Section A-Research paper
ISSN 2063-5346

An in vitro comparative evaluation of quantitative dissolution ability exhibited by Orange oil and Eucalyptus oil, when Endoseal®, NanoSeal -S®, RC Seal endodontic sealers as well as gutta percha were immersed in it.

[1]Dr.Shruti Sharma, [2]Dr.Sonam R. Bhore, [3]Dr.Rana K. Varghese, [4]Dr. Mallepally Deepthi, [5]Dr. Nandita Das, [6]Dr. Nikita Kapse

[1]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Shree Guru Gobind Singh Tricentenary University Budhera, Gurugram, Haryana, India
[2]Post graduate student, [3]Dean, Professor and HOD, Department of Conservative Dentistry and Endodontics, New Horizon Dental College and Research Institute, Sakri, Bilaspur, Chhattisgarh., India
[4]Bachelor of Dental Surgery, SVS Institute of Dental Sciences, Mahabubnagar, Telangana, India
[5,6]Post graduate student, Department of Conservative Dentistry and Endodontics, Chhattisgarh Dental College and Research Institute, Rajnandgaon, Chhattisgarh, India

Corresponding author: Dr.Shruti Sharma, Senior Lecturer, Department of Conservative Dentistry and Endodontics, Shree Guru Gobind Singh Tricentenary University Budhera, Gurugram, Haryana, India **Email:** drshruti0603@gmail.com

ABSTRACT

Introduction: To make Endodontic retreatment successful, reentry to the root canal system to remove all filling materials, identification and correction of pathological or iatrogenic defects is a prerequisite.

Objective: This study was intended to compare the dissolving efficacy of eucalyptus oil, orange oil and distilled water versus three types of endodontic sealer, Viz.,Endoseal®, NanoSeal -S®, and RC Seal. The dissolution capacity of gutta percha was also studied independently in eucalyptus oil, orange oil and distilled water.

Materials and methods: Sixty (60) stainless steel molds were fabricated, where each cement sample was placed to the edge and left to set in the incubator, simulating normal oralconditions for 7 days. Subsequently, the solubility of each cement was analyzed by immersing the samples in eucalyptus and orange essential oil for twelve minutes in a static environment. The solubility of the cement was evidenced by the difference between the weight before and after contact with the oils for 12 minutes, similarly 3 groups of gutta percha of 30 sample size each were kept in oils to check dissolution. Sample data were statistically analysed with the ANOVA test and the post hoc Tukey test.

Results: The control group have no significant effect on the pre and post weight of solubility of different sealers used and hence on the mean difference also. The orange oil had better dissolution effects,($p < 0.05$).

Conclusions: The most susceptible cement was Endoseal sealer, while the least soluble was Nanoseal sealer in all the solvents studied. Gutta percha cones dissolution was more in orange oil compared to eucaluptus oil.

Keywords: Endodontic sealer, eucalyptus oil, gutta percha, orange oil, solvents, solubility.

INTRODUCTION

Failure to resolve root canal infection is among the main causes of unsuccessful endodontic treatment.(6) This failure will be associated with symptoms of pain along with apical periodontitis, such as, persistent apical lesions. Overall, the endodontic causes of failure essentially involve existing infection or re-infection.(16) As far as possible, the first option will be nonsurgical retreatment for a failed primary endodontic treatment. It requires the removal of the filling material from the root canal, so that itcan be shaped and cleaned. Different techniques and materials allow this: hand or mechanical(rotatory or reciprocation)instrumentation used commonly on the primary endodontic treatment, rotary files designed explicitly for retreatments, ultrasonic tipsand files, heat pluggers, and Nd:YAG lasers.(17)(18) However, a barrier to retreatment is access to the obturator material for its removal to be effective, especially when it is well condensed and resistant to instrument penetration or, most critically, in curvature regions of the rootwhere perforation is a risk.(6)(16)(19)(20) In these cases, the use of solvents is commonly advocated.Solvents are solutions used in endodontic therapy to soften the root filling material, usually the gutta-percha (GP).(21)(22) Many types of solvents are available, such as, chloroform, eucalyptol, orange wood oil, tetrachloroethylene(Endosolv), and xylene, but none meet all the requirements of an ideal solvent, which should be nontoxic andnon-carcinogenic to adjacent tissues, patient, and clinicians; deliver efficient GP softening; be viable for an adequate time and cost-effective.(17)

Many studies(6)(17)(23)(20)(22) have tested the efficacy of files and solvents in removing residual GP during retreatment, or the amount of material remaining after using different files and solvents. However, which methods are more effective and whether solvents are essential for root material filling removal are still unclear. Additionally, scoping reviews offeran important tool that can provide a map of the range of available evidence. Thus, this study aimed to map the evidence about the use of solvents for GP dissolution and removal during endodontic retreatments, and discuss the necessity of using such a solution.

