Mineral Content Removal after Papacarie Application in Primary Teeth: A Quantitative Analysis

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*The **aim** of this study was to quantify the mineral content removed from primary teeth after using a chemomechanical system, called Papacarie®. **Materials:** Twenty human primary extracted molars were divided into two groups of 10 specimens each. Group A presented sound molars and Group B decayed molars on the occlusal or occlusal-proximal surface. In Group A, cavities in enamel and dentin with high speed drills were made before treatment. All teeth were treated with Papacárie® following the manufacturer's instructions. Each cavity was filled in with the product, allowing curing for 45 seconds, and then removed with the non-cutting edge of the curette. The collected material was sent for laboratory analysis using atomic absorption spectrophotometry technique. Medians for each group were calculated through the application of Mann-Whitney and a statistically significant difference (p <0005) was observed. To verify the quantity of calcium removed from sound tissue, the median of calcium in group A (0.08% Ca) was compared with that of the gold standard (0.04% Ca), which showed a close correlation of values between them. **Results** indicate that the amount of calcium removed with Papacárie® affects only the carious component of teeth. This goes in accordance with the principles of cavity preparation and follows the current philosophy of preventive dentistry.*
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INTRODUCTION

Dental caries is an infectious and contagious disease that determines the localized destruction of mineralized tissues, through the metabolism of fermentable carbohydrates from the diet, by acid byproduct bacteria. The demineralization of dentin and denaturing of collagen occurs with the advancement of the process.[1]

This demineralized organic matrix makes collagen and other components more susceptible to degradation by enzymes, especially bacterial proteases and hydrolases.[2]

Dentinal carious lesions consist of at least two layers which differ in their microscopic structure as well as in their biochemical, physiological, and bacteriological characteristics. Color and hardness have been used for its clinical assessment and differentiation.[3]

The very superficial infected layer is soft, highly contaminated by bacteria penetration, has no sensitivity and cannot be repaired due to irreversible denaturation of collagen fibers. Below the infected layer is the contaminated dentin, which is a hard substance, has few bacteria, and is able to regenerate.[4]

Thus, it becomes clear that an effective system for caries removal should identify those layers, removing only the infected outer layer of carious dentin, characterized by irreversible changes and bacteria invasion.[5]

Traditionally, carious lesion removal is performed with cutting curettes and high and low speed dental drills. However, new methods for caries removal are currently being used, such as laser, air abrasion, and chemomechanical removal, which attempt to decrease pain, reduce sound tissue removal, as well as eliminate other disadvantages of con-

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ventional techniques such as fear, noise, discomfort, and use of anesthesia.[6]

The products used for chemical and mechanical dental caries removal are based on a solution that interacts directly with the pre-degraded collagen of the lesion, and then, the softened carious tissue is easily removed with the use of non-cutting hand tools.[7]

The first studies on dental caries chemomechanical removal were carried out by Habib, Kronman, and Goldman, in the 1970s, using a 5% sodium hypochlorite solution, which removed the carious dentin once it was applied onto it.[2]

However, sodium hypochlorite alone was aggressive to sound tissue, which encouraged the addition of a buffer solution (sodium hydroxide, sodium chloride, and glycine), generating a new formula (GK101), in which glycine was later replaced by aminobutyric acid to improve the reaction speed. From that formula, the first commercially available system emerged under the name of Caridex™.[8]

Caridex™ disrupted the collagen of carious dentin, facilitating its removal; however, it presented disadvantages such as slow process (10 to 15 minutes) and the need for large and expensive equipment to heat it up, so it was withdrawn from the market in the early 1990s.[9]

In 1998, Carisolv™ system emerged in Sweden, aiming to remove caries with maximum preservation of sound dental tissue. The most important difference was the use of three amino acids (glutamic acid, leucine, and lysine) to neutralize the aggressive effect of sodium hypochlorite on sound oral tissues. However, it requires the purchase of specific instruments, which increases costs and prevents its application in large scale.

Studies on papain, an enzyme extracted from papaya peels, were performed with the intention to globalize the use of the technique, mainly in public health arena.[10] Based on these studies, Bussadori *et al* (2005)[6] developed a new formula called Papacarie®.

Papacarie® is a biomaterial composed of papain, chloramine, and toluidine blue. Papain is an endoprotein with bacteriostatic, bactericidal, and anti-inflammatory activity, besides being a proteolytic enzyme that interacts with the partially degraded collagen of carious tissue. Papain makes the infected dentin softer, and allowing its removal with non-cutting instruments without local anesthesia and burs.[11]

The chemomechanical method for caries removal stands out among other alternative methods. The objective of chemomechanical caries removal is to eliminate the outer layer or infected dentin, leaving the affected layer or partly demineralized dentin, which can be remineralized and repaired.[12]

According Silva *et al,*[7] papain gel breaks the links between the collagen fibrils of carious dentin, leaving the sound dentin intact. It is not affected by the product because neither it is demineralized nor it has its collagen fibrils exposed.

The purpose of this study was to quantify the removed mineral content and examine whether there is sound tissue loss after the use of Papacarie®.

