EJPMR, 2025, 12(11), 265-269 Research Article Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

ISSN (O): 2394-3211
ISSN (P): 3051-2573
Coden USA: EJPMAG

EFFECT OF THREE GUTTAPERCHA SOLVENTS ON MICROHARDNESS OF HUMAN ROOT DENTINE - AN INVITRO STUDY

***[1]Dr. P. Nihar MDS, [2]Dr. Mohankumar Reddy S. MDS, [3]Dr. Pragnya MDS, [4]Dr. K. S. Chandra Babu MDS, [5]Dr. Cidda Sindhuja, [6]Dr. Shravani Reddy S.**

[1]Associate Professor, Department of Conservative Dentistry and Endodontics, CKS Theja Institute of Dental Sciences and Research, Tirupati. Andhra Pradesh, India.
[2]Associate Professor, Department of Conservative Dentistry and Endodontics, CKS Theja Institute of Dental Sciences and Research, Tirupati. Andhra Pradesh, India.
[3]Associate Professor Department of Conservative Dentistry and Endodontics, CKS Theja Institute of Dental Sciences and Research, Tirupati, Andhra Pradesh, India.
[4]Professor, Department of Conservative Dentistry and Endodontics, CKS Theja Institute of Dental Sciences and Research, Tirupati Andhra Pradesh, India.
[5]Cosmetic Dental Surgeon Narayana Dental College. Nellore Andhrapradesh, India.
[6]Cosmetic Dental Surgeon CKS Theja Institute of Dental Sciences and Research, Tirupati, Andhra Pradesh, India.

***Corresponding Author: Dr. P. Nihar MDS**

Associate Professor, Department of Conservative Dentistry and Endodontics, CKS Theja Institute of Dental Sciences and Research, Tirupati. Andhra Pradesh, India.
DOI: https://doi.org/10.5281/zenodo.17539704

How to cite this Article: *1Dr. P. Nihar MDS, 2Dr. Mohankumar Reddy S. MDS, 3Dr. Pragnya MDS, 4Dr. K. S. Chandra Babu MDS, 5Dr. Cidda Sindhuja, 6Dr. Shravani Reddy S. (2025). Effect of Three Guttapercha Solvents on Microhardness of Human Root Dentine - An Invitro Study. Journal of Pharmaceutical and Medical Research, 12(11), 265–269.

Article Received on 09/10/2025 **Article Revised on 30/10/2025** **Article Published on 01/11/2025**

ABSTRACT

Aim: The purpose of this study is to compare the microhardness of human root dentine after the appilication of three gutta-percha solvents. **Methodology**: 45 Extracted human maxillary anterior teeth were sectioned longitudinally and embedded in acrylic resin blocks and are then polished and were treated with Xylene, Orange oil, Turpentine oil for 5 and 10 minutes. After each treatment period, the specimens were rinsed, dried, and prepared for Vicker's micro hardness analysis. Vicker's micro hardness values for each specimen were recorded before and after treatment, and the differences were statistically compared. **Results**: Statistically significant difference was found in solvent-treated groups & decrease in microhardness values is directly propotional to the exposure time. **Conclusion**: This study showed that among the experimental solvents, turpentine oil shows less effect on microhardness of human root dentine.

KEYWORDS: Xylene, Orangeoil, Turpentine Oil, Root Dentine, Micro Hardness.

Clinical Significance: During root canal treatment there is considerable loss of dentine, Further loss is appreciated in endodontic retreatment procedures causing damage to the tooth structure. Hence there should be precise thinking in selecting gutta-percha solvent that should not have any deleterious effects to dental hard tissue and should have good softening action on gutta-percha.

