

# Seal that Heals

Shiny Benjamin, Roshni, Shamina Pradhan, Mohan T Nainan

## ABSTRACT

**Introduction:** Dentinal hypersensitivity can be treated by dentinal tubule occlusion which prevents any stimuli from causing dentinal fluid movement. This *in vitro* study aims to compare the dentinal tubule occluding capability of four chemical compounds, a bonding agent, a compound of fluoride and hydroxyapatite, potassium oxalate gel and sodium fluoride varnish.

**Materials and methods:** Forty dentin samples were divided into four groups of 10 samples each. Group A (treated with Clearfil SE Bond), Group B (treated with Remin Pro), Group C (treated with Potassium Oxalate, Vi-sense,) and Group D (treated with Pro Fluoride varnish). The samples were treated with ethylene diamine tetraacetic acid (EDTA) gel prior to application of desensitizing agents to remove the smear layer and open the dentinal tubule orifice. Following the desensitizing treatment the specimens were washed and dehydrated using graded series of ethanol treatments (25, 50, 75, 90 and 100%). After each treatment tubule occlusion was analyzed by scanning electron microscope.

**Results:** Qualitative and quantitative analysis demonstrated potassium oxalate gel to cause maximum tubule occlusion followed by Remin Pro > Sodium fluoride varnish > Clearfil SE Bond.

**Conclusion:** Life expectancy is increasing and patients are retaining their natural teeth for a longer time due to effective treatment strategies. The results showed the potential use of these products as an effective means of tubule occlusion.

**Keywords:** Dentin hypersensitivity, Sodium fluoride, Remin Pro, Potassium oxalate, Bonding agent, Scanning Electron Microscope (SEM), Tubule occlusion, Dentin permeability.

**How to cite this article:** Benjamin S, Roshni, Pradhan S, Nainan MT. Seal that Heals. World J Dent 2012;3(3):243-246.

**Source of support:** Nil

**Conflict of interest:** None declared

## INTRODUCTION

Dentin hypersensitivity is associated with dentin exposure to oral environment as a consequence of loss of enamel or cementum. The pain is short and sharp<sup>1</sup> and can be explained by the hydrodynamic theory proposed by Brannstrom and Astron in 1964. Dentinal tubules exposed to the oral environment, when stimulated, allow the movement of dentinal fluid inside the tubules, indirectly stimulating the extremities of pulp nerves, causing pain.<sup>2</sup>

Desensitization by tubule occlusion using chemical compounds is a viable treatment modality for hypersensitivity.<sup>3,4</sup> The present study compared the tubule

occluding capability of a new compound Remin Pro with other clinically established desensitizers.

## MATERIALS AND METHODS

### Selection of Teeth

The study comprised of 40 dentin samples obtained from ten maxillary central incisors. The criteria for selection of teeth were:

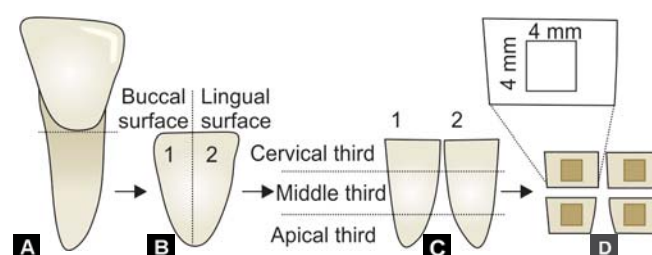
- Noncarious
- Without any cracks
- Free of attrition, erosion, radicular abrasion.

**Specimen preparation:** The extracted central incisors were cleaned free of debris and calculus and stored in 0.05% thymol solution. The specimens were prepared as depicted in Figures 1A to D and Flow chart 1. Specimens were divided into four treatment groups (Table 1).

### Scanning Electron Microscope

- Specimens coated with gold sputter were observed under scanning electron microscope (Quanta 200 FEI Netherlands) at 3000× magnification.
- The photomicrographs were analyzed qualitatively considering the dentin surface characteristics to evaluate the occlusion of dentinal tubules.
- Percentage of occluded tubules