MATERIALS AND METHODS

This study did a quantitative comparative evaluation of the dissolving ability of gutta percha and endodontic sealers in various solvents Viz., orange oil, eucalyptus oil and distilled water. Three endodontic types of sealer cement (Endoseal®,NanoSeal -S®, and RC Seal)were utilized together with orange and eucalyptus essential oils (100% pure). 60 stainless steel cylindrical moulds were used to make the sealer discs with an outer diameter of 10 mm and a thickness of 3mm. Prior to starting the experiment, the discs were thoroughly cleaned with 90% alcohol to remove any greaseresidue. The endodontic cement samples (Endoseal®, NanoSeal -S®, and RC Seal) were mixed onto the pad provided by the manufacturers, considering the instructions for use. For the test, the discs were filled with cement using a steel spatula. Each disc was taken to the incubator at 37 °C and 100%humidity for 7 days until the cement gets set. At the end of the established period, the discs were removed, the excess material as eliminated from the periphery with a scalpel blade, registering the pre-immersion weight on a digital precision balance with "accuracy of 3 thousandths.”For the experimental phase, the discs were immersed for 12 minutes in 10 ml of essential oil; they were then placed in the incubator for 24 hours for drying and final weighing. 30 each Gutta percha cones (F3) were also immersed in petri dish containing orange oil and eucalyptus oil for 20 min to see dissolution and pre immersion weight and post immersion weight was recorded using same digital precision balance.

DATA ANALYSIS

The data was tabulated in Microsoft excel and analysed with SPSS V.24 software. The variables are presented with mean and standard deviation. One way ANOVA and paired t test are used for the comparisons. The p value ≤0.05 is considered as statistically significant. The solubility of Endoseal®, RC Seal and NanoSeal -S® in orange oil and eucalyptus oil with mean and standard deviation is tabulated in Table 1,2 and 3 respectively. The pre and post weight of Endoseal®, RC Seal and NanoSeal -S®, in solvents along with control is shown in graph 1,3 and 5 respectively. The difference between pre and post weight of Endoseal®, RC Seal and NanoSeal -S® along with control group is shown in graph 2,4 and 6 respectively.
The solubility of Gutta Percha in orange oil and eucalyptus oil with mean and standard deviation is tabulated in Table 4. The pre and post weight of Gutta Percha in solvents along with control is shown in graph 7. The difference between pre and post weight of Gutta Percha along with control group is shown in graph 8.