INTRODUCTION

Several factors are associated with the outcome of endodontic treatment. however, the prospects of treatment not meeting a desirable objective markedly increases if any of the procedural step is imprecise.[1] Non surgical endodontic retreatment is an effort to reinstate healthy periapical tissues after defective treatment or reinfection of an obturated root canal because of coronal or apical leakage. It necessitates reobtaining access to the complete root canal system by removal of defective root canal filling, additional cleaning and shaping and reobturation.[2] Principle reasons of endodontic failure are inappropriate cleaning and filling of the root canal system, procedural errors, or the lack of an hermetic seal, which allows the survival of bacteria within dentinal tubules, apical ramifications, accessory and secondary canals.[3] However, when the coronal restoration is imperfect or absent, contamination with saliva may cause root canal sealer dissolution, thus providing a space for bacterial diffusion that may contribute to the letdown of the treatment.[4] The use of solvents, heat and mechanical instrumentation, alone or in combination are the various approaches available for the removal of gutta-percha.[5] Most part Gutta-percha cones are composed of a vegetable resin, which lends its name to the product, and they are softened by chemical solvents.[5]

One of the drawbacks of gutta-percha as an obturating material is the lack of an effective seal.[6] Chemical solvents like Orange oil, eucalyptol, xylol, chloroform, halothane, and rectified turpentine have all been used as adjuncts to remove endodontic obturating materials.[7] The term "retreatodontics" is introduced by Schilder to signify that the branch of endodontics in charge of reprocessing an endodontic treatment in orthograde (conservative) or retrograde (surgical) way.[8] The orthograde non-surgical retreatment is the repetition of a primitive faulty endodontic treatment and the main purpose is to eliminate all the filling materials from the root canal system and to regain the access to the apical third in order to achieve a new correct treatment.[9] The radicular and coronal dentin and the enamel were exposed to gutta-percha solvents deposited in the pulp chamber during retreatment procedures. Such solvents may enable surface alterations to both dentin and enamel and affect their contact with materials used for obturation and coronal restoration, as well as inhibiting resistance to bacterial ingress and permitting coronal leakage.[10]

MATERIALS AND METHODS

Forty five human permanent maxillary Anterior teeth which are extracted due to periodontal reasons are taken for the study. Fractured tooth, Restored tooth, Tooth with external root resorption & Hypo plastic tooth were excluded from the sample. Crowns were removed at the cemento-enamel junction using a high-speed bur under water cooling. Pulp tissues were extirpated with barbed broaches. The roots of the teeth were sectioned longitudinally in a mesiodistal direction into buccal and lingual segments making a total of 90 specimens. The root segments were mounted in autopolymerizing acrylic resin so that their root dentine was exposed. The specimens surface were finished and polished with silicone carbide papers. Ninety Specimens were divided in to three groups based on the type of solvents being used. Among the thirty specimens in each of the three groups (n=10). 10 specimens were tested for Vickers microhardness before keeping them in gutta-percha solvents. 10 specimens were treated with gutta-percha solvents for 5 minutes and remaining 10 specimens for 10 minutes in an enclosed vessel with turpentine oil, orange oil and xylene respectively. Treatment consisted of pipetting 50 microliters of each solution onto the exposed dentin surfaces. After each treatment period, the specimens were rinsed with copious amounts of distilled water and dried for 20 minutes on a soft absorbent paper at room temperature and microhardness was then measured. Indentations were made at three widely separated locations. The locations were chosen at 1 mm level to root canal wall in apical, middle and cervical region of the roots by means of 300g load used for 20 seconds. All the analysis was done using SPSS version 18. $p<0.001$ was considered statistically significant. Dentin microhardness values for each time interval were compared and statistically analyzed by means of one-way analysis of variance (ANOVA).

