



## EFFECT OF RCPREP, PHYTIC ACID, ETIDRONATE ON DENTINAL DEFECT FORMATION DURING ROOT CANAL PREPARATION USING SCANNING ELECTRON MICROSCOPY

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### ABSTRACT

**Aim:** To analyze the effect of RcPrep, phytic acid, and etidronate on dentinal defect formation during root canal preparation, a scanning electron microscopic study.

**Materials and Methods:** Twenty samples of extracted single-rooted mandibular premolar teeth were decoronated at cemento-enamel junction. Samples were grouped into 5 groups, Control Group (5% sodium hypochlorite and distilled water), GROUP A (5% sodium hypochlorite and 1% phytic acid), GROUP B (5% sodium hypochlorite and etidronate), Group C (5% sodium hypochlorite and RcPrep). Biomechanical preparation of all the samples was done using Dentsply Protaper files (S1, S2, F1, F2, F3) with irrigation using respective irrigants mentioned in the respective groups.

All the specimens were subjected for scanning electron microscopy for detection of dentinal defect formation in each group.

**Result:** Irrigation with 5% NaOCl + 1% Phytic acid caused the maximum dentinal defect formation in root dentin while irrigation with 5% NaOCl + Distilled water caused minimum dentinal defect formation.

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## INTRODUCTION

The goal of endodontic therapy is to obtain a proper cleaning and shaping, microbial control and complete obturation of the canal space.<sup>2</sup> An amorphous irregular layer known as the smear layer covers the instrumented walls during cleaning and shaping. Smear layer consists of organic and inorganic substances such as microbial debris, odontoblastic process, and necrotic debris.<sup>12</sup>

Endodontic Irrigation is believed to be the most common method to remove microorganism and their by-products.<sup>13</sup> Sodium hypochlorite is the most commonly used irrigant and is only capable of removing organic part of smear layer, whereas inorganic layer is removed using decalcifying agents such as phytic acid, etidronate or chelating agent such as EDTA.<sup>4</sup>

Chelating agents along with the NiTi files during cleaning and shaping induce dentinal micro cracks and various other dentinal defects by altering the chemical composition of dentin.<sup>10</sup> Any change in the Calcium and phosphate ratio will affect microhardness, permeability, solubility characteristics of dentin as well as adhesion of dental

materials and sealing ability such as resin-based cement and root canal sealers to dentin.<sup>5</sup>

Etidronic acid also known as hydroxy ethylidene bisphosphonate (HEBP), a substance that prevents bone resorption and is used systemically in patients suffering from osteoporosis and Paget's disease<sup>6</sup>.

HEBP is a weak chelating agent that attacks less dentin surface than other commonly used chelators, such as EDTA, but the HEBP solutions need 5 min to completely remove the smear layer. It is considered the unique chelator that can be mixed with NaOCl without interfering with its antimicrobial property<sup>8</sup>.

Phytic acid also is known as inositol hexakisphosphate (IP6), is the major storage form of phosphorus in plant seeds and bran that contributes in a variety of cellular functions. It is also present in mammalian cells, with a concentration ranging from 10 to 100 mmol/L.<sup>9</sup> IP6 can be extracted from rice bran. It has multiple negative charges which make it an effective chelator of multivalent cations such as calcium (Ca<sup>2+</sup>), magnesium, and iron.<sup>16</sup>

IP6 has proved to be effective in removing the smear layer from NaOCl-treated flat coronal dentin surfaces and instrumented root canals. IP6 is highly negatively charged molecule that has an affinity to Ca<sup>2+</sup>. On root canal surfaces,

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the effect of both IP6 and EDTA in cleaning the apical third was less than that in the middle third, and this is attributed to the anatomy of the former region. The pH of 1% IP6 solution was around 1.2, and this acidity contributed to better Ca<sup>2+</sup> extraction. Thus, both the acidity and chelate function of IP6 made it an effective smear layer removal agent<sup>8</sup>.

RC-Prep is a chemo-mechanical preparation for root canals that uses a unique formation of glycol, urea peroxide, and EDTA in a special water-soluble base to help remove calcifications and lubricate canals to permit more efficient instrumentation.

Therefore, the present study has been undertaken to evaluate the effect of different irrigation regimens on dentinal defect formation.

## MATERIALS AND METHOD

Twenty single-rooted mandibular premolars were collected and were stored for 2 weeks in 10% formalin and then in normal saline until use. The premolars were decoronated at the cementoenamel junction using a diamond disc under copious water irrigation followed by cleaning and shaping of samples using Protaper files (S1 to F3)<sup>10</sup> along with irrigation with various irrigating solutions like phytic acid, etidronate and a chelating agent Rc Prep.