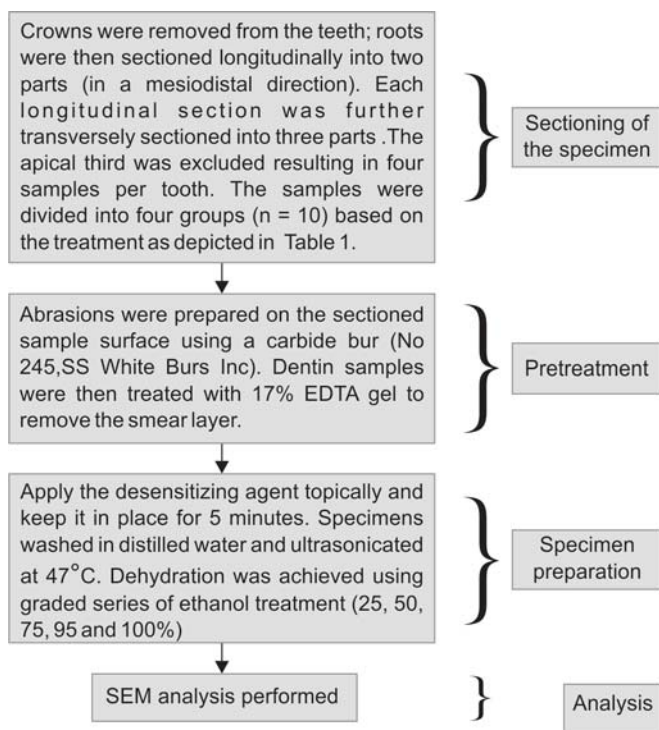
$$= \frac{\text{Total number of occluded tubules} \times 100}{\text{Total number of tubules}}$$



**Figs 1A to D:** Image representing the method of specimen preparation (reprinted with permission). Copyright 2009 by the Academy of General Dentistry<sup>2</sup>

**Table 1:** Treatment groups

Group A	Clearfil SE Bond
Group B	Remin Pro
Group C	Potassium oxalate gel
Group D	Pro fluoride varnish



Flow Chart 1: Specimen preparation

## RESULTS

Results were analyzed both qualitatively and quantitatively.

Qualitative analysis was done by analyzing the photomicrographs considering the dentin surface characteristics (Figs 2A to D).

*Group A (Clearfil SE Bond):* Shows partially obliterated dentinal tubules.

*Group B (Remin Pro):* The dentinal tubules are sealed to a great degree and the surface is visibly smooth.

*Group C (Potassium Oxalate):* Considerable number of small crystals scattered over the treated surface. Most of the dentinal tubules were obliterated.

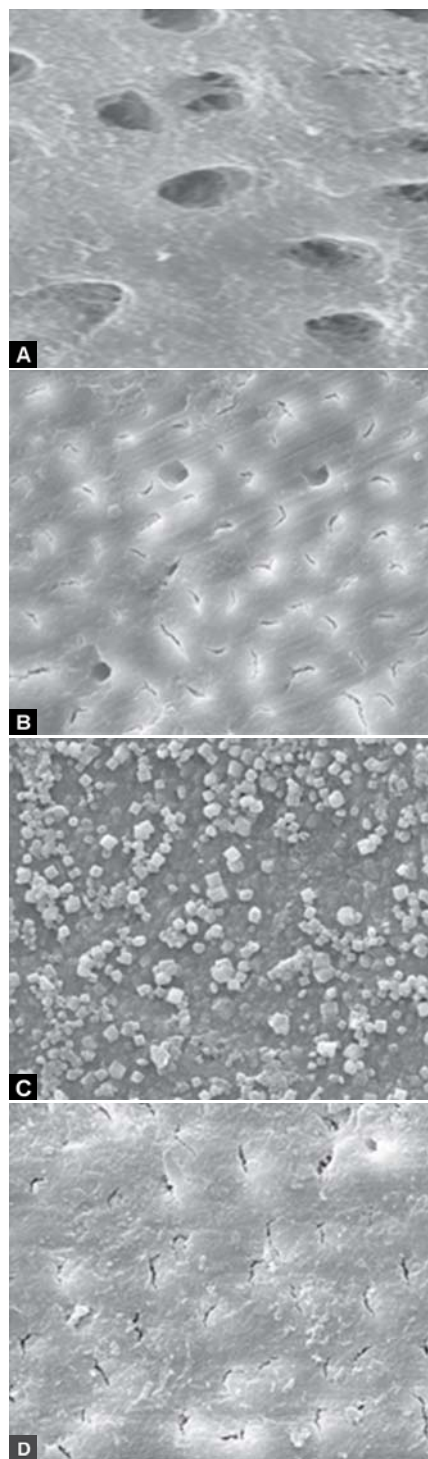
*Group D (Pro Fluoride varnish):* The diameter of the exposed dentinal tubule orifices was decreased. The dentin surface was uniformly occluded by the varnish.

