

*Evaluation of Potential Inhibition of
Enamel Demineralization by a
Fluoride Releasing Sealant*

Thesis

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Abbreviations

ACP	Amorphous calcium phosphate
ADA	American Dental Association
Ca	Calcium
EDI	Enamel decalcification index
FV	Fluoride varnish
JPEG	Joint Photographic Experts Group
mm	Millimeter
mV	Millie volt
NaF	Sodium fluoride
P	Phosphate
PER	Pre operative
ppm	Part per million
PS	Pro Seal
PTD	Probable toxic dose
QLF	Quantitative laser fluorescence
SnF₂	Stannous fluoride
TISAB	Total ionic strength adjustment buffer
USB	Universal Serial Bus
WSLI	White spot lesion index
WSLs	White spot lesions
μCT	Micron computer tomography
μm	Micron millimeter

Introduction

Dental caries is a disease of the hard tissues of the teeth that result from the interactions between cariogenic bacteria in dental plaque (such as *Streptococcus mutans*, *Streptococcus sobrinus* and *Lactobacillus*) and fermentable carbohydrates. This interaction leads to mineral loss from tooth structure and initiation of demineralization process. The earliest stage of this process is the formation of white spot lesions (WSLs) which is specially seen in orthodontic patients.⁽¹⁾

Worldwide, tooth decay is considered one of the most prevalent chronic diseases and continues to be a major public health problem affecting children and adults. The prevalence of caries for adults is declining in developed countries, increasing in less developed countries and is an epidemic in countries with emerging economies. However, challenges remain in controlling caries for young children.⁽²⁾⁽³⁾

The consequences of untreated dental caries negatively affect the oral health-related quality of life of children due to dental pain which lead to sleeping disturbances, diminished chewing ability and eventually delayed growth. In addition, psychosocial problems may develop due to impaired esthetic and speech problems. There are also important financial implications for this disease attributed to direct costs (such as high costs of dental treatment and more expensive complicated operations) and indirect costs (parents need to leave their work for commitment to dental visits).⁽⁴⁾

For many decades, prevention of dental decay was achieved by adequate self-care and healthy lifestyle habits as well as with the aids of professionally applied preventive products. Fluoride varnishes have gained popularity because they are easy to use and do not depend on patient cooperation. In addition, since fluoride varnishes adhere to the tooth surface they enhance fluoride release for a long period of time. It also has the ability to reverse early enamel lesions by enhancing remineralization process. ⁽⁵⁾

Lately, a new fluoride releasing material called Pro Seal was introduced to save time for patient and dentist. This may be achieved by decreasing the number of visits that are needed for re-application of fluoride varnish. It also deals with white spot lesions. It is a light cured sealant with 100% polymerization which completely sets without an oxygen inhibited layer allowing for a smooth and hard coating on enamel surface. ⁽⁶⁾

Accordingly the overall goal of the current study was to evaluate the efficacy of a fluoride releasing sealant (Pro Seal) in reducing enamel demineralization and to investigate its fluoride release and recharging abilities.

Review of Literature

Development of caries

Dental caries is a multi factorial disease. It involves the interaction of diet, dental plaque and host factors such as tooth morphology, saliva and the acquired pellicle.⁽⁷⁾ Risk factors for development of dental caries include high levels of cariogenic bacterial colonization, frequent exposure to dietary sugar and refined carbohydrates, low saliva flow rates, developmental defects of tooth enamel, lack of access to dental care, low community water fluoride levels and low socioeconomic status.⁽⁸⁾⁽⁹⁾ There are other factors which are related to children such as inappropriate bottle feeding, children with chronic systemic diseases (as bronchial asthma, diabetes, and cerebral palsy), low parental educational level and high maternal levels of cariogenic bacteria.⁽¹⁰⁾⁽¹¹⁾⁽¹²⁾

Demineralization of tooth minerals by organic acids is the first step of caries initiation. Plaque microorganisms produce organic acids when fermentable carbohydrates are present. This interaction results in pH drop and then complex chemical and physical processes are initiated. At resting pH levels, plaque fluid is supersaturated with calcium phosphate while when the pH falls, this level of saturation is changed. At critical pH (approximately 5.5), demineralization begins and the organic acids diffused out to the enamel surface through the acquired pellicle. This will lead to dissolution of dicalcium-phosphate-dihydrate and fluoridated-hydroxyapatite and then