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Article · July 2018

DOI: 10.17921/2447-8938.2018v20n2p87-93

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Use of BRIX-3000 Enzymatic Gel in Mechanical Chemical Removal of Caries: Clinical Case Report

Utilização do Gel Enzimático BRIX-3000 na Remoção Químico Mecânica da Cárie: Relato de Caso Clínico

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Received: January 18, 2018

Approved: March 27, 2018

Abstract

Less traumatic alternative methods for removal of decayed tissue has been developed. A non-invasive technique, which consists of applying a proteolytic substance that softens the infected dentin tissue and preserves healthy tooth tissue was released in the market. Thus, this work intended to describe a clinical case of caries removal using BRIX-3000 papaine-based enzymatic gel. A 6-year-old male patient attend to a University Dental Clinic complaining of painful sensitivity during mastication. After examination, acute deep carious lesion was found in dental elements 64 and 65. The caries removal procedure was performed for both teeth without anesthesia, under relative isolation, following the principles of atraumatic restorative treatment - ART. The gel was taken into the cavity and leaved to act for 2 minutes and the infected tissue was excavated. Caries lesion was then detected below the OM cusp with undercut enamel, needing to enlarge the cavity in the occlusal region with rotating cutting instruments and reapply the gel. After the second application, all the infected tissue had been removed and the teeth restoration with chemical ionomer cement was performed. At the end of the treatment, the discomfort during the performed procedure was asked to the patient using the Wong-Baker Face Scale. The child pointed to score 1, indicating mild pain for both treatments. It can be concluded that the use of enzymatic papaine gel-based was an efficient alternative for caries removal, easy to use, and preserve to the maximum the dental structure healthy, showing promise to be used as atraumatic caries removal technique.

Keywords: Dental Caries. Papain. Pediatric Dentistry.

Resumo

Métodos alternativos menos traumáticos para remoção de cárie vem sendo desenvolvidos. Uma técnica não invasiva, que consiste na aplicação de uma substância proteolítica que amolece a dentina infectada e preserva o tecido dental hígido foi lançado no mercado. Sendo assim, este trabalho visa relatar um caso clínico de remoção da lesão de cárie através do gel enzimático a base de papaína, BRIX-3000. Paciente do gênero masculino, 6 anos, compareceu à Clínica Odontológica Universitária com queixa de sensibilidade dolorosa durante a mastigação. Após avaliação, constatou-se lesão cariosa profunda aguda nos elementos dentais 64 e 65. O procedimento de remoção de cárie foi realizado sem anestesia e sob isolamento relativo, seguindo os princípios do tratamento restaurador atraumático (ART). O gel foi levado à cavidade, deixado agir por 2 minutos e realizado a escavação do tecido infectado. Foi detectado lesão de cárie abaixo da cúspide OM com esmalte socavado, necessitando de ampliação da cavidade na região oclusal com instrumentos cortantes rotatórios e reaplicação do gel. Após a segunda aplicação, todo o tecido infectado foi removido e realizada a restauração dos dentes com cimento de ionômero químico. Ao final do tratamento, foi aplicado a escala de faces de Wong-Baker. A criança apontou score 1, indicando dor leve para ambos os tratamentos. Pôde-se concluir que a utilização do gel enzimático a base de papaína é uma alternativa eficiente para remoção do tecido cariado, de fácil utilização, preservando ao máximo a estrutura dental sadia, sendo promissor para ser utilizado na técnica atraumática de remoção da cárie.

Palavras-chave: Cárie Dentária. Papaína. Odontopediatria.