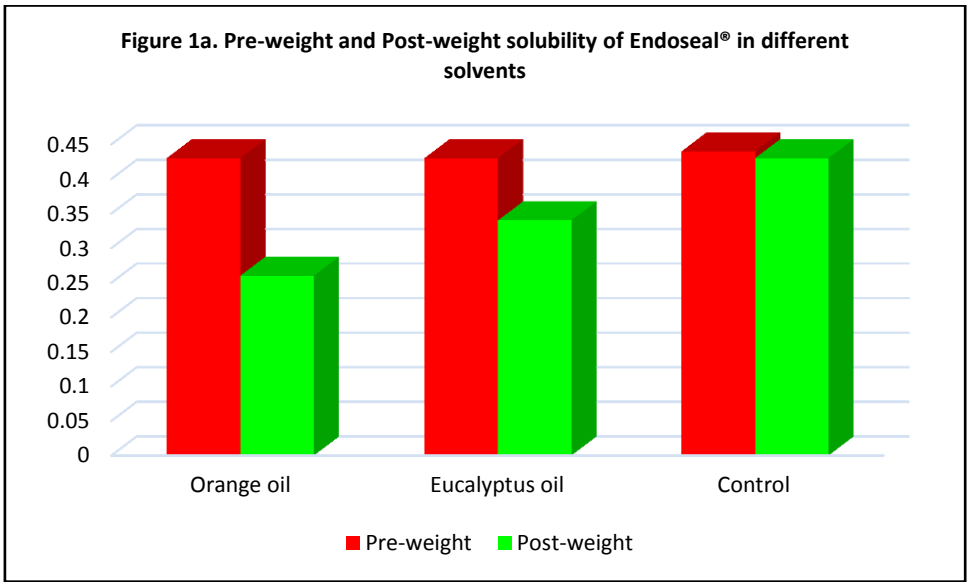
RESULTS

In the control group, no amount of cement was dissolved mean difference between pre weight and post weight of solubility of all the sealers used i.e. Endoseal®, RC Seal and NanoSeal -S® were (0.01,0.00,0.00) respectively ; thus, concerning the effectiveness of the environment during cement dissolution. Orange oil was vastly superior in dissolution potential compared to eucalyptus oil.Orange oil demonstrated to have a better action compared to the eucalyptus oil and control group.The mean difference between pre weight and post weight of solubility of all the sealers used i.e. Endoseal®, RC Seal and NanoSeal -S® in orange oil were (0.17,0.08,0.05) respectively, which was higher when compared to other two groups.
In eucalyptus oil the mean difference between pre weight and post weight of solubility of all the sealers used i.e. Endoseal®, RC Seal and NanoSeal -S® were (0.09,0.05,0.02) suggestive of less weight of sealers been dissolved when compared to orange oil.
The mean difference of pre and post weight dissolution of gutta percha in orange oil (0.04) and eucalyptus oil (0.02) showed results of statistically significance.
In retreatment cases it is easier to remove gutta percha if the gutta percha is sealed with Endoseal®, followed by RC Seal and NanoSeal -S®.

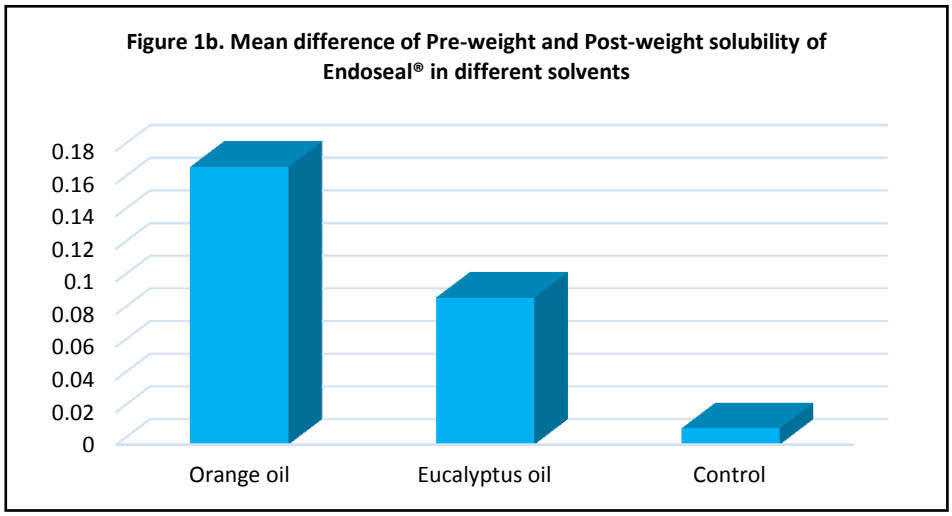
Table 1. Comparison of solubility of Endoseal® **in different solvents**

Solvents	**Pre-weight**				**Post-weight**				**Mean difference**	**P value for paired t test**
	Minimum	**Maximum**	**Mean**	**SD**	**Minimum**	**Maximum**	**Mean**	**SD**		
Orange oil	0.42	0.45	0.43	0.01	0.22	0.30	0.26	0.03	0.17	0.000*
Eucalyptus oil	0.42	0.45	0.43	0.01	0.32	0.37	0.34	0.02	0.09	0.000*
Control	0.42	0.46	0.44	0.01	0.40	0.46	0.43	0.02	0.01	0.011*
P value for ANOVA	0.249				0.000*					

*Statistically significant difference exists (p<0.05)



