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Research Article

IN VITRO COMPARATIVE EVALUATION OF GUTTAPERCHA RETRIVAL ABILITY OF PROTAPER RETREATMENT FILES USING THREE DIFFERENT SOLVENTS IN ROOT CANAL RETREATMENT

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ABSTRACT

Aim : The objective of this study was to compare the gutta-percha retrival ability of the protaper retreatment files using xylene, orangewood oil and eucalyptus oil.
Materials and Methods : 30 extracted anterior teeth were selected. Root canal treatment was carried out using standardized methods. Samples were grouped into three groups. Obturated material was removed with protaper retreatment files using xylene, orangewood oil and eucalyptus oil respectively. Time taken for complete retrival was noted. Samples were sections and observed under stereomicroscope. Data were statistically analyzed by Kruskal Wallies ANOVA.
Result: Xylene exhibited best dissolving efficiency by taking least time followed by orangewood oil and eucalyptus.
Conclusion : There is no significant difference between the effectiveness of orangewood oil and xylene in removal of obturating material using protaper retreatment file, but as cytotoxicity is more for xylene, orange wood oil can be used as an effective alternative to xylene as organic solvent.

INTRODUCTION

Regardless of advent of newer technologies, one-third of endodontically treated teeth do not have satisfactory outcomes because of persistence of infection which requires retreatment. the main aim of endodontic retreatment is removal of existing obturating material and persistent intra and extra radicular infections.[1] precise removal of obturating material is important and this can be achieved by endodontic hand files, rotary files and ultrasonics, either alone or in combination with heat or chemical solvents. This combination provides potential removal of obturating materials from the canal facilitating proper cleaning, disinfection, shaping and refilling of root canals.[2,3]

Rootcanal is three dimensional complex structure consisting of ramifications, fins and isthmus which are very difficult to access. Due to the difficulty in gaining access to all difficult ramifications of root canals, removal of these filling materials without damaging teeth can be successfully achieved using chemical solvents.[4,5] Solvents of organic origin are more potent chemical substance to dissolve obturating materials. The most frequently used organic solvents are chloroform, xylol, halothane, eucalyptol, turpentine and orangewood oil.[6]Xylene is a potent organic solvent which has the ability to dissolve obturating materials. But few studies have suspected its deleterious toxic effect on tissues.[7] Orange wood oil have a similar action on gutta-percha like xylene, but without any deleterious effect on tissues. Guttapercha is also easily soluble in essential oil like eucalyptus, which has been reported as safe to use intra orally.

Rotary retreatment instruments can be used as an important aid in removing obturating materials.[8] The ProTaper Universal system, which includes shaping, finishing and retreatment instruments. The retreatment system consists of three instruments (D1, D2 and D3) which are designed for removing obturating materials from root canals. They are designed with various tapers and diameters at the tip- size 30 with 0.09 taper, size 25 with 0.08 taper and size 20 with 0.07 taper. The full lengths of these retreatment files are 16 mm for D1, 18 mm for D2 and 22 mm for D3. The three retreatment files D1 is designed to be used in coronal, D2 in middle region whereas D3 in apical area.[8]

The aim of this study was to compare and evaluate the amount of remaining gutta-percha in root canal after retreatment with protaper retreatment files using xylene, orange wood oil and eucalyptus as chemical solvents.

MATERIALS AND METHODS

30 Extracted human maxillary anterior teeth of similar tooth length were collected. Soft tissue and calculus were removed using ultrasonics. Following standard protocols, access cavity preparation was done for all the tooth specimens. A size 15 K file (Maillefer files, Dentsply) was inserted into the root canal

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of each specimen tooth until its tip was just visible at the apical foramen. The working length was established 1 mm short of the foramen. Cleaning and shaping was achieved using a modified step-back flare technique and the canals were irrigated alternatively with 5.25% sodium hypo chlorite (NaOCl), 17% ethylenediaminetetra acetic acid (EDTA) and saline. Canal preparation was done sequentially till 30k file till working length. A step-back procedure in 1 mm increments to a file size 50 was then carried out. Obturation was done using cold lateral compaction technique using gutta-percha points (DeTrey, Dentsply) and zinc oxide eugenol sealer. The access cavities were sealed with Cavit (DeTrey, Dentsply). After obturation, all the specimens were stored at 37˚C in a humidor for 15 days to allow complete setting of the sealer.