### Preparation of irrigant

9% etidronate prepared by adding 9 ml of etidronate liquid into 100 ml of distilled water and 1% phytic acid is prepared by adding 1 ml of phytic acid liquid into 100ml of distilled water.<sup>14,8,16</sup>

### The treatment groups were as follows

- Group A: 5% NaOCl for 5 min- distilled water.
- Group B: 5% NaOCl for 5 min- 1% phytic acid for 5 min
- Group C: 5% NaOCl for 5 min- 9% etidronate for 5 min
- Group D: 5% NaOCl for 5 min- Rc Prep.

All the specimens were irrigated using 5% NaOCl for 5 mins followed by irrigation using

- 5ml of distilled water for 5 min (control group).
- 5ml of 1% phytic acid for 5min (group B)
- 5ml of 9% etidronate for 5min (group C)
- Rc Prep was introduced into the respective samples using a 2 ml syringe.

All the samples were sectioned buccolingually one sample from each pair is selected randomly.

All the samples were stored until further examination under SEM for the detection of dentinal defects (ARM LAB, India).

### Statistical Analysis

Comparison of dentinal defect formation using etidronate, phytic acid, and Rc Prep was done using two-way analysis of variance (ANOVA) by using the tested irrigants and dilutions. In case of significance, statistical analyses were performed by Tukey multiple comparison tests ( $\alpha = 0.05$ )

- Effect one way ANOVA test.
- p-value < 0.05 was considered as significant.



Fig 1 Decoronated premolar



Fig 2 Cleaning and shaping up to F3 file

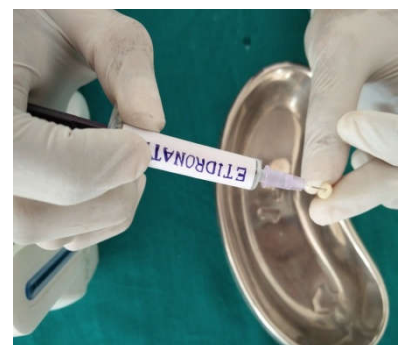
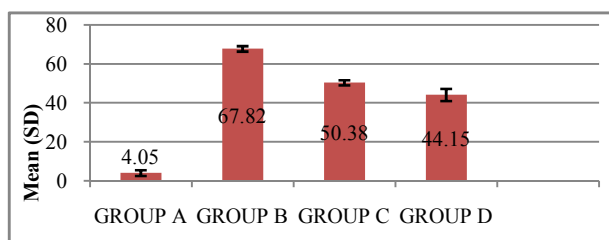


Fig 3 All samples are irrigated using respective irrigant in the group

## RESULT

The mean dentinal defect formation and its standard deviation along with intergroup comparison were calculated by ANOVA test



In this study, the control group that is NaOCl + distilled water ( $4.05 \pm 1.06$ ) and NaOCl + Rc Prep ( $44.15 \pm 1.89$ ) are least followed by the group with phytic acid ( $67.82 \pm 1.35$ ), etidronic acid ( $50.38 \pm 1.25$ ). There was a statistically significant difference between all groups.  $F = 729.902$  and  $P < 0.05$