Graph 1 – Pre – weight and post weight of Endoseal® in different solvents

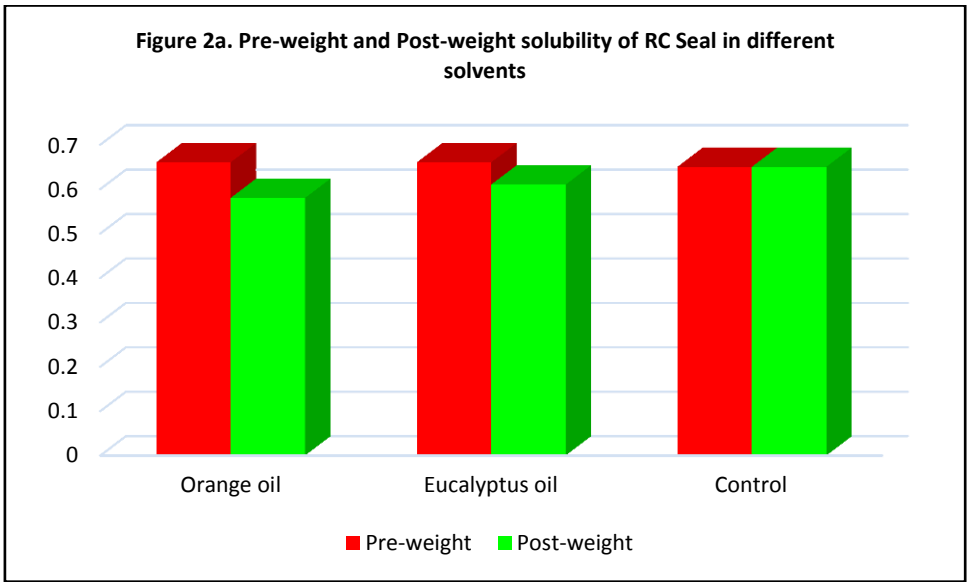


Graph 2 – Mean difference between pre weight and post weight of solubility of Endoseal®,in different solvents

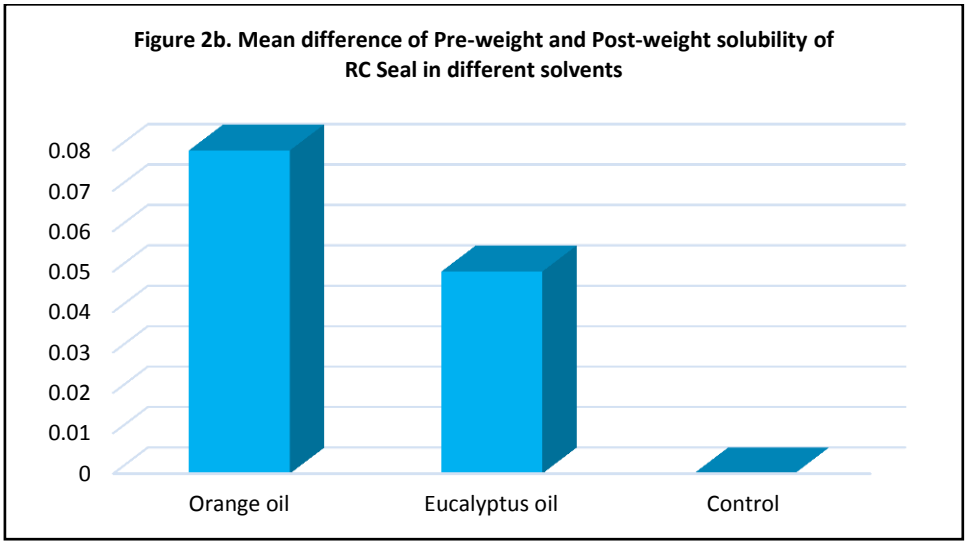
Table 2. Comparison of solubility of RC Seal in different solvents

Solvents	Pre-weight				Post-weight				Mean difference	P value for paired t test
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD		
Orange oil	0.64	0.67	0.66	0.01	0.56	0.59	0.58	0.01	0.08	0.000*
Eucalyptus oil	0.64	0.68	0.66	0.01	0.59	0.63	0.61	0.01	0.05	0.000*
Control	0.64	0.67	0.65	0.01	0.64	0.65	0.65	0.00	0.00	0.213
P value for ANOVA	0.207				0.000*					