Retreatment procedure

Prepared tooth specimens were randomly divided into three groups of 10 each (Table 1). Root fillings were removed with ProTaper Universal retreatment instruments following the manufacturer's instruction using xylene, orangewood oil and eucalyptus as solvents in respective group. The three retreatment files D1, D2 and D3 were sequentially used for coronal, middle and apical one third of the canal till working lenth.1ml of chemical solvent selected for each group was introduced into the canal and left for 2minutes. At the end of 2 minutes instrumentation was started at a speed of 500 rpm as recommended by manufacturer. Canals were irrigated with 5.25% NaOCl and 17% EDTA and instrument was cleaned in between to remove the adhering debris. Retrival of obturating material was considered complete when no debris of gutta-percha /sealer was visible on the surface of instruments and the canal walls were smooth. Time taken for completing the retrival of obturating material for each tooth was recorded from initial removal of gutta-percha till achieving working length.

Table 1 Grouping of study samples

Group	Chemical Solvent
Group A (n = 10)	Xylene
Group B (n = 10)	Orangewood oil
Group C (n = 10)	Eucalyptus

The samples were sectioned bucco-lingually along the canal using a diamond disc at low speed. The sectioned halves were examined under a stereomicroscope at 20x magnification to view the remaining gutta-percha material in retreated root canals. Scores were given from 1 to 4, for each sample based on the presence of remaining filling material in the root canal (Table 2).

Table 2 Scoring criteria for each one third of canal

Score 1	No presence of filling material in the canal
Score 2	25% filling material remaining in the canal
Score 3	50% filling material remaining in the canal
Score 4	> 75% filling material remaining in the canal

To reduce bias single operator carried out all endodontic procedures and evaluation of gutta-percha remnants was done by a second investigator who was blind in the study.The tabulated results were subjected to statistical analysis using Kruskal Wallies ANOVA.

RESULTS

The amount of time taken for removal of obturating material and the scoring for the three solvents are shown in table 3,4,5.

Figure 1 shows effectiveness of xylene in removing obturating material. Steriomicroscopic evaluation showed complete removal of obturating material in coronal, middle and apical third of region. Scoring has been tabulated in table 3. The average time taken to achieve complete working length is 5.21min.

Table 3 Time taken for removal of obturating material along with scoring for group A (Xylene)

Sl.no	Time (In Minutes)	Scoring given		
		Coronal	Middle	Apical
01	6.30	0	0	0
02	4.20	0	1	2
03	5.00	1	0	0
04	5.20	0	0	1
05	5.40	0	1	0
06	6.10	2	1	2
07	4.00	1	1	2
08	7.10	0	0	1
09	3.20	0	0	0
10	5.00	0	0	0

The average time taken for the removal of obturating material with xylene is 5.21minutes.

Figure 2 shows effectiveness of orange wood oil in removing obturating material. On stereomicroscopic microscopic observation slight presence of gutta-percha in the apical third and middle third of root can be noted for which scoring has been tabulated in **table 4** and the average time take taken to achieve complete working length is 8.12min.

Table 4 Time taken for removal of obturating material along with scores for group B (Orange wood oil)

Sl.no	Time (In Minutes)	Scoring given		
		Coronal	Middle	Apical
01	7.00	0	1	1
02	8.30	1	1	1
03	9.00	1	1	2
04	10.00	1	1	2
05	6.35	1	2	2
06	10.10	0	1	2
07	7.50	1	1	2
08	6.00	1	2	1
09	8.50	0	0	0
10	5.00	0	2	1

The average time taken for the removal of obturating material with Orange wood oil is 8.12 minutes.

