



**EFFECT OF DENTIN SURFACE TREATMENT ON LEAKAGE OF PULP SPACE  
OBTURATIONS IN CANALS TREATED WITH ETHYLENE DI-AMINE TETRA ACETIC  
ACID AND SODIUM HYPOCHLORITE: AN IN VITRO STUDY**

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**ABSTRACT**

In the present study, spectrophotometric analysis was carried out to quantitatively analyse the amount of dye leakage with four sealers. Twenty four distal roots of mandibular molars were selected and randomly divided into four groups with six specimens. After cleaning and shaping, obturation was done with gutta-percha. The sealers used in the four groups were Zinc oxide eugenol, Ketac endo, Light cured glass ionomer, Dyract AP thinned out with prime and bond 2.1. It indicated maximum transmission with zinc oxide eugenol and least with ketac endo, indicating least leakage with zinc oxide eugenol and maximum with ketac endo.

**KEY WORDS:** Zinc oxide eugenol, Ketac endo, Dyract AP, Light cured glass ionomer, Dye leakage, Spectrophotometric analysis

**INTRODUCTION**

The pulp space is usually obturated with gutta-percha combined with a sealer. Specific requirements for a pulp space sealer have been outlined by Grossman<sup>1</sup>. The specific requirements included ability to flow into irregularities of the pulp space to provide an adequate seal when set, to adhere to wall of the pulp space, compatible to gutta-percha and ability to remove in toto the sealer during re-treatment procedures.

With the introduction of adhesive cements like Glass ionomers, and introduction of recent generation of dentin bonding systems, shifted the scenario from Zinc oxide eugenol to Glass ionomers, resins and resin modified Glass ionomer cements. The basic advantages highlighted were that the material would bond chemically to the pulp space walls with a high degree of reliability. The introduction of light cured Glass ionomers by Antonucci and his co-workers in 1988 and its further development into a commercially viable cement by Mitra in 1989 was a progressive step in the direction of combining the advantage of composite and Glass ionomer<sup>2</sup>. When dual cured glass ionomers are used as pulp space sealants, one should remember that these cements do chemically set even in the absence of visible light activation and hence one may think of difficulties of using a light cure system to focus through the pulp space system. The introduction of polyacid modified composite resin was a further step in improving certain deficiencies of both glass ionomers and composite resin.

In the present study we have attempted to utilize non conventional sealants including ketac endo, Fuji III, C, Resin modified glass ionomer, Dyract A P, a polyacid modified composite resin thinned out with primer supplied, Zinc oxide eugenol as a control. To simulate the clinical condition all canals were treated with Ethylene di-amine tetra acetic acid (EDTA) and sodium hypochlorite as standard irrigation regimen.

The aim of the present study was to investigate the quantitative apical microleakage observed with non conventional sealants in comparison with Zinc oxide eugenol.

**MATERIALS AND METHOD**

Twenty four distal roots of mandibular first and second molars were selected and stored in deionized water with thymol. The crowns of the teeth were removed to the level of cemento-enamel junction with a thin diamond wheel on a straight slow speed hand.

In the four experimental groups the canals were instrumented upto number forty Hedstrom file to the working length, then four files larger, each with a working length of one, two, three and four millimeter respectively short of the working length to flare the canal. Coronal flaring was done using No: 1,2,3 Gates Glidden drills (Mani, U.S.A). During cleaning process, copious amounts of 2.5% sodium hypochlorite (Novo, India) and normal saline (Parental drugs, India) along with EDTA (File EZE, Ultradent products, Inc) was used to irrigate the canals between changes in file size. The following sealers were used in each of the groups.

Group 1 Ketac endo (3M ESPE, Australia)

Group 2 Light cured Glass ionomer (GC corporation, Tokyo, Japan)

Group 3 Dyract AP thinned out with prime and bond 2.2 (Dentsply, Asia)

Group 4 Zinc oxide eugenol (Deepak enterprises, India)

After the obturation was completed, the samples were coated with nail polish all over the root surface except 2mm around the apical foramen. 2ml of 2% methylene blue was taken in twenty four vials and the apical third of the root was suspended in the dye for 72 hours.

The teeth were then removed from the dye, cleaned and placed in 20ml of 35% nitric acid solution each for 72 hours. Simultaneously 1%, 0.55%, 0.2%, 0.05%, 0.02%, 0.01% of methylene blue in 35% nitric acid were made and stored for 72 hours as standard solutions.

The solutions were filtered and centrifuged for one minute after 72 hours and the supernatant were subjected to spectrophotometric analysis using a filter of 670nm. The amount of leakage was extrapolated from the standard linear regression curve constructed from stock standard methylene

blue dye solutions. The results were subjected to statistical analysis.

