Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 3535 - 3543
Received 15 April 2021; Accepted 05 May 2021.

Comparative Evaluation Of Gutta- Percha Solvents in Endodontic Retreatment – An InVitro Analysis

Running Title: Gutta Percha solvents in Retreatment

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Abstract

Introduction

The epidemiological surveys conducted so far have reported that more number of root canal treated teeth are associated with periapical radiolucencies as a result of poor endodontic therapy. The aim of this study was to evaluate the efficacy of gutta percha removal in endodontic retreatment using orange oil and comparing it with current gold standard Xylene.

Materials and Methods

Freshly extracted 30 single rooted teeth were used in this study. It was divided into two groups by alternate sampling technique.

The teeth were prepared using rotary protaper universal system and obturated by single cone technique. Two drops of solvents were placed in the canal orifice of obturated root canal and gutta percha(GP) was removed

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using peso reamer and manual filing with H-files. Post Operative radiographs were taken to visualize the efficacy of gutta percha removal using different solvents.

Results

The remaining amount of GP present after using GP solvents are evaluated using Hulsman and Slotz classification(Hülsmann & Stotz, 1997). Radiographic and histological studies were done to evaluate the effectiveness of GP solvent. Statistical analysis was done using the Chi-Square test.

Keywords

Retreatment , GP solvents , Radiograph , Histology , Organic Solvents.

Introduction

Retreatment is the procedure of complete removal of previously treated root canal filling material. The incidence of retreatment is as high as 61% of previously treated teeth. It is often required in primary endodontic treatment failure cases.

Post treatment disease is the term used to describe those cases that would previously have been referred to as treatment failures. The treatment failure may be due to incomplete obturation, root perforation, external root resorption , overfilled or over extended canal , missing canal, accessory canal unfilled, constant trauma , broken instrument, canal blockage, ledge formation, poor post endodontic restoration, etc..(Akbar, 2015; Carneiro, 2006; Lin, Pascon, Skribner, Gängler, & Langeland, 1991; Mustafa et al., 2021; Sedgley & Wagner, 2003; Tabassum & Khan, 2016).

According to Glossary of Endodontic Terms (AAE) , defined retreatment as " A procedure to remove root canal filling materials from the tooth , followed by cleaning,shaping and obturating the canals. The commonly used GP solvents are Xylene, chloroform, halothane , rectified turpentine and other organic solvents like orange oil , eucalyptol can also be used (Esmat, El gendy, & Khalaf, 2021; Kirici, Karataş, Kol, & Arslan, 2019). The solvents minimally degraded the composite resin, although they did influence the degradation of both resin-modified glass ionomer resin and resin reinforced with glass ionomer(Martos, Machado Silveira, Silveira, Suita de Castro, & Ferrer-Luque, 2013).

Xylene is an aromatic hydrocarbon with a chemical formula $C_6H_4(CH_3)_2$, widely used in industry and it is a colorless , sweet – smelling liquid or gas occurring naturally in petroleum, coal and wood tar (Franck & Stadelhofer, 1988; Kandyala, Raghavendra, & Rajasekharan, 2010). In dentistry Xylene is used for tissue processing , cover slipping ,staining in histological laboratories and as a gutta percha solvent(Metgud, Astekar, Soni, Naik, & Vanishree, 2013; Sravya et al., 2018; Wynnchuk & Wynnchuk, 1994).

Xylene has few toxic effects on the nervous system, eyes, nose ,throat, pulmonary edema due to over exposure, liver and kidney injury , anemia , gastrointestinal tract infections, reproductive system etc(Kandyala et al., 2010). It also has a carcinogenic effect(Edokpolo, Yu, & Connell, 2014; McMichael, 1988). Like Xylene chloroform also found to have side effects like tissue necrosis(Bergman, 1979; Davidson, Hannigan, & Bowen, 2021; Wang et al., 2021).

Orange terpenes can be used as gutta percha solvents. It is an essential oil produced by cells within the rind of an orange fruit. It is extracted as a byproduct of orange juice. Mostly composed of d-limonene(>90%). It can be extracted from oil by distillation.

Orange oil is effective in dissolving apexit plus and endomethasone N sealer(Aryadi, Aryadi, Tanujaya, & Hardini, 2020; Yadav, Yadav, Chandra, & Thakkar, 2016). The bond strength of fibreglass post to root canal dentin is not affected by orange oil and xylene (Elnaghy, 2014; Guedes et al., 2014).Orange oil is most effective on thermoplastic GP than other materials(Tanomaru-Filho, Orlando, Bortoluzzi, da Silva, & Tanomaru, 2010).