*Statistically significant difference exists ($p<0.05$)



Graph 3 – Pre – weight and post weight of RC Seal in different solvents

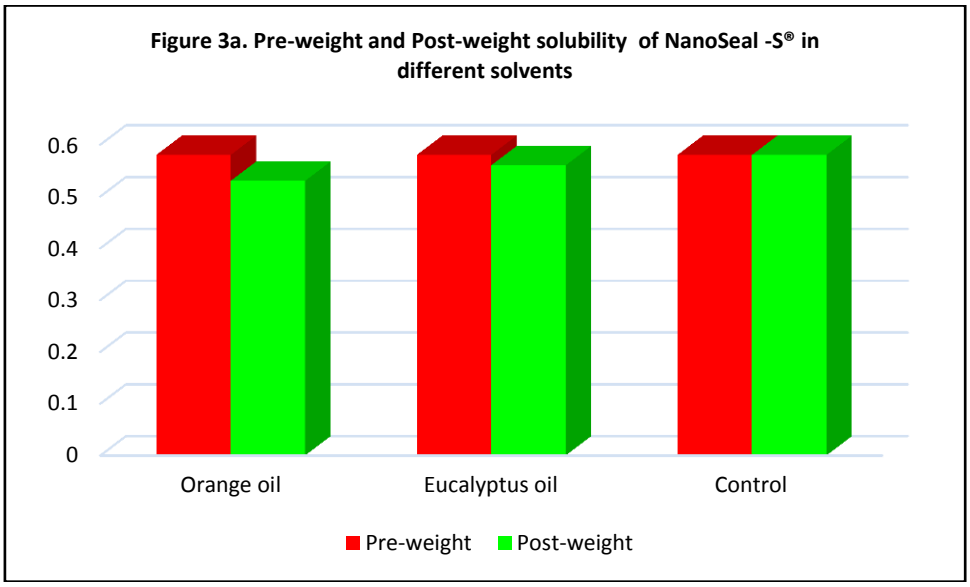


Graph 4 – Mean difference between pre weight and post weight of solubility of RC Seal in different solvent

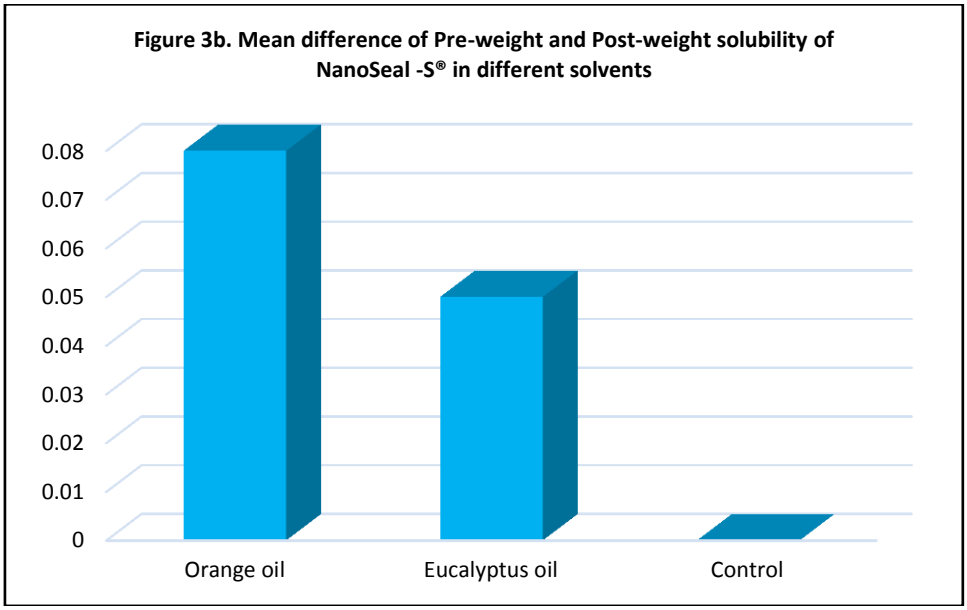
Table 3. Comparison of solubility of NanoSeal -S® in different solvents