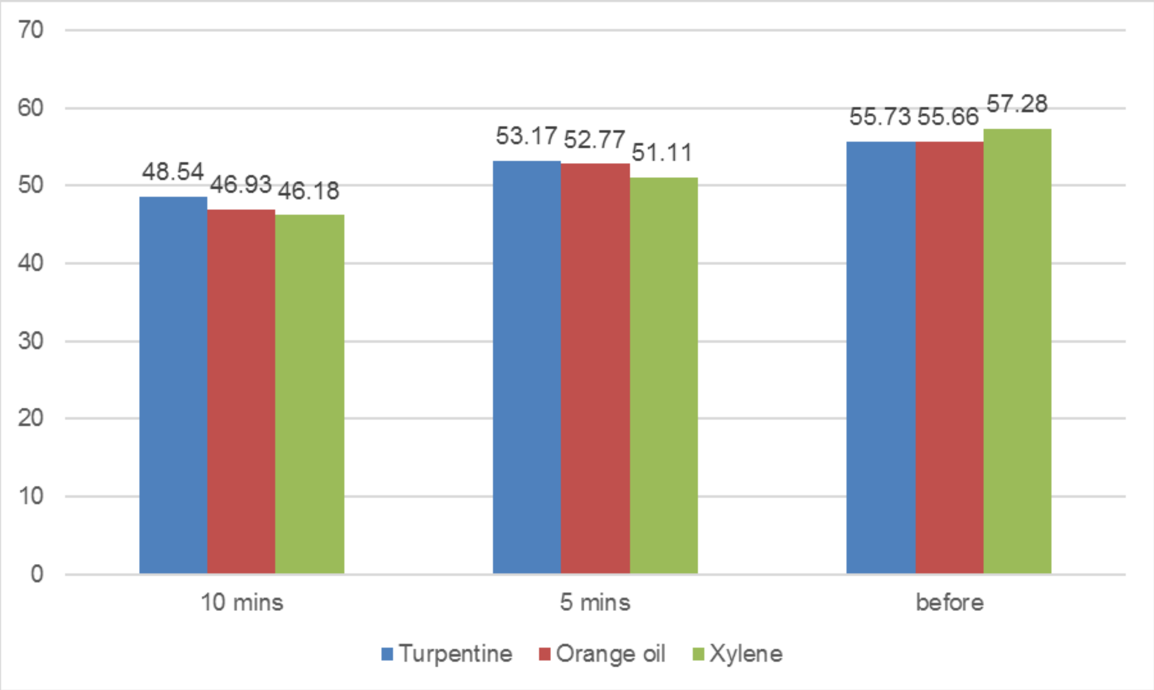
RESULTS

The results were found to be statistically significant ($p<0.001$). In the present study Xylene showed highest reduction in micro hardness followed by orange oil and turpentine oil.
Level of significance was set at $p<0.001$.
Distribution of hardness in each concentration within the group is listed in table 1 & 2 respectively.

Table: 1.

Group	Concentration	Hardness			P-value	Post-hoc test
		Mean	SD	N		
Turpentine	10 mins	48.54	4.48	30	<0.001; Sig	Before , 5 mins >10 mins
	5 mins	53.17	4.04	30		
	before	55.73	3.45	30		
Orange oil	10 mins	46.93	4.99	30	<0.001; Sig	Before >5 mins >10 mins
	5 mins	52.77	3.84	30		
	before	55.66	4.05	30		
Xylene	10 mins	46.18	5.41	30	<0.001; Sig	Before >5 mins >10 mins
	5 mins	51.11	3.72	30		
	before	57.28	3.59	30		

Table: 2.



DISCUSSION

The removal of root filling material is sometimes necessary to facilitate retreatment of a failed endodontic case or for restorative reasons, such as the preparation of a tooth for a post-restoration. Using gutta-percha solvents is one of the ways of removing the root canal filling.[11] When the coronal restoration is faulty or absent, contamination with saliva may cause root canal sealer dissolution, thus providing a space for bacterial penetration that may contribute to the failure of the treatment.[12] Knowing the risk of the use of purely mechanical means to remove gutta-percha, such as perforation, fracture or alteration of the original root form, several techniques have been proposed seeking efficiency, speed and practicality in gutta-percha removal. These include the use of heated instruments, of microscopes, or of manual instruments either by themselves or combined with sonic apparatus or Gates-Glidden drills in the cervical third. The use of solvents is, however, necessary for all techniques for removal of gutta-percha.[13] Introducing essential oils in endodontics is growing because of their proved safety, biocompatibility and non-carcinogenicity.[14] According to Stabhouz and Friedman, the use of solvents is essential for filling material removal within dentinal tubules and ramifications, therefore making easy the biomechanical preparation and the penetration of the irrigant solutions and intracanal medications.[15] The root canal dentin is exposed to solvents during endodontic retreatment for removing the gutta percha. These solvents may change the physical and chemical properties of dentin.[16]