The aim of this study was to evaluate the efficacy of GP removal in retreatment using organic solvent and current gold standard Xylene, a chemical solvent.

Materials and Methods

Kiran Rehman et al(Rehman, Khan, & Aman, 2013) in their study used 27 extracted molars and divided it into two groups as 14 teeth in one group and 13 teeth in another group. In this study we have used 30 teeth , it was divided as:

Group 1 - 15 teeth – Orange Oil

Group 2 – 15 teeth – Xylene

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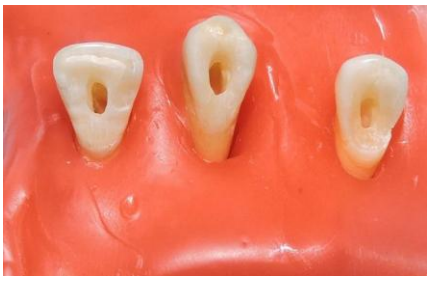
An In Vitro experimental study was conducted , freshly extracted 30 single rooted teeth was used in this study. Access cavity was prepared using Endo Access bur and Endo – Z bur. Orifice was enlarged using Gates Glidden drills. The teeth were prepared using a rotary method using protaper universal system (Figure 1).

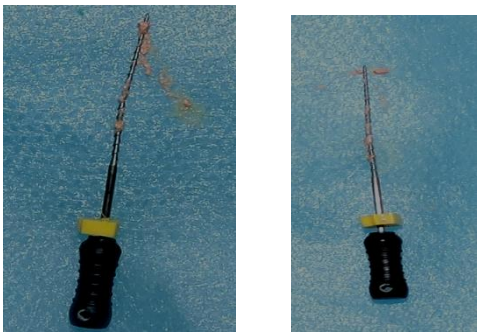


During cleaning and shaping with a rotary system , the canals were irrigated using 5.2 % of sodium hypochlorite solution, 17% EDTA solution and the final rinse was done using saline. The canals were dried using paper points and teeth are obturated using single cone obturation technique with the corresponding gutta percha for the pro taper universal files (Figure 2).

Radiographs were taken after obturation and teeth were divided into 2 groups, containing 15 each group . In group 1 the removal of gutta percha is done with orange oil , whereas in group 2 the obturated canal with gutta percha is removed using Xylene.

Group 1 is orange oil and group 2 is Xylene. The GP were removed using paeso reamers and manual filing using Hedstrom file(H-files). The amount of GP removed was calculated using Hulsman and Slotz classification(Hülsmann & Stotz, 1997).

The pictures showing amount of GP removed in each group are given below (Figure 3&4):



GROUP 1 **GROUP 2**

Picture Showing Amount of GP Removed Using H Files In Each Group

Figure 3

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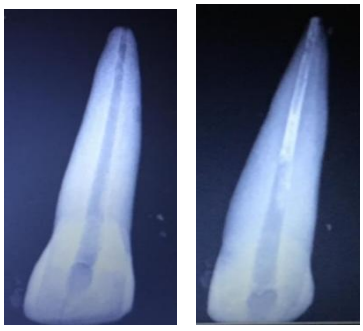

GROUP 1 **GROUP 2**

Radiographs showing Amount Of GP Removed In Each Group

Figure 4

Histologic Evaluation

The samples were resin mounted and sectioning was done at three different levels coronal, middle and apical level using Hard tissue Microtome-LEICA-SP-1600 (Figure 5-7).

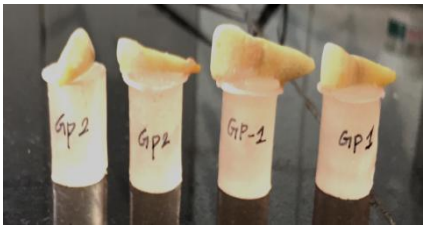

Figure 5: Resin Mounted Samples

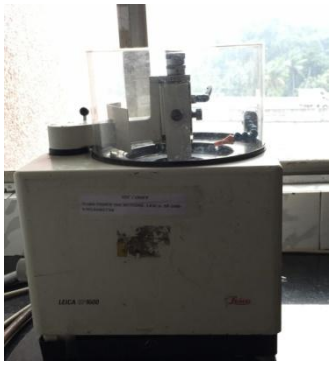

Figure 6: Hard Tissue Microtome -LEICA-SP-1600

GROUP 1 **GROUP 2**

Figure 7: Histological Section Showing Coronal, Middle And Apical Portion Of Each Sample. The Encircled Portion Shows The Amount Of Remaining Gp In Each Group.