1 Introduction

In recent years, caries disease has undergone a careful analysis of the therapeutic resources to be used in its removal, and the adoption of a more conservative and less invasive practice was discussed. This concept is based on the impediment or the postponement of a restorative intervention, and when indicated, should be the most conservative possible.¹ It is also based on the fact that the conventional restorative treatment can cause a psychological trauma due to fear and anxiety, especially in children, and the aversion to noise from rotary instruments and anesthesia is the main driving force behind this situation. Most often, such situations not only make

the patient postponed the dental treatment but also make him to avoid it, which can result caries progression, increasingly the difficult of the treatment.² patients commonly present with cavitated caries lesions or failed restorations that are in need of operative intervention. Although much of clinical practice is devoted to preventing and managing the effects of caries and subsequent failure of the tooth-restoration complex, the clinical survival of restorations is often poor and becomes significantly worse as they increase in size and complexity. Minimally invasive (MI) Considering these factors, a dentistry with a more “friendly” approach was developed through the use of a chemical-mechanical removal caries allied to the

preservation of dental tissue.³This new form of thinking was denominated minimally invasive dentistry.⁴

The chemical-mechanical removal agents appeared in 1972 and are characterized by the ability to dissolve organic matter from the action of chemicals on carious dentin, resulting in the dissolution of the softened tissue.^{3,5-7} Carisolv[®] (n = 27) The first studies were published in 1975, using a product called GK 101,^{8,9} which remove the carious tissue through a sodium hypochlorite solution presented in its formulation. Habib, Goldman and Kronmann⁸, observed that the 5% sodium hypochlorite solution in contact with dentin caused its removal, but this hypochlorite concentration was unstable and aggressive to healthy tissue. Thus, sodium hydroxide, sodium chloride and glycine were added to their formulation in order to improve the undesirable effects of hypochlorite. Even with some changes, the GK 101 still had the disadvantage of removing the carious tissue very slowly.^{6,9} From this, the GK 101 manufacturers withdrew it from the market and launched a new product, Caridex, which despite improvements, still had some limitations, such as: the need for a large volume of solution to remove the infected tissue, product heating during its action, limited indications, prolonged treatment time, instability of the solution and the need for complex equipment to be used, thus generating a high cost to use the product.^{10,11}

At the end of 1997, Swedish researchers developed Carisolv, whose main difference from previously released products was the presence of three aminoacids in their composition (leucine, lysine and glutamic acid), instead of only one, which produced a distinct effect on the affected dentin. There was still the presence of sodium hypochlorite, but in the concentration of 0.95%. Sodium hypochlorite reacts with the aminoacids present in Carisolv, which, in turn, degrade the collagen found in the demineralized portions of the carious lesion, thus neutralizing aggressive behavior in healthy tissues and allowing the rapid removal of caries. The disadvantage of Carisolv was, in addition to its high cost, short shelf life, need to be kept under refrigeration, bad odor and unpleasant taste and the need to acquire a set of specific curettes specially designed for the removal of infected dentin, which increased the cost of the procedure.^{3,5,12}

In 2003, Papacárie was released in order to be used in public health due to its low cost. It is an easy to apply material, which does not require technological devices in order to proceed to the chemical-mechanical removal of atraumatic caries.^{3,13} The gel composition basically contains papain, a protein extracted from papaya, chloramine, thickener and toluidine blue. Papain interacts with the exposed collagen causing the dissolution of minerals from the dentin and bacteria, thus making the infected dentin more softened, which facilitates its removal with the use of non-cutting instruments and without anesthesia and rotary instruments.^{14,15}

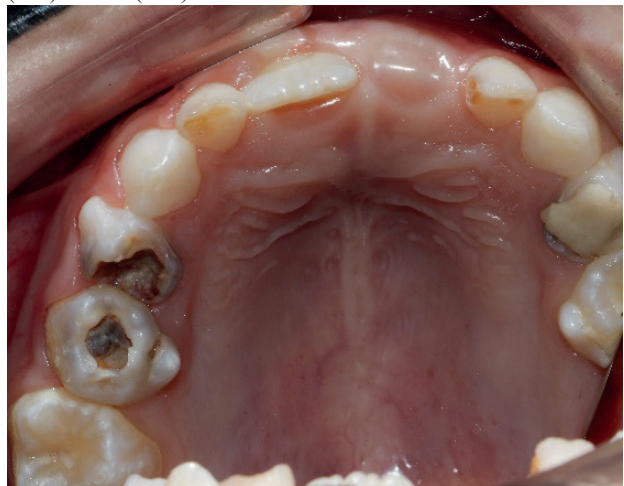
In 2012, the BRIX-3000 was released, a chemical-mechanical agent, also papain-base, with a proteolytic enzyme

obtained from leaves latex and fruits of green papaya (*Carica Papaya*) that acts as a chemical debridant. The differential of this product according to the manufacturers is the amount of papain used (3,000 U/mg in a concentration of 10%) and the bioencapsulation thereof by EBE technology, which gives the gel the ideal pH to immobilize the enzymes and liberate them at the moment of exerting its proteolysis on the collagen. Then, the objective of this study was to report a clinical case of chemical-mechanical removal of caries lesion using the enzymatic gel BRIX-3000.