Gutta-percha solvents affects the organic components of the treated enamel and dentin, causing an enlargement of the intercrystalline spaces and thus increasing the porosity and permeability of these tissues.[17] Many authors have employed eucalyptus and pine tree essential oils because gutta percha is soluble in these oils in the same way like in xylol and chloroform without presenting any harmful effects.[18] In this study, the ability of the Vicker's microhardness test to detect surface changes of dentin after treatment with turpentine oil, orange oil, and xylene was demonstrated. Akcay et al, conducted study using Vickers test for the measurement of microhardness, indents were made at the mid-third of the root canal at 100µm distance from the pulp-dentin interface. and he concluded that the specimens in the EDTA + 0.50% cetrimide solution group showed the highest change in microhardness. The plain EDTA and plain 0.50% cetrimide groups had similar values.[19] It is important to test the effect of solvents on root dentine, as the number of dentine tubules per unit area is less for radicular dentine, meaning that the area of intertubular dentine is greater in the root dentine than the crown dentine. The directions of the tubules are also different in coronal and root dentine. Therefore, the micro hardness of dentine may change depending on the region.[20] Some studies have reported that the root dentin microhardness decreases from the surface towards the deeper zones. Increased number of open dentinal tubules and peritubular spaces around the pulp decreases the resistance of dentin to microhardness indenter.[16]

Any change in the Ca:P ratio may in turn change the microhardness, permeability and solubility characteristics of dentin and also affect the sealing ability and adhesion of dental materials. Microhardness reduction is seen at 5 minutes and further reduction of microhardness is seen at 10 minutes, this reduction may be due to the change in original Ca: P ratio which in turn changes the micro hardness, permeability, and solubility characteristics of dentin.[21] Microhardness test is a simple tool for the assessment of the mechanical characteristics, and the microhardness value can be an indirect indicator of mineral loss or deposition in the hard tissue of a tooth. Moreover, a positive correlation exists between the microhardness values and the mineral content of teeth.[16] The results of our investigation indicate that xylene, orange oil and turpentine oil caused physical alterations to dental hard tissues respectively. In the present study, group treated with Xylene showed highest reduction in micro hardness. This result is in agreement with studies done by Erdemir et al, Kaufman et al, Chutich et al.[11]

Xylene is chlorinated hydrocarbon commonly considered as gutta percha solvent. It may also soften or dissolve the sealers and could potentially facilitate their mechanical removal.

The only known solvents of gutta-percha that are available today for clinical use are the Eucalyptol oil and xylene and they are not considered potential carcinogens by the public health services (PHS). The atmost problem with xylene is that it is very toxic.[18] Pecora et al. presented orange oil as an alternative solvent without deleterious effects and with the same softening action as xylol.[22] Orange oil is an excellent substitute solvent compared to potentially toxic solvents, being used either on zinc oxide eugenol cement or to soften and dissolve gutta-percha.[23] Orange oil comprises limonene, aliphatic hydrocarbon alcohols, and aldehydes such as octanal.It serves as a good replacement for chloroform and xylene for Guttapercha softening and removing endodontic sealers in retreatment.[24]

Turpentine oil is a kind of fluid isolated from live trees, mainly pines. It consists of terpenes including monoterpenes, alpha-pinene, beta-pinene and some amount of careen, camphene, dipentene, and terpinolene. Turpentine oil is slower and probably safer, but long-term studies assessing its feasibility for retreatment are still required.

Rectified turpentine oil can be used to soften or dissolve gutta-percha in the root canal space to facilitate endodontic retreatment Turpentine is one of the original solvents used in the commercial production of gutta-percha. At body temperature (37°C) it is a weak gutta-percha solvent. when heated to 71°C (160°F), its ability to dissolve gutta-percha is considerably increased.[25] The rate at which the warming turpentine oil softens and dissolves gutta-percha increases with the increase in the chemical reactivity of the warming rectified turpentine oil. Heating Rectified turpentine oil over an open flame must be avoided as it has flash point of 93°F. A bead sterilizer, coffee or other electronic heat source can be used to warm it. The mercury bulb thermometer can be used to check the temperature of the rectified turpentine oil. At room temperature. rectified turpentine oil is less effective than the turpentine oil when heated 158°F.[26]

CONCLUSION

Within the limitations of the study after 5 minutes and 10 minutes time interval, Xylene had highest reduction of micro hardness followed by orange oil and turpentine oil.

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