**RESULTS**

Spectrophotometric analysis to quantitatively analyse the amount of dye leakage with Ketac endo, light cured glass ionomer, DyractAP thinned out with prime and bond 2.1 as sealer in comparison with Zinc oxide eugenol sealer.

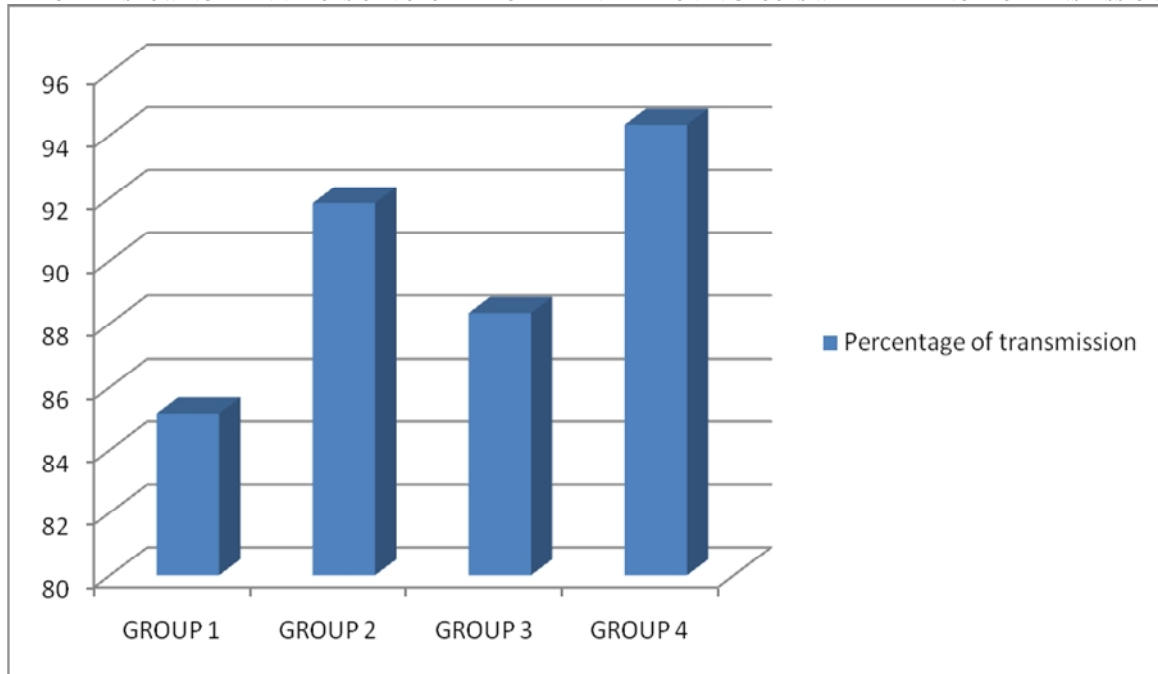
**TABLE 1: MEAN AND STANDARD DEVIATION VALUES OF VOLUMETRIC DYE PENETRATION IN GROUPS WITH REFERENCE TO TRANSMISSION.**

GROUP	TRANSMISSION(%)	
	MEAN	STANDARD DEVIATION
I	85.167	3.251
II	91.833	5.193
III	88.333	3.011
IV	94.333	3.933

**TABLE 11 INDICATES THE MANN- WHITNEY U TEST RESULTS OF DIFFERENT GROUPS WHEN COMPARED WITH EACH OTHER.**

GROUP	Z	TRANSMISSION	
		VALUE OF SIGNIFICANCE	SIGNIFICANCE
I V/S II	Z = 2.093	P=0.036	Significant
I V/S III	Z= 1.537	P >0.05	Not significant
I V/S IV	Z=2.656	P=0.0079	Highly significant
II V/S III	Z=1.051	P>0.05	Not significant
II V/S IV	Z=1.054	P>0.05	Not significant
III V/S IV	Z=2.258	P>0.05	Significant

**BAR CHART SHOWING MEAN VALUES OF VOLUMETRIC DYE PENETRATION IN GROUPS WITH REFERENCE TO TRANSMISSION.**



**DISCUSSION**

In the present study, we have utilized four different sealers- Ketac endo, Fuji II L.C, Dyract AP thinned out with prime and bond 2.1, Zinc oxide eugenol and spectrophotometric analysis was carried to quantitatively analyse the amount of apical dye leakage.