Solvents	Pre-weight				Post-weight				Mean difference	P value for paired t test
	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD		
Orange oil	0.56	0.59	0.58	0.01	0.51	0.55	0.53	0.01	0.05	0.000*
Eucalyptus oil	0.56	0.59	0.58	0.01	0.54	0.57	0.56	0.01	0.02	0.000*
Control	0.56	0.59	0.58	0.01	0.56	0.59	0.58	0.01	0.00	-
P value for ANOVA	-				0.000*					

*Statistically significant difference exists ($p<0.05$)



Graph 5– Pre – weight and post weight of NanoSeal -S® in different solvents

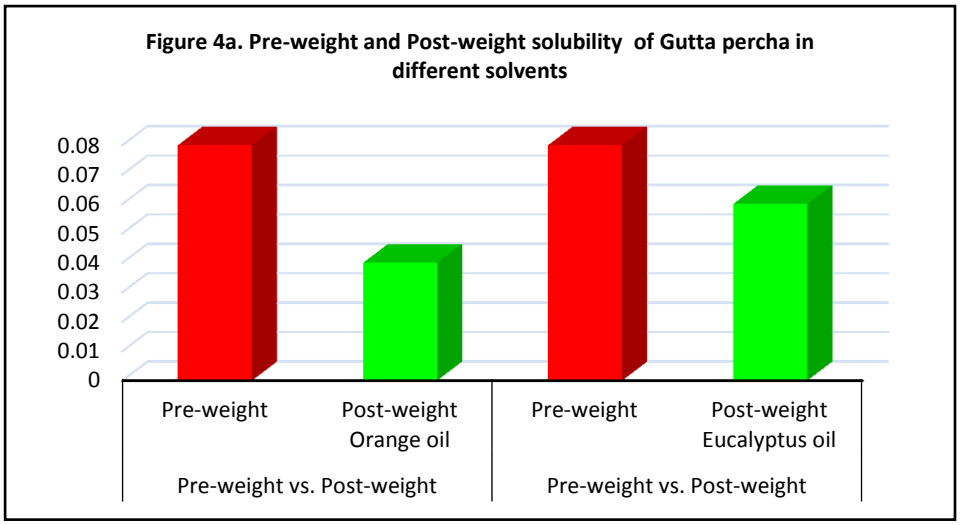


Graph 6 – Mean difference between pre weight and post weight of solubility of NanoSeal -S® in different solve

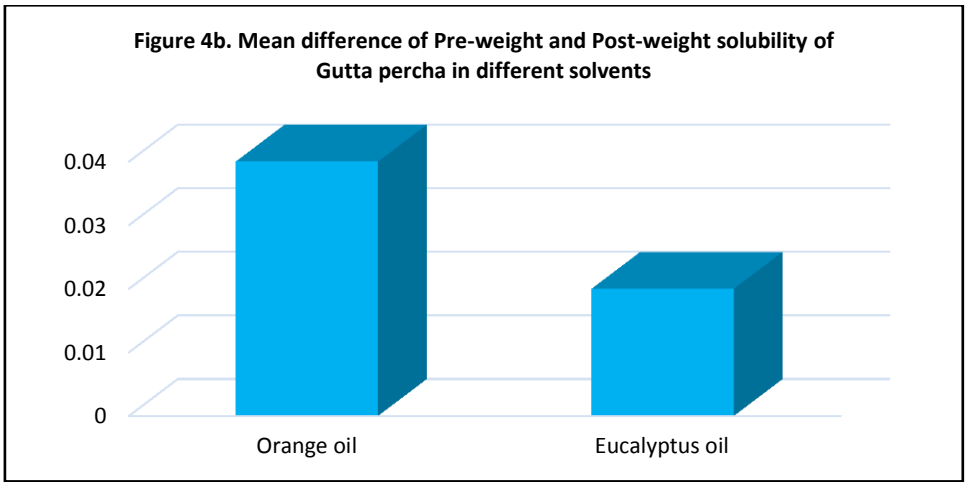
Table 4. Comparison of solubility of Gutta percha in different solvents

Solvents		Minimum	Maximum	Mean	SD	Mean difference	P value for paired t test
Pre-weight vs. Post-weight	Pre-weight	0.08	0.08	0.08	0.00	0.04	0.000*
	Orange oil	0.04	0.05	0.04	0.004		
Pre-weight vs. Post-weight	Pre-weight	0.08	0.08	0.08	0.00	0.02	0.000*
	Eucalyptus oil	0.06	0.07	0.06	0.003		