MATERIALS AND METHODS

To perform this study, the project was submitted to Ethics and Research Committee under the protocol 07.086.4.02.III. After written consent, 20 primary molars were used from the human teeth bank of the University of Southern Santa Catarina. They were divided into 2 groups in order to compare the quantity of calcium removed between them. Group A was composed of ten sound primary molars and Group B was composed of 10 primary molars with occlusal or proximal carious lesions.

Initially, a sample of Papacarie® gel was analyzed through atomic absorption spectrophotometry to determine the amount of calcium that the product contained (gold standard).

All teeth were stored in physiological serum and frozen at the time of the extraction. For the study, they were placed at room temperature and X- to confirm the presence or absence of lesions. The cavities were prepared into enamel-dentin junction with diamond burs with a high speed handpiece on the sound teeth of Group A.

In both groups, the teeth were treated with Papacarie®, according to the procedures recommended by the manufacturer. For that purpose, the cavity was filled in with Papacarie®, allowing the product to operate for 45 seconds. Then, the material was removed with the non-cutting edge of the curette, without washing the cavity between applications.

Group A sound teeth received three applications as a standard procedure to collect sufficient amount of gel for laboratory analysis.

Group B decayed teeth received gel applications repeatedly until a light unaltered color was obtained, since, according to the manufacturer, blurred color indicates that there is decomposition of carious tissue.

The collected material was dispensed individually, in sealed plastic tubes, and sent for laboratory analysis using atomic absorption spectrophotometry .

The analysis of the results was carried out using Mann-Whitney statistical test at 5% level of significance.

RESULTS

To verify the quantity of calcium removed from sound tissue, the median of calcium in group A (0.08% Ca) was compared with that of the gold standard (0.04% Ca), which showed a close correlation of values between them. The percentage of calcium in both Group A (sound teeth) and Group B (decayed teeth) could be observed through atomic absorption spectrophotometry technique, as shown in Figure 1.

The means in both groups resulted in a 0.08 mean for group A and 1.27 for group B. A statistically significant difference between groups was observed ($p < .0005$).

DISCUSSION

In the present study a statistically significant difference in

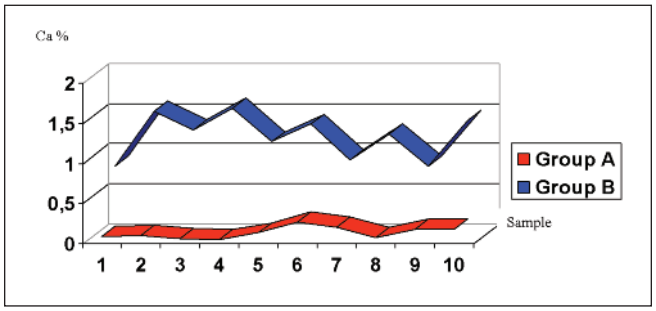

Figure 1. Percentage of calcium (Ca) removed from teeth in groups A and B, after the application of Papacárie®.

the percentage of calcium was found between groups A and B, indicating that the amount of calcium removed with papacarie only affected the carious portion of teeth. This result can be interpreted because in Group A there was only calcium from sound tissue and in Group B calcium from the damaged dentin.[14] This is in accordance with Corrêa *et al* [5] (2007) who showed that chemical and mechanical carious tissue removal is based on the application of a solution that interacts directly with the pre-degraded collagen in carious dentin, softening the tissue, removing calcium with a non-cutting hand instrument.[5] This result shows that the technique preserves healthy dental structure which is not the case with the use of high speed handpieces.

The statistically significant difference between the groups can be understood because papain is an enzyme that contributes to the degradation and elimination of fibrin network formed by carious process. According Flindt,[13] papain acts only upon injured tissues due to the absence of plasma antiprotease, a1-antitrypsin, which prevents its proteolytic activity upon normal tissues. Other components of Papacarie®, such as chloramine, composed of chlorine and ammonium, is used to soften chemically the carious dentin, while toluidine blue dye is used to act as an antimicrobial agent on oral microorganisms.[1] Currently, Papacarie® gel contains 10% papain and 0.5% chloramine-T .[14]

Considering that prevention is one of the major concerns in contemporary dentistry, preserving healthy tooth structure is a goal. Papacarie® gel removes only irreversibly damaged dental tissue, with maximum preservation of sound tissue (gold standard. The action of 1-anti-trypsin prevents proteolytic action of papain on healthy tissue.[14] Udod and Storojuk (1981)[10] have been using 0.2% papain solution in patients with purulent skin wounds in various parts of the body and have concluded that papain facilitates the clearing of necrotic tissue and secretions, reducing the wound-healing period, and preserving healthy tissue around the lesion. An *in vivo* and *in vitro* study of changes in sound dentin, found that Carisolv™ destroys cellular components of odontoblastic processes, but not the collagen fibers in sound teeth.[8]

From this, it can be proposed that for better preservation of dental tissue, removal of only carious tissue, coupled with an antibacterial material, results in significant reduction and/or total inactivation of microorganisms in the remaining dentin, without the risk of sound dental structure.[13]

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

A statistically significant difference in the percentage of calcium was shown from the comparison between groups A and B, which reveals that a larger amount of calcium was removed after the use of Papacarie®.

Papacarie® is a selective material to remove carious lesions and the quantity of mineral content removed from sound tissue(gold standard) is in accordance with the principles of cavity preparation, following the current philosophy of preventive dentistry.

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