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Impact of Solvents on Apically Extruded Debris and Irrigants during Root Filling Removal: In Vitro Study

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Abstract
INTRODUCTION: *An ideal solvent must facilitate convenient Gutta percha removal during root canal retreatment so that apical extrusion of solvents and debris could be prevented. Endosolv helps in the removal of zinc-oxide eugenol and phenolic resin-based root canal sealers. RC Solve is derived from orange oil which helps in dissolving guttapurcha & zinc oxide cement.*
AIM AND OBJECTIVE: *To evaluate the impact of different solvents based on the weight of apically extruded debris and irrigant while retreatment in an agar gel model.*
MATERIALS AND METHODS: *Solvents such as Endosolv and RC Solve were chosen. Sixty extracted human mandibular premolar teeth were divided into three groups (n = 20). Root canal treatment was done for all specimens and the weight of the specimen was measured alone prior to insertion and after insertion into the test apparatus. To measure the mean initial weights, the weight of the specimen from the weight of the test apparatus was subtracted and recorded. The test solvent was applied after removing the coronal 4 mm of root filling. Solvent was not used in the control group. Root fillings were removed from all groups using reciprocating instrument. During retreatment procedures, the periapically extruded debris and test solvents were collected. By subtracting the mean initial weight from the weight of the test apparatus excluding the specimen. The mean weight of apically extruded debris and irrigant were calculated following the retreatment procedures.*
RESULT: *The groups in which solvents were used resulted in significantly less extruded debris and irrigant unlike the control group (P < 0.001). No significant difference was seen between RC Solve and Endosolv groups.*
CONCLUSION: *Apically extruded debris was significantly less with the use of solvents.*
Key Words: *Endosolv, apical extrusion, RC solve, Reciproc.*

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I. Introduction:

One of the major causes of post-treatment disease is persistent or secondary intraradicular infection[1]. If the initial procedure has failed, then Nonsurgical retreatment is indicated. With improved root canal disinfection and debridement, and by achieving a good obturation root canal failure can be corrected[2].

Periapical extrusion of materials, debris, microorganisms and irrigants beyond the apical foramen during root filling removal has been reported[3]. The type of instruments used had an influence on the amount of apically extruded debris[4].

The various techniques that have been developed for the root filling removal include ultrasonics, lasers, hand files, rotary systems and solvents[5-8]. RC Solve which is a derivative of Orange oil, is routinely used as a solvent for root filling removal. Due to the pleasant smell, good softening efficacy, non- toxicity, and non-carcinogenicity of orange oil it is a well accepted and a commonly used solvent[9,10].

Endosolv helps in the removal of both zinc-oxide eugenol based and resin-based sealers. Owing to the high softening potency of solvents there is reduced risk associated with rotary instruments during mechanical root filling removal. Canal preparation techniques have been associated with a certain degree of apical extrusion. Reciprocating systems have been related with less periapical extrusion during the removal of gutta percha from the root canal system when compared to that of rotary systems and hand files[11,12].

Aim And Objective: The aim of this study was to evaluate the weight of apically extruded debris and irrigant during root filling removal using Reciproc R25 instrument in conjunction with Endosolv and RC Solve using an agar gel model. The null hypothesis tested was that whether a solvent is used or not it did not affect the amount of extruded debris.

II. Material And Methods:

ETHICAL CLEARANCE:
A detailed protocol explaining the purpose and procedures of the study was submitted to the Institutional Review Board, Vivekanandha Dental College for Women and the approval for the study was obtained.

INCLUSION CRITERIA:
Intact human mandibular premolar teeth which was extracted for orthodontic purpose with single straight roots, single root canals and fully formed apices were included for this study.

EXCLUSION CRITERIA:
Carious, restored and malformed teeth were excluded from this study.

III. Methodology:

SAMPLE PREPARATION:-

Sixty extracted human mandibular premolar teeth were selected. All teeth were examined both visually and radiographically before the experiment began. The specimens were decoronated to a standard length of 14 mm under water cooling using an Isomet saw (Buehler). The determination of the working length was done visually with a size 10 K-file. This file was introduced into the canal until the tip of the latter was visible at the major apical foramen and the working length was established subtracting 1 mm from this length. Root canals were instrumented with the ProTaper Universal System (Dentsply Maillefer, Ballaigues, Switzerland) up to F3 file at working length based on the manufacturer's instructions. For irrigation during instrumentation 5.25% NaOCl solution was used. Final irrigation was done by using 17% EDTA, 5.25% NaOCl and distilled water. Paper points were used to dry the canals. The obturation technique used was cold lateral compaction with gutta-percha cones (Dentsply Maillefer) and the sealer used was AH Plus sealer (Dentsply DeTrey, Konstanz, Germany). The adequate canal filling was then confirmed with radiographs. To allow the sealer to set completely the specimens were stored at 37 °C with 100% humidity. This was done for two weeks. The prepared specimens were randomly divided into three groups (n = 20).