Figure 3 represents the effectiveness of eucalyptus oil as solvent, observation revealed the presence of obturating material in the complete canal for which scoring has been tabulated in **table 5** and the average time take taken to achieve complete working length is 11.43min.

Table 5 Time taken for removal of obturating material along with scores for group C (Eucalyptus)

Sl.no	Time (In Minutes)	Scoring given		
		Coronal	Middle	Apical
01	12.00	2	2	3
02	10.00	2	2	2
03	14.25	1	3	3
04	11.15	1	1	2
05	11.00	1	2	3
06	12.20	2	1	3
07	15.40	2	2	2
08	13.20	1	3	2
09	12.50	1	1	1
10	14.30	1	2	3

The average time taken for the removal of obturating material with Eucalyptus is 11.43 minutes.

Comparision of solubility effect of different solvents in removal of obturating material showed statistical difference in

the dissolution of material. Xylene exhibited the better dissolving capacity of gutta-percha with least time followed by orangewood oil and eucalyptus. But slight presence of sealer in the canal was noted. Orangewood oil showed more amount of removal of sealer along with gutta-percha Statistical analysis revealed presence of more amount of obturating material in the eucalyptus group compared to orange wood oil and xylene. Orangewood oil showed statistically equivalent efficiency as xylene in removing gutta-percha and sealer.

Table 6 Statistical Analysis using ANOVA

Kruskal wallies ANOVA			
Time			
Group	**Mean**	**St dev**	**p**
Xylene	5.21	0.48	
Orangewood	8.12	1.24	0.002
Eucalyptus	11.43	1.39	
Table 6(a) Coronal			
Group	Mean	St dev	p
Xylene	0.2	0.447	
Orangewood	0.8	0.447	0.012
Eucalyptus	1.6	0.547	
Table 6(b) Middle			
Group	**Mean**	**St dev**	**p**
Xylene	0.2	0.447	
Orangewood	1	0	0.004
Eucalyptus	2	0.707	
Table 6(c) Apical			
Group	**Mean**	**St dev**	**p**
Xylene	0.6	0.894	
Orangewood	1.6	0.547	0.017
Eucalyptus	2.4	0.547	

Table 6 reveals lesser time taken by xylene followed by orange oil and Eucalyptus(p=0.002).Table 6(a) shows lesser score for xylene and orange oil in coronal region(p=0.012). Table 6(b) shows lesser score for xylene and orange oil in middle region(p=0.004). Table 6(c) shows least score for xylene in apical region(p=0.017).

DISCUSSION

Lack of cleaning and shaping of root canal leads to incomplete removal of microorganisms leading to reinfection of the canal after obturation. Non surgical retreatment is necessary for the beneficial prognosis of these teeth.

Retreatment of endodontically treated teeth is a challenge that requires complete removal of previous obturated material. It was not possible to remove all the traces of gutta-percha and sealer from the root canal walls with any of the techniques, which has also been reported in other studies.[9,10] Many studies have showed that retreatment was performed in significantly less time using rotary retreatment systems than the manual technique.[10-12] So in our study protaper retreatment system has been used along with xylene, orangewood oil and eucalyptus oil as organic solvents.

NiTi rotary instruments have been proposed for removing obturating material from root canals.[13,14] In the present study, the protaper universal rotary instruments with solvents left a smaller percentage of obturating material in the canal. The files D1, D2 and D3 have three progressive tapers and lengths. These files along with removal of gutta-percha it also removes superficial layer of dentin. The specific flute design of the instrument pulls the obturating material into the flutes of the file and direct it towards the orifice. The small amount of frictional heat produced during preparation plasticize the obturating material. Evaluation of remaining GP was done under stereomicroscope as this provides better magnification.

