13(1):44-58. Pubmed PMID: 24291220.
[30]. Kumar S, Sneha S. Knowledge and awareness regarding antibiotic prophylaxis for infective endocarditis among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2016;154.
[31]. Christabel SL, Gurunathan D. Prevalence of type of frenal attachment and morphology of frenum in children, Chennai, Tamil Nadu. World J Dent. 2015 Oct;6(4):203-7.
[32]. Kumar S, Rahman RE. Knowledge, awareness, and practices regarding biomedical waste management among undergraduate dental students. Asian Journal of Pharmaceutical and Clinical Research. 2017;10(8):341.
[33]. Sridharan G, Ramani P, Patankar S. Serum metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Cancer Res Ther. 2017 Jul-Sep;13(3):556-561. Pubmed PMID: 28862226.
[34]. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. J Intercult Ethnopharmacol. 2016 Jan 27;5(1):92-6. Pubmed PMID: 27069730.
[35]. Thamaraiselvan M, Elavarasu S, Thangakumaran S, Gadagi JS, Arthie T. Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession. J Indian Soc Periodontol. 2015 Jan-Feb;19(1):66-71. Pubmed PMID: 25810596.
[36]. Thangaraj SV, Shyamsundar V, Krishnamurthy A, Ramani P, Ganesan K, Muthuswami M, et al. Molecular Portrait of Oral Tongue Squamous Cell Carcinoma Shown by Integrative Meta-Analysis of Expression Profiles with Validations. PLoS One. 2016 Jun 9;11(6):e0156582. Pubmed PMID: 27280700.
[37]. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and in vivo analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019 May;29(4):276-290. Pubmed PMID: 30461321.
[38]. Ramakrishnan M, Bhurki M. Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children-Review. International Journal of Pharmaceutical Research. 2018 Oct 1;10(04):109-14.