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COMPARATIVE EVALUATION OF PROTECTIVE POTENTIAL OF TOOTHMIN AND NOVAMIN CONTAINING TOOTHPASTES ON ENAMEL SURFACE UNDER CONFOCAL MICROSCOPE: AN IN VITRO STUDY

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ABSTRACT

Aim: To evaluate the protective potential of calcium sucrose phosphate and novamin containing toothpaste on enamel surface. **Settings and Design:** *In vitro*- study. **Materials and Methods:** This study consisted of 30 samples embedded in orthodontic resin with either buccal or lingual surface exposed. The samples were assigned to either calcium sucrose phosphate containing paste; novamine toothpaste; or control group. The groups were then subjected to cycling in a demineralizing solution and a remineralizing solution. Groups II and III received prior application of calcium sucrose phosphate paste and novamine toothpaste respectively followed by cycling in a demineralizing solution and a remineralizing solution. Following 14 days of cycling, the samples were sectioned and examined using confocal microscopy. The depths of lesions were evaluated. **Statistical Analysis:** Image Proplus software was used to analyze the images. The values were statistically evaluated using one – way ANOVA and Scheffe's Test. **Results and Conclusion:** Within the limitations of study it was concluded that enamel surfaces treated with calcium sucrose phosphate paste exhibited the least lesion depths followed by enamel surfaces treated with the novamin tooth paste and control group respectively.

Keywords: Caries, Calcium-sucrose Phosphate, Novamin.

INTRODUCTION

Dental caries is an infectious microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified tissues. The largest increase in prevalence of caries has been associated with dietary changes. The largest increase in prevalence of caries has been associated with dietary changes.[1] Caries process is dependent upon interaction of protective and pathologic factors in saliva and plaque biofilm as well as the balance between cariogenic and noncariogenic microbial populations that reside in saliva. High fluoride strategy cannot be followed in most of instances to avoid potential for adverse effects due to overexposure to fluoride.

Therefore, there is great scope of new agents that can be used with fluoride to enhance anti-caries activity.[2] Toothmin tooth cream, a newly introduced remineralizing agent is based on Anticay Technology. This unique technology has been commersialized by Biodental Remin, an Australia based biotechnology

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company.[3] Novamin is the trade name for calcium sodium phopshosilicate bioactive glass that has been developed for use in oral health care.[4] This article will focus on the mechanisms of action of both these agents and present the results from an in vitro study that demonstrates the potential of these materials in areas of caries prevention.

AIMS AND OBJECTIVE

- To determine whether enamel samples treated with toothmin and novamin containing paste can resist acidic challenge in vitro when measured with confocal microscopy.
- To determine whether there is significant difference in lesion depth between untreated enamel surfaces and enamel surfaces treated with toothmin and novamin.

MATERIALS AND METHODS

Thirty extracted human premolars without enamel defects or decalcification were used in this study. Roots were sectioned at the cementoenamel junction and crowns were sectioned into buccal and lingual halves using high speed water-cooled hand piece and carborundum disc. The crowns were placed in a glass container with deionized water. Tooth crown samples were embedded in orthodontic acrylic with the buccal or lingual surface exposed. A 2×2 mm window of exposed enamel was created in middle of the sample surface by applying a uniform coat of nail varnish around it. Each mounted specimen was assigned to one of the three different experimental groups and it was stored in deionized water until further use.

Demineralizing solution used was:

- 1 mM (milliMolar) CaCl2 (Calcium chloride)
- 2.2 mM NaH2PO4 (Monosodium phosphate)
- 50 mM C2H402 (Acetic acid)

Remineralizing solution used was:

- 20 mM HEPES (4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid)
- 1.5 mM Ca2+ as CaCl2 (Calcium chloride)
- 0.9 mM phosphate as KH2PO4 (Monopotassium phosphate)
- 1 ppm Fluoride as NaF (Sodium Fluoride)

TREATMENT GROUPS

- Teeth in group I were placed in a demineralising solution with pH 4.46 for period of 8 hours and then removed and placed in artificial saliva for 1 hour. After 1 hour, the teeth were placed in a remineralizing solution with pH 7.00 for the balance of 24 hours (15 hours). This cycling continued for 14 days.
- Novamine tooth paste was applied to exposed enamel surface of teeth in group III with a rubber glove and allowed to sit for 5 min. The specimens in this group were further treated similar to group I.
- Toothmin was applied to exposed enamel surface of teeth in group II with rubber glove, according to the manufacturer's directions, and allowed to sit for a period of 5 min. The specimens in this group were further treated similar to group I.

Carborundum disc was used to section the samples in a buccolingual direction to obtain samples of ~200 μm thickness. 0.1 mM of rhodamine B solution was prepared by adding 23.95 mg of rhodamine B dye to 500 ml of deionized water.

The sectioned specimens were stored in 0.1 mM rhodamine B for 24 h and then placed in deionized water until further use.

Rhodamine B from the solution incorporates in demineralized tooth structure and does not penetrate sound tooth structure or orthodontic resin.

USE OF CONFOCAL MICROSCOPY

A confocal laser scanning microscope was used at 10x magnification to view the images. HeNe 543 nm wavelength laser source was used with a rhodamine filter to excite rhodamine B dye. The images were analyzed using Image proplus software (Figure 1). One-way ANOVA and Scheffe's test were used to

analyze the data. Significance was established at P<0.05.

RESULTS

The mean lesion depth observed in the control group was 55 µm.