Figure 1- Shows effectiveness of xylene in removing obturating material. Steriomicroscopic evaluation showed complete removal of obturating material in coronal, middle and apical third region

Fig 1a - Coronal Fig 1b - Middle Fig1c - Apical

Figure 2- Shows effectiveness of orange wood oil in removing obturating material. Stereomicroscopic observation showed slight presence of gutta-percha in the apical third of root canal

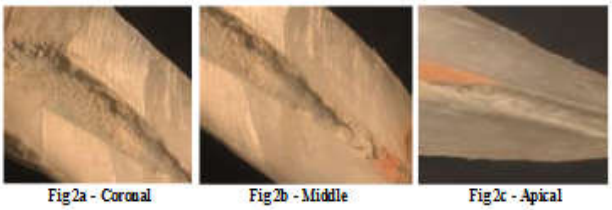

Fig 2a - Coronal Fig 2b - Middle Fig 2c - Apical

Figure 3- Represents the effectiveness of eucalyptus oil which revealed the presence of obturating material in the apical and middle third of root canal

Fig 3a - Coronal Fig 3b - Middle Fig 3c - Apical

Xylene has the ability to dissolve several organic materials like gutta percha, polymers, resins and sealers.[15,16] This dissolving action can be attributed to the presence of covalent bonds between the carbon atoms. Orange wood oil, an extract of the peel of sweet orange fruit (*Citrus sinensis*) is an efficient alternative to potentially toxic solvents as it consists of approximately 90% D-limonene. In the current study orange oil was used as a solvent which has been reported effective and less cytotoxic than eucalyptol, xylol, chloroform, and halothane.[17] Eucalyptus oil is the distilled oil obtained from the leaves of *Eucalyptus globulus*; a plant of the family Myrtaceae with 1,8-cineole as its major constituent. It exhibits antibacterial and anti-inflammatory properties.[12]

In the present study, after obturation, samples were stored for 15 days to allow complete setting of the material. Residual obturated material was found to be more in apical third than middle and coronal third in all the study groups. This could be due to accumulation of more debris apically and presence of apical ramifications.[16-18]

The evaluation of remaining obturated material was performed by calculating the percentage of debris in each third of the canal in relation to the canal area of each third as per previous studies done by Martos *et al*.[12] In this method the remaining debris is visualized three dimensionally under stereomicroscope at 20x magnification and the error is minimized.

In our study, xylene has been compared with orangewood and eucalyptus. Many studies have revealed the deleterious effect

of xylene on the tissue.[9] To come out with the solvent which has equivalent efficiency as xylene but not having deleterious effect on the tissues orangewood oil has been tried. Barbosa *et al* dissolved 2.5 grams of gutta-percha in 5 mililiters of chloroform, halothane and xylene and spread them over mouse fibroblasts cell culture. Chloroform and xylene showed higher toxicity.[19] Scelza *et al* exposed mice peritoneal macrophages to chloroform, eucalyptol and orange oil for 30 minutes. All solvents were cytotoxic whereas orange oil showed least cytotoxicity.[20]

The results showed maximum amount of removal of guttapercha using xylene in lesser time compared to orange oil and eucalyptus. This result is consistent with previous study done by Tanomaru Filho *et al* who tested orange oil, xylol, eucalyptol and d-limonene. Xylol was the most effective.[21]

In our study orange wood showed significantly equivalent effect in removing guttapercha with slightly longer time interval than xylene. The amount of sealer removal is more with orange oil and the reason for this behavior might be greater solubility of zinc oxide based sealer in orange oil which is in accordance with study done by Pecora *et al* and other studies.[7] In the present study eucalyptus showed least solubility of gutta-percha by taking longest time because slower dissolution property which is in contrast with the study done by Hunter *et al*.

As many studies suspected hazardous effect of xylene on tissues orange wood oil can act as better replacement for xylene with less cytotoxicity. Eucalyptus showed maximum amount of obturating material in the middle and apical region compared with xylene and orangewood oil.

CONCLUSION

There is no significant difference between the effectiveness of orangewood oil and xylene in removal of obturating material using protaper retreatment file, but as cytotoxicity is more for xylene, orange wood oil can be used as an effective alternative to xylene as organic solvent.

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