## Quantitative Analysis

The mean values of the average number of occluded dentinal tubules in each of the treatment groups, as analyzed by the scanning electron images is depicted in Table 2.<sup>5</sup>

## DISCUSSION

Dentinal hypersensitivity can be effectively treated by dentinal tubule occlusion which reduces permeability and



Figs 2A to D: SEM photomicrographs (magnification 3000x): Group A: Clearfil SE bond, Group B: Remin Pro, Group C: Potassium oxalate gel, Group D: Pro fluoride varnish

Table 2: Average no. of occluded tubules per 100 dentinal tubules on the dentin surface

Groups	Mean(%)
Clearfil SE Bond	13.89
Remin Pro	57.09
Potassium oxalate	82.4
Pro fluoride varnish	57.04

prevents stimuli from causing dentinal fluid movement.<sup>3</sup> Desensitizing agents fill or change the tubule contents via the precipitation of proteins and calcium crystals at the aperture of, or inside the dentinal tubules.<sup>2</sup> Remin Pro is a new agent hoping to join the desensitizer family.

The samples were pretreated with EDTA to remove the smear layer and open the orifices of the dentin tubules<sup>6</sup> to facilitate better penetration of desensitizing agents. Samples were analyzed qualitatively using scanning electron microscopy because scanning electron microscopes have large depth of field, yielding a characteristic 3-D appearance useful for understanding the surface structure of a given sample.

Sealing of tubules with resins and adhesives have been advocated for many years. Adhesives effectively seal the dentinal tubules and act as a barrier against noxious stimuli. In general results have been good but the adhesive may break away resulting in exposure of the tubules.<sup>7-9</sup> This could prove to be a disadvantage.

Group A specimens (Clearfil SE Bond) show partially obliterated dentinal tubules.

In group B where specimens were treated with Remin Pro, the dentinal tubules were sealed to a great degree and the surface was visibly smooth. Remin Pro is a water-based cream that contains hydroxyapatite and fluoride. It has been recommended for the management of dentinal hypersensitivity, to prevent enamel demineralization and promote remineralization of enamel subsurface lesions. The results of the present study indicate that Remin Pro compares favorably with established desensitizing agents and may be a promising alternative.

Topical use of 3% potassium oxalate on exposed dentin after periodontal therapy reduces dentin hypersensitivity. The oxalate ions react with calcium ions in the dentinal fluid to form insoluble calcium oxalate crystals that block the tubules and prevent fluid movement, reducing sensitivity.<sup>4,9,10</sup> Potassium oxalate is effective, easy to apply, safe, relatively inexpensive and well-tolerated by patients. Hence, it was used in this study. In the present study, potassium oxalate demonstrated highest number of obliterated tubules with no smear layer. A considerable number of small crystals were seen scattered over the treated surface. However, the disadvantage of potassium oxalate is its potential toxicity. Professionals avoid its application for the treatment of generalized dentinal hypersensitivity as it may result in gastric irritation.<sup>1</sup>

Profluoride varnish samples in group D demonstrated decrease in the diameter of the exposed dentinal tubule orifices. The dentin surfaces were uniformly occluded by the varnish. 1 ml of Pro Fluoride varnish contains 50 mg of

sodium fluoride equivalent to 22.6 mg of fluoride. The application of fluoride seems to create a barrier by precipitation of calcium fluoride crystals which are formed in the inlet of dentinal tubules, blocking them. However, this precipitate dissolves in saliva overtime which may explain the transitory action of this barrier.<sup>3,11,12</sup>

## CONCLUSION

In the present study, the experimental product Remin Pro showed good tubule occlusion and hence maybe an effective desensitizer. But the longevity of its effectiveness needs to be determined and compared with other known and accepted desensitizers including bioactive glass lasers.<sup>13-19</sup> The study may be conducted *in vivo* to further validate the results of the present study.

## ACKNOWLEDGMENT

The authors thank the Indian Institute of Science, Bengaluru, for permitting the use of Scanning Electron Microscope. We are grateful to Mr Manoj Mullamangalam, Statistician for his help with statistical analysis. Thanks to our colleagues and family for their support.

## Manufacturers Names

- Clearfil SE Bond, Kuraray, Sakazu, Kurashiki, Okayama 710-0801, Japan
- Remin Pro, Voco, Germany
- Potassium Oxalate, Vi- sense, Vishal Dentocare Pvt. Ltd. Sahajanand Estate, Sarkhej, Ahmedabad, Gujarat, India
- Pro Fluoride Varnish, Voco, Germany.

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