The mean lesion depth observed in the toothmin tooth paste-treated group was 21.88 µm.

The mean lesion depth observed in novamine tooth paste-treated group was 35 µm (Graph I).

DISCUSSION

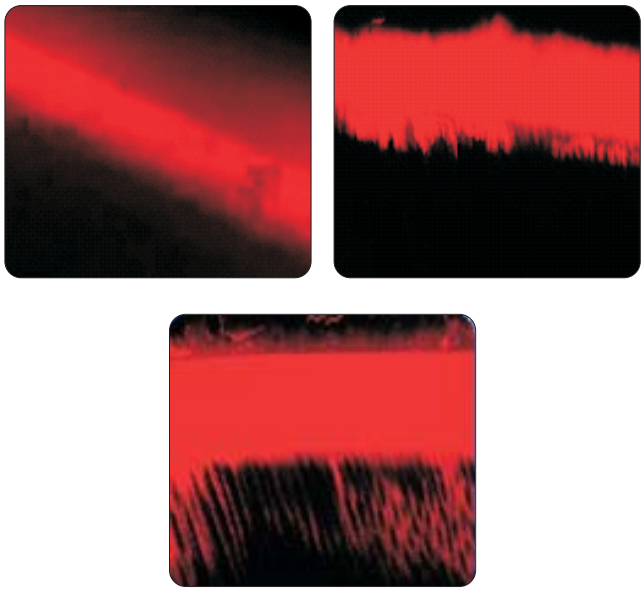
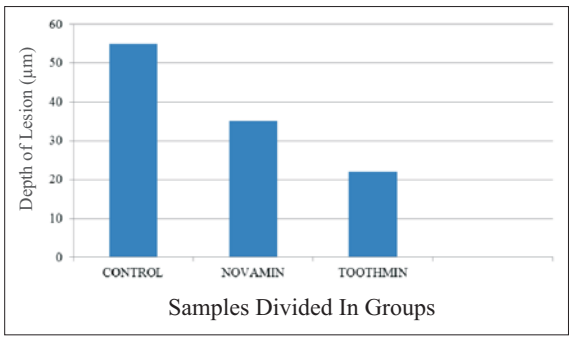


Figure 1: Confocal microscope images were analyzed using Image proplus software



Graph 1: Graph showing mean depth of lesion in various groups

Calcium sodium phosphosilicate is an inorganic compound that reacts in aqueous environments to release calcium, sodium, and phosphate ions over time. Originally developed as a bone regenerative material, this compound has been shown to be effective at physically occluding dentinal tubules through development of a hydroxyapatite-like mineral layer (Andersson and Kangasniemi, 1991; Hench and Andersson, 1993).[4,5] Clinical evaluations of NovaMin for the treatment of dentin hypersensitivity have shown statistically significant and clinically positive results (unpublished data from IRB-approved clinical trial at the University of Maryland, 1998; Du et al., 2008). The significant clinical treatment of hypersensitivity through formation of crystalline apatite led researchers to hypothesize that NovaMin could be useful in remineralization and prevention of demineralization of tooth structures, especially dentin.

While it is clear that commercially available fluoride dentifrices (1000-1500 ppm) have been very successful in reducing the incidence of juvenile coronal caries, it is also clear that root caries and erosion lesions are increasing at a significant rate (Fejerskov et al., 1993; Lussi and Schaffner, 2000).[7] Use of 5000-ppm fluoride compositions appears to be better at controlling root caries than standard fluoride compositions, although use of these products is not without some controversy (Lynch and Baysan, 2001).[8] Since fluoride requires a source of calcium to be effective in remineralization, and salivary insufficiency is a common issue in persons with root caries, an additional source of calcium, in combination with fluoride, could be beneficial in the treatment of root caries. Standard in vitro models have been established to predict the clinical efficacy of active ingredients in oral health care products.

The results of in vitro study presented here demonstrate that NovaMin, can enhance remineralization of enamel and dentin lesions, as well as prevent demineralization from acid challenges. In situ results of repair of surface lesions and abrasions with NovaMin

further demonstrate the mechanisms of action of the material and suggest potential of this material to repair tooth structures (both dentin and enamel).[9] If this technology is to be fully accepted, it is necessary to demonstrate the efficacy of calcium sodium phosphosilicate (NovaMin), both alone and in combination with fluoride, in prospective, randomized clinical trials, several of which are currently in progress.[10]

Toothmin tooth cream is a newly introduced remineralizing agent that is based on Anticay Technology.[3] This unique technology has been commercialised by Biodental Remin, an Australia based Biotechnology Company. Anticay is a mixture of calcium sucrose phosphates and inorganic calcium phosphates consisting of 10–12% calcium and 8–10% phosphorous by weight. Calcium sucrose phosphate decreases tooth enamel demineralization, inhibits plaque formation and promotes enamel remineralization. Its effective remineralizing action is because of its solubility in water providing high concentrations of free calcium and phosphate ions several times higher than normally present in saliva.[10] Anticay also acts as a complement to fluoride.[12]

CONCLUSION

According to our knowledge, this is the first study comparing remineralizing potential of Novamin versus Toothmin tooth cream. Our study has some limitations. First it is an in vitro study. Remineralization in the oral cavity is a complex procedure involving a change in pH and replenishment of calcium and phosphate elements. This may not be achieved in the in vitro conditions. We recommend further studies using these products in vivo conditions. Secondly, scanning electron microscopy of enamel surface might add more value to the results.

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