*Statistically significant difference exists ($p<0.05$)



Graph 7– Pre – weight and post weight of Gutta Percha in different solvents



Graph 8 – Mean difference between pre weight and post weight of solubility of Gutta Percha in different solvent

DISCUSSION

Even after the difficulties in execution, non-surgical endodontic retreatment is an effective alternative to apical surgery and the extent of difficulty depend on the sealer used along with the gutta percha compaction.(1). To remove gutta percha, various methods are being employed namely mechanical action, heat, solvents.(2)(3)(4). This study shows orange oil is superior in solubility of different cements viz., eugenol based, epoxy bonded and polymethylsiloxane based sealer ($p<0.05$).

Chloroform was introduced nearly 100 years ago for chemical removal of gutta percha but it was banned by FDA due to its carcinogenic effects. Xylol or Xylene emits vapours which irritate mucous membrane and cause CNS depression.(5)(6)(7)(8)

Essential oils are natural aromatic substances which gives fragrance to flowers. These oils are soluble in organic solvents and alcohol. They have less solubility in water. They are biocompatible with oral tissues and orange oil shows maximum biocompatibility.(9)(10)

Tnomaru Fihlo et al. did an in vitro study and concluded that eucalyptus oil shows solubility in eugenol-based cements after 10 minutes.(11) This contradicts results of our study as orange oil shows better solubility. This difference can be attributed to the differences in the

experimental methodology. In this study, samples were not immersed in distilled water after removing them from essential oils. Contrary to the results shown in a study by Yadav et. al, wherein orange and eucalyptus oil showed equal solubility, this study showed orange oil got a better solubility than eucalyptus oil ($p<0.05$).(12) This disparity may be due to the difference in size of the moulds used.

Orange oil is antimicrobial and has antioxidant properties. It is extracted from orange pulp, peel and seeds. It consists of sesquiterpenes, monoterpenes, aldehydes, alcohol, esters.(13) In a study conducted by Rubino et al, it was concluded that the solubility of eucalyptus oil decreases in room temperature. The findings of this study are same since orange oil showed increased solubility than eucalyptus oil with various cements (RC seal , Endo seal, Nanoseal).(14)

Eucalyptus oil is extracted from trees of eucalyptus and has active component cineol, which is soluble in water.(15)

Furthermore, the contact area of the sealer samples with the solvents, in this study is higher when compared to the sealer present in root canal and this may results in a comparatively lower solubility in clinical settings. Immersion time was maintained at 12 minutes to keep up the working time closely implemented usually in a typical clinical setup.

CONCLUSION

Within the limitations of this laboratory research, it is concluded that orange oil is superior solvent than eucalyptus oil. In terms of solubility, Endoseal was most soluble followed by and RC Seal,Nanoseal. Gutta percha is also more soluble in orange oil in comparison to Eucalyptus oil. Endodontic retreatment depends on solubility of both Gutta percha and the sealer used, therefore, orange oil is superior than eucalyptus oil in terms of its solubility, while considering its use as a solvent for endodontic retreatment.