Group I (n=20): Control group
Group II (n=20): RC Solve group
Group III (n=20): Endosolv group

Teflon tape was wrapped around the surfaces of the specimens leaving the apical foramen and root end exposed. The specimens were then numbered. All the specimens were weighed using an analytical balance with 10-4 g accuracy (CAI-35,Contech Instruments Ltd, Navi Mumbai, India) thrice and mean values were calculated. Agar solutions of about 100 mL were prepared in 500-mL flasks, which contained 100 mL distilled water and 1.5 g agar to achieve a 1.5% final concentration[13], and 3 mL of this 1.5% agar gel was injected into each Eppendorf tube, and the specimens were positioned in them. After the gelation of agar, the test apparatus was weighed again thrice. By subtracting the first measurement obtained from the second measurement, the weight of each apparatus was calculated. The tubes were placed in a glass bottle while the root filling was removed. For isolation a rubber dam was fixed around the coronal portion of the roots. The Experimental and the control groups were treated as follows:

RC Solve Group: to remove the coronal 4 mm of the root filling Size 2 and 3 Gates-Glidden drills were used at 1000 rpm, and then, 0.1 mL of RC Solve was placed onto the root filling for 2 min. A Reciproc R25 instrument was then used in the 'forward reciprocating' mode of a CanalPro CL2 endodontic motor (Coltène/Whaledent Private Ltd, Mumbai, India) for root filling removal. The Reciproc R25 instrument was used in 3 slow in-and-out pecking motion for about 3 mm amplitude with a brushing motion against the walls of the root canal. After

this, the flutes of the instruments were cleaned by using a sterile gauze which was impregnated with 1% sodium hypochlorite. Until the instrument reached the WL, this procedure was repeated. Using an R40 file Final canal preparation was performed till there was absolutely no filling material on the instrument. As these instruments are for single use only, they were discarded after each instrument was used for one specimen. During root filling removal 4 ml of distilled water was used for irrigation.

Endosolv Group: The same procedure was repeated as in the previous group with Endosolv as solvent.

Control Group: The same procedure was repeated as in the previous groups, but solvent was not used in this group.

When root filling removal was completed, the specimens were removed along with Teflon tapes from the Eppendorf tube. Then the tubes were weighed. By subtracting the weight of the apparatus after removing the specimen, from the initial weight the periapically extruded debris was calculated.

IV. Result:

The obtained result was statistically analysed using one way ANOVA test (Table-1) and Duncan post hoc test using the software SPSS 10.0(Table-2, Figure-1), shows that in the control group(Group I), significantly greater amounts of extruded debris were produced compared to the test groups ($P < 0.001$).There was no significant difference between RC Solve(Group II) and Endosolv(Group III) groups.

	N	Mean	SD	SE	ANOVA	P
(Group I)No solvent	20	0.02580	0.00483	0.00108	323.27	0.001**
(Group II)R C Solve	20	0.00508	0.00047	0.00011		
(Group III) Endosolv	20	0.00757	0.00045	0.00010		
Total	60	0.01282	0.00972	0.00125		

Table-1: Statistical analysis by One-way ANOVA test

weight of apically extruded debris and irrigant				
Duncan Post Hoc Tests				
Group	N	Subset for alpha = .05		
		1	2	3
(GroupII)R C Solve	20	0.00508		
(GroupIII)Endosolv	20		0.00757	
(GroupI)No solvent	20			0.02580

Table-2: Statistical analysis by Duncan Post Hoc test

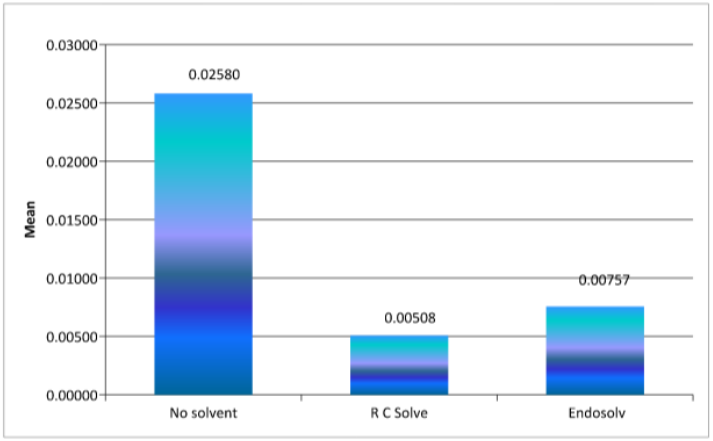

Figure-1: Weight of apically extruded debris and irrigant of all the groups

V. Discussion:

Flare-ups during root canal treatment can be mainly caused by apical extrusion of debris, gutta-percha, sealer and tissue remnants. This is an unpleasant situation both for clinicians and patients[14]. Many studies have been published on the amount of extruded debris during root filling removal[8,12]. At present, all retreatment instruments produce periapically extruded debris among them the Reciproc system was reported to produce less periapical extrusion when compared to rotary NiTi systems[11,12]. Reciproc is able to completely prepare root canals with only one instrument . As suggested by previous studies, in this present study also two files (R25 and R40) were used to enlarge the initial apical preparation for reduction of residual filling materials[15,16]. The main function of solvents are to soften and dissolve gutta-percha. A recent study reported that there is reduced amounts of periapical extrusion when solvents were used[8]. The present study aimed to compare the weight of periapical extrusion during retreatment using RC Solve and Endosolv as solvents. The use of RC Solve and Endosolv reduced the amount of periapical extrusion significantly when compared to the control group in the present study. The softening and removal of the bulk of the filling material in a coronal direction could be the reason for this finding. The results of the present study are like the findings of a recent study, even though the solvents and apparatus used in that study were different[8,15]. Therefore, there is reduction in periapical extrusion when solvents are used. When choosing the correct solvent there should be a balance between solvent effectiveness and clinical safety. RC Solve (Prime Dental, Thane, Maharashtra, India) and Endosolv (Septodont, Paris, France), which contain orange oil and tetrachloroethylene as the principal compounds, respectively, are routinely used gutta-percha solvents[17]. With the introduction of new instruments for retreatment, the retreatment procedure can be completed more quickly, and predictably, with the introduction of new instruments but with no periapical extrusion will still be a challenge.

VI. Conclusion:

The use of solvents significantly reduced apically extruded debris compared to that of the control group, although there was no statistical difference between the amount of apically extruded debris between the two test groups.

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