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Results

The results were evaluated by the presence of the remaining amount of GP after using different types of GP solvents by Hulsman and Slotz classification.GP is softened more in orange oil when compared with Xylene.

Statistical analysis was done using chi square test for histological apical group , middle and coronal group and also for radiologic evaluation method (Table 1).

Histologic evaluation in apical portion

Table 1: Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	60.000[a]	4	.000
Likelihood Ratio	83.178	4	.000
Linear-by-Linear Association	48.660	1	.000
N of Valid Cases	30		

a. 4 cells (40.0%) have expected counts less than 5. The minimum expected count is 4.00.

Radiographic evaluation

Table 2: Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.444[a]	3	.000
Likelihood Ratio	33.716	3	.000
Linear-by-Linear Association	3.733	1	.053
N of Valid Cases	30		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.00.

The results showed that group 1 (Orange oil) showed better removal of GP in apical portion when compared with group 2(Xylene) (Table 2).

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Discussion

Endodontic retreatment replaced the periapical surgeries for the management of failed root canal treatment(Bergenholtz, 2010; Mandel & Friedman, 1992). In this study , we have evaluated the presence of GP in the coronal , middle and apical portion of the root canal after using organic and chemical GP solvents. It has shown that the orange oil removes GP better in apical portions of the root canal. There are various techniques in removing GP for retreatment . Few of them are gates glidden , gates glidden with various solvents or system B (Arora, Bahri, & Mittal, 2012; Jorgensen, Williamson, Chu, & Qian, 2017; Pasari, Reddy, Admala, & Dinapadu, 2013; Roggendorf et al., 2010).

The Xylene is a chemical solvent and causes side effects on acute and chronic exposure(Langman, 1994; Negi et al., 2013). Xylene has the capability of dissolving epoxy resin sealers within 1 to 2 minutes(Kfir, Rosenberg, Tamse, & Tsesis, 2012; Shenoi, Badole, & Khode, 2014). In this study we have evaluated the radiologic and histology in order to evaluate remaining gp solvents.

In endodontic retreatment procedures , the complete removal of previously filled root canal filling material is important, followed by proper cleaning and shaping and refilling of the root canal.

The common etiological factor for root canal failure is due to Enterococcus Faecalis. Xylene does not have antibacterial activity against E. Faecalis organisms(Subbiya, Padmavathy, & Mahalakshmi, 2013). Xylene is considered effective in dissolving conventional GP and Resilion(Mushtaq, Farooq, Ibrahim, & Khan, 2012; Soares et al., 2015; Tanomaru-Filho et al., 2010).

The organic solvents have less degradation effect on composite resin(Martos et al., 2013). Chloroform leads to more root canal transportation. Orange oil can be used as a GP solvent , as it is organic and is less harmful for patients. The orange oil, chloroform and Xylene softens the GP(Oyama, Siqueira, & Santos, 2002; Pecora, 1993; Scelza, Coil, Maciel, Oliveira, & Scelza, 2008).

The R- endo system removes more root canal filling materials and in the previous study , they have said that apical portion of root canal had more filling materials when compared to coronal and middle third(Reddy et al., 2011). The GP solvents had adverse effects on bond strength on resin sealers to root canal dentin(Nasim, Neelakantan, & Subbarao, 2014).

Other methods like retreatment files can be used for endodontic retreatment. The rotary NiTi retreatment files usage must follow the use of H-files for better cleaning efficacy(Jayasenthil, Sathish, & Prakash, 2012). However more procedural errors are seen when using rotary NiTi system, ProTaper Universal retreatment files and reciprocating systems(Rödig et al., 2012, 2014).

Conclusion

Within the limitations of the study, this study showed that orange oil is effective in retreatment, even in apical third of the obturated tooth this helps in removal of more gutta percha when compared with xylene. Since, it is non carcinogenic and biocompatible to the oral tissues, orange oil can be used as an gutta percha solvent in retreatment cases.

Acknowledgement

With sincere gratitude, we acknowledge the staff members of the department of Conservative dentistry and Endodontics and Saveetha dental college for the extended support towards the completion of the research.

Financial support and Sponsorship

Nil

Conflicts of interest

There are no conflicts of interest.

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