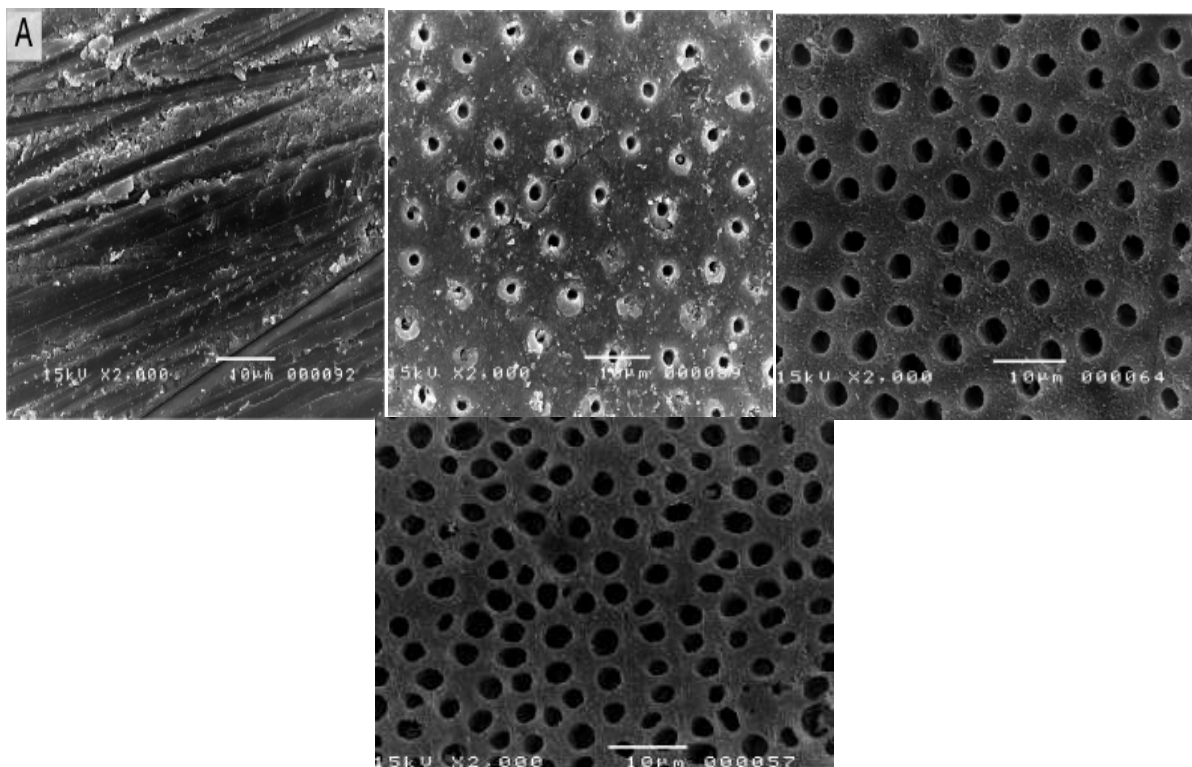


Fig 4 Scanning electron microscopic view 15 kV x 2.000 10µm

## DISCUSSION

Dentin is composed of organic and inorganic components, in which calcium and phosphorus are distributed in the form of hydroxyapatite crystals. The Ca/P ratio in hydroxyapatite is approximately 1.67 and it depends on many factors such as level of mineralization, type of crystals, an age of tissue and anatomical site.<sup>15</sup>

During biomechanical preparation of root canal, a smear layer formed on the root dentin. A good irrigant should remove both organic and inorganic part of the smear layer.<sup>4</sup> However, reports have been indicated that the use of EDTA and NaOCl was unable to reduce the stress to a limit that prevents or reduces dentinal defects.<sup>5</sup>

A study conducted by Zhang *et al.* (2010) concluded that showed that NaOCl may have a deleterious effect on dentinal walls as it leads to increased ratio of apatite crystals to collagen making dentin more brittle and cause more dentinal defects<sup>17</sup>. Similar study conducted by Vineeta Nikhil *et al* (2016) showed 17% EDTA reduced the dentin microhardness more significantly than 1% phytic acid and 0.2% chitosan.<sup>14</sup> Hemant Kumar *et al* (2016) conducted a study on calcium of root dentin using etidronic acid, BioPure MTAD, and SmearClear, it showed calcium loss is around  $16.36 \pm 0.27 \mu\text{g/ml}$  for etidronic acid which is similar to that of SmearClear<sup>7</sup>. This finding shows that microhardness depends upon the chemical composition of radicular dentin, particularly any alteration in the calcium phosphate ratio.

Lottanti *et al.* (2009) where NaOCl and distilled water hardly eluted any Ca in the control group, no chelating agent was used but still some calcium loss was seen as a result of its mechanical flushing action on smear layer formed on root dentin. Since chelating agents cause demineralization of

Hemant Kumar *et al* (2016) concluded that the chelating efficiency of 18% HEBP was found better than 9% HEBP because of higher concentration. A less aggressive calcium complexing agent such as 7-10% HEBP could be administered during the whole course of root canal preparation to prevent erosive dentinal changes.<sup>7</sup>

In our study, we found that more dentinal defect formation is seen in Group B (1% phytic acid) followed by etidronate and RcPrep.

With maximum dentinal defect formation with phytic acid (67.82 ppm), may result in maximum loss of microhardness followed by etidronate (34.15ppm) and Rc Prep (44.15).

## CONCLUSION

- In this study, all the solutions caused dentinal defects with 1% phytic acid causing the maximum. Irrigation with 5% NaOCl + 1% PHYTIC ACID caused maximum dentinal defects which adversely affects dentin microhardness around the apex mainly. On the contrary, 1% phytic acid caused maximum smear layer removal. Whereas irrigation with 5% NaOCl + Rc Prep caused minimum dentinal defect formation compared to 9% etidronate, but the smear layer removal capability of RcPrep and etidronate is inferior to 1% phytic acid.
- On the basis of this study, it is advised that a thorough irrigation regime of 5% NaOCl and Rc Prep repeated between each file sequence should eliminate the major portion of the smear layer with minimum dentinal defect formation thus obtaining the main goal of cleaning and shaping procedure.

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