2 Clinical Case Report

A 6-year-old male patient was accompanied by his mother to the Unipar Multidisciplinary Clinic II (Umuarama/ PR), with complaints of painful sensitivity during mastication. After anamnesis and clinical examination, class II-occlusion-distal (OD) acute deep carious lesion was observed in dental element 64 and occlusal-mesial (OM) in dental element 65 (Figure 1).

Figure 1 - Clinical aspect of caries lesion in dental elements 64 (OD) and 65 (OM)



Source: The authors.

Absence of fistula and presence of sufficient dental structure for a direct restoration were also found. A cold sensitivity test was performed as the patient reported pain sensitivity, getting positive response. Radiographic examination showed no periapical lesions and no proximity to the pulp. It has not been reported history of systemic diseases, as well as medications taken for long periods and diseases in early childhood. The mother reported that the child was afraid of the dentist due to traumatic experiences in the past, so he was not a collaborator patient. Therefore, the chemical-mechanical removal of caries using the BRIX-3000 papain gel (Brix Medical Science, Carcañá, Argentina,) (Figure 2) was chosen to remove the infected tissue.

Figure 2 - BRIX-3000 papain based gel



Source: The authors.

After the responsible for the patient signs the free and informed consent form, the restorative procedures were conducted. The procedure was performed without anesthesia, under relative isolation of the operative field, following the principles of Atraumatic Restorative Treatment (ART).^{16,17}

The papain base gel BRIX-3000 (Brix Medical Science) was applied to the cavity of the dental element 65 using a #2 dentin excavator (ART Duflex, SS White, Rio de Janeiro, RJ, Brazil), leaving it to act for 2 minutes (Figure 3), following the manufacturer’s instructions. After 1 minute, the formation of oxygen bubbles was observed and the gel turned from translucent green color to cloudy (Figure 4). The infected tissue was then removed through curettage, first at the surrounding walls, using a #2 dentin excavator (ART Duflex) followed by pulp wall removal, whose material was mixed with the gel, being easily removed (Figure 5).

Figure 3 - Application of papain based gel (BRIX-3000) on infected tissue.



Source: The authors.

Figure 4 - Bubbles formation and gel color change from translucent green to cloudy staining after 2 minutes.



Source: The authors.

Figure 5 - Removal of infected tissue, first in the surrounding walls, with #2 dentin excavator



Source: The authors.

After the gel removal, the cavity was rinsed with water and dried using syringe with mild air blow. It was observed that the cavity still had softened dentin tissue, and that a good part still remained undermined, making impossible direct access with excavators. It was necessary to make use of rotary cutting instruments with #1014 spherical diamond tip (KG Sorensen, Cotia, SP, Brazil) (Figure 6) in high speed, under refrigeration to the enlarge the cavity at the occlusal region for access the lesion and to removal the enamel prisms without dentin support.

Figure 6 - Use of rotary cutting instruments to enlarge the cavity in the occlusal region and to remove the unsupported enamel prisms.



Source: The authors.

According to the manufacturer’s guidelines, the product could be applied as many times required to remove all of the infected carious tissue. Thus, the product was reapplied, waiting for more 2 minutes, observed the gel color change and new curettage performed. It was noted that after the second application all the infected tissue had been removed, as only dentine “splinters” start to be removed by the excavator, and the dentin changed to a vitreous appearance (Figure 7). At this moment, there was a complaint of painful sensitivity by the patient, thus confirming the presence of affected dentin. The cavity was then washed with 0.2% chlorhexidine solution

(Dermo Suave Riohex 0.2% Lotion, Rioquímica, São José do Rio Preto, SP, Brazil) to remove dentin residue and then dried with a gentle air jet (Figure 8).