REFERENCES

1. Sebastián M. Ulloa-Alvarez a, María E. Guerrero-Coello b, José E. Torracchi-Carrasco. study), Dissolution capacity of orange and eucalyptus oils versus endodontic types of cement (in vitro. s.l. : Mexican Journal of Medical Research ICSa ICSa, Vol. 10, No. 19 (2022) 29-33.
2. Hartwell G. Retratamiento no quirúrgico. In: Torabinejad M, Walton RE, editors. Endodoncia: Principios y Práctica. 4th ed. Barcelona:Elsevier Masson and 2010.
3. Canalda-Sahli C, Suñé-Pumarola J. Retratamiento no quirúrgico de los fracasos endodónticos. En: Canalda C, Brau-Aguadé E, editors.Endodoncia: Técnicas y bases científicas. 3rd ed. Barcelona: Elsevier,Masson, 2014.
4. Roda R, Gettleman B. Retratamiento no quirúrgico. In: Hargreaves KM, Cohen S, Berman LH, editors. Vías de la pulpa. 10th ed. Barcelona: Elsevier Masson; 2011.
5. Pineda-Mejía M, Palacios-Alva E, Terán-Casafranca L., Núñez-Lizárraga M, Gloria-Zevallos W, Abuhadba-Hoyos T. 2011, Evaluación in vitro de tres solventes de gutapercha. Odontol. Sanmarquina. and 14:15-28.
6. Bodrumlu E, Er O, Kayaoglu G. Solubility of root canal sealers with different organic solvents. Oral. Surg. Oral. Med. Oral. Pathol. Oral. Radiol. Endod. 2008 and 67-9, 106:.
7. Yadav-Kumar H, Yadav-Kumar R, Chandra A, Rameshbhai-Thakkar R. The effectiveness of eucalyptus oil, orange oil, and xylene in dissolving different endodontic sealers. J. Conserv. Dent. 2016 and 19:332–37.
8. Nagayama Oyama KO, Siqueira EL, dos Santos M. In Vitro Study of Effect of Solvent on Root Canal Treatment. Braz. Dent. J. 2002 and 208-11., 13:.

9. López-Luengo MT. Los Aceites Esenciales: Aplicaciones farmacológicas, cosméticas y alimentarias. Offarm. 2004 and 23:88-91.
10. Khedmat S, Hasemi A, Dibaji F, Kharrazifard MJ. Effect of Chloroform, Eucalyptol, and Orange Oil Solvents on the Microhardness of Human Root Dentin. J. Dent. 2015 and 12:25-30.
11. Tanomaru-Fihlo M, Orlando T, Bortoluzzi EA, da Silva GF,Tanomaru-Guerreiro JM. Solvent capacity of different substances on gutta-percha and Resilon. Braz. Dent. J. 2010 and 21:46-9.
12. Yadav-Kumar H, Yadav-Kumar R, Chandra A, Rameshbhai-Thakkar R. The effectiveness of eucalyptus oil, orange oil, and xylene in dissolving different endodontic sealers. J. Conserv. Dent. 2016 and 332–37., 19:.
13. Kamal GM, Anwar F, Hussain AI, Sarri N, Ashraf MY. Yield and chemical composition of Citrus essential oils as affected by drying pretreatment of peels. Int. Food. Res. J. 2011 and 18:1275-82.
14. Rubino G, Akisue E, Nunes B, Gavini G. Solvency capacity of guttapercha and Resilon using chloroform, eucalyptol, orange oil, or xylene. J. Health. Sci. Inst. 2012 and 22-5., 30(1).
15. Astaq-Mohal K, Seatara K, Hossain MK, Rahman L.Characterization of the eucalyptus (e. Globulus) leaves oil. J Bangladesh. Chem. Soc. 2012 and 25:97-100.
16. Virdee SS, Thomas MBM. A practitioner's guide to gutta-percha removal during endodontic retreatment. Br Dent J. 2017;222(4): 251-257.
17. 17.Good ML, McCammon A. Removal of gutta-percha and root canal sealer: a literature review and an audit comparing current practice in dental schools. Dent Update. 2012;39(10):703-708.
18. Rossi-Fedele G, Ahmed HMA. Assessment of root canal filling removal effectiveness using micro–computed tomography: a systematic review. J Endod. 2017;43(4):520-526.
19. Aydin B, Köse T, Çalis¸kan MK. Effectiveness of HERO 642 versus Hedström files for removing gutta-percha fillings in curved root canals: an ex vivo study. Int Endod J. 2009;42(11):1050-1056.
20. Sa_glam BC, Koçak MM, Türker SA, Koçak S. Efficacy of different solvents in removing gutta-percha from curved root canals: a microcomputed tomography study. Aust Dent J. 2014;40(2):76-80.
21. Patel SBJ. Contemporary endodontics—part 2. Br Dent J. 2011;211: 517-524.
22. Betti LV, Bramante CM, De Moraes IG, Bernardineli N, Garcia RB. Comparison of GPX with or without solvent and hand files in removing filling materials from root canals: an ex vivo study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2010;110(5):675-680.
23. Kfir A, Tsesis I, Yakirevich E, Matalon S, Abramovitz I. The efficacy of five techniques for removing root filling material: microscopic versus radiographic evaluation. Int Endod J. 2012;45(1):35-41.