Spectrophotometric analysis is shown to be a reliable and effective method for quantitatively measuring apical dye leakage. The methodology of using Spectrophotometric analysis to measure leakage have been described by several researchers in the previous studies<sup>3</sup>

Methodology include optimum wavelength 670 n.m, 72 hours for dye leakage to take place and 20ml of 35% nitric acid was used to dissolve the teeth. Even though there is a high co-relation between linear and volumetric measurements, volumetric method has advantage when compared to linear method. The linear measurement does not

allow for differentiation in density of leakage, it provides only a 2-dimensional view of a 3- dimensional body. It does not amount for the leakage that penetrates laterally into the dentinal tubules unlike the volumetric method<sup>3</sup>.

Cohen and Burns<sup>4</sup> stated that it is very significant that materials used to obturate the pulp space possess good sealing properties. They further stated an inadequate seal at the apex accounts for 60% failures of pulp space therapy.

Pittford<sup>5</sup> recommended a material in paste form in conjunction with the single or multiple gutta percha points. Many pulp space sealants based on mixtures of zinc oxide eugenol are in clinical use since the time of Grossman.

Siriporn Timpawat<sup>6</sup> stated from the conclusion of their study that there was no clear difference between using a zinc oxide eugenol sealer and ketac endo with or without the smear layer. However in our present study we have utilized sodium hypochlorite and EDTA combination for effective removal of

smear layer from the pulp space, observed that maximum leakage was seen with Ketac endo, a chemically cured glass ionomer cement and there was a highly significant result when compared with zinc oxide eugenol group.

Goldberg<sup>7</sup> while comparing the sealing capacity of zinc oxide eugenol group with that of glass ionomer cement after treatment of the canals found similar results with or without the smear layer in agreement with the study of Siriporn Timpawat<sup>6</sup>

Gencoglu N<sup>8</sup> observed that removing the smear layer enhances the adhering of gutta percha. These observations were based on studies when only the coronal and middle third of the canal were cleaned of the smear layer and the effect of adaptation might be poor in apical areas where there might be some intact smear layer. The present quantitative study indicated maximum transmission with zinc oxide eugenol cement and least with ketac endo indicating least leakage with zinc oxide eugenol and maximum with ketac endo. Fuji II L.C did not yield statistically significant results in comparison with zinc oxide eugenol when tested under Mann Whitney U test. The leakage values were minimum but next to zinc oxide eugenol group.

Al Ajan A.D.K<sup>9</sup> were disappointed to find that a highly promising material like ketac endo did not offer advantage over the traditionally used zinc oxide eugenol. This is in agreement with the findings in the present study.

R.Holland<sup>10</sup> observed statistically significantly less leakage when the root canals were treated with EDTA before filling with ketac endo. However in the present study as a standard regimen in all groups we utilized EDTA and sodium hypochlorite before utilizing a sealer.

Leakage value studies may be affected by many different parameters especially when a sealant in the form of dyract AP has been utilized with no set standard method of mixing with a specific liquid to obtain a paste form.

W.P.Saunders<sup>11</sup> carried out a pilot study using glass ionomer as a root canal sealer. They utilized a resin based glass ionomer as an experimental sealant. Their results demonstrated that the removal of smear layer allowed the sealer to enter some of the dentinal tubules and that there was a good adaptation of the sealer. They concluded from their study that a resin based glass ionomer sealer may have a potential as a root canal sealer. The results of our in-vitro investigation revealed that resin modified glass ionomer, Fuji II L.C when used as a sealant yielded almost the same values or very close to leakage values observed with conventional zinc oxide eugenol. Statistical comparison between group II and IV was not significant. There are several in-vitro studies available with ketac endo, a conventional glass ionomer cement with zinc oxide eugenol and results are not very encouraging.

The sealers with the widest use today are zinc oxide eugenol based sealers. Zinc oxide eugenol sealants have remained to stay for the last decades by providing an acceptable apical seal but still do not fulfill all the ideal characteristics advocated for endodontic sealer. Hence the practicing endodontist and academicians have been looking out for an alternative sealant. The pursuit of new and improved endodontic sealers, producing materials of varying combinations of most desirable properties. The resin modified glass ionomer has been recommended because they also have a feature of dual cured facility with all the advantages of glass ionomers. Dyract A.P. which yielded almost the same or close leakage values of group I, ketac endo, with standard techniques could prove to be an alternative to either zinc oxide eugenol or resin based glass ionomer.

#### CONCLUSION

In the present study, spectrophotometric analysis was carried out to quantitatively analyse the amount of dye leakage with four sealers, zinc oxide eugenol, ketac endo, light cured glass ionomer, dyract A.P thinned out with prime and bond 2.1. Zinc oxide eugenol indicated maximum transmission and least with ketac endo, indicating least leakage with zinc oxide eugenol and maximum with ketac endo.

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