Figure 7 - Vitreous appearance of the cavity after chemical-mechanical removal of the infected tissue.



Source: The authors.

Figure 8 - Chlorhexidine solution (0.2%) being applied on the cavity to remove dentin residues.



Source: The authors.

The cavity was conditioned with 11.5% polyacrylic acid (Vitro Conditioner, DFL, Rio de Janeiro, RJ Brazil), which was applied with microbrush (Kg Brush Extrafino, KG Sorensen) allowing to act for 10s. Both enamel and dentin were washed during 30s and dried. Restorative material (Vidrion R, SSWhite,) was prepared according to the manufacturer's instructions, 2 drops of the liquid and two measures of powder were agglutinated. Then, the material was inserted into the well using a syringe (Sistema Centrix, DFL industria e comércio S. A., Rio de Janeiro, RJ, Brazil) (Figure 9) to avoid bubbles during insertion of the material. Three layers of varnish (Varnal, Biodynamic, Ibioporã, PR, Brazil) was applied with microbrush (Kg Brush Extra Fino, KG Sorensen). The occlusion was then checked with occlusal mark film (Accufilm II, Parkell Inc., Edgewood, NY, USA). Figure 10 shows the clinical appearance of the teeth after the completion of the restoration with glass ionomer cement.

Figure 9 - Glass ionomer cement being inserted into the cavity with a Centrix syringe.



Source: The authors.

Figure 10 - Clinical aspect of teeth after restoration.

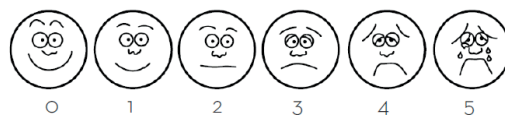


Source: The authors.

Immediately after the treatment, the child was questioned about the discomfort with the performed procedure using the Wong-Baker face scale¹⁸ (Figure 11).

Figure 11 - Wong-Baker Face Scale.

Escala de Faces Wong-Baker



Classificação de dor:

- 0 - sem dor
- 1- 2 - dor leve
- 3 - dor moderada
- 4 - dor forte
- 5 - dor insuportável

Source: The authors.

The child was instructed to point to the picture that represents his level of discomfort after the following question:

what did you feel during treatment? The child pointed to score 1, that is equivalent to mild pain for both treatments (dental elements 64 and 65).

2.1 Discussion

Advances in the field of cariology and the philosophy of minimally invasive intervention have led to transform restorative treatment of dental caries. The most striking change involves the selective removal of carious tissue and maximal preservation of healthy dental tissue. The treatment of dental caries lesions can be either by conventional drill and fill approach using rotary instruments, or by the atraumatic approach, using only hand instruments. The conventional methods involve the use of rotary burs, alone or together with metal hand instruments.⁷ The pain and discomfort associated to conventional cavity preparation have led to the reluctance of many patients to seek dental treatment.¹⁹ Besides this, the local anaesthesia, frequently needed to control the pain associated with cavity preparation, is potentially responsible for discomfort and pain.^{20,21}

An important limitation of conventional restorative methods is the increase risk of pulp exposure, the postoperative pulpal symptoms and the weakening of the tooth as a result of a more invasive caries removal.^{22,23} Such factors led to the development of the Atraumatic Restorative Treatment - ART around 1985. The ART is a minimally invasive approach, which involves removal of decayed tissue using hand instruments solely, usually without use of anaesthesia and electrically-driven equipment and the restoration of the dental cavity with an adhesive material with glass ionomer cement.^{1,24} The advantages of ART compared to the conventional restorative techniques include a biologically friendly approach, minimal cavity preparations, reduced risk for subsequent endodontics and tooth extraction, and lower dental anxiety in children and adults (more 'patient-friendly').^{7,20,25}

Considering that the patient has afraid of dentist due to traumatic past experiences and this make him not collaborating, it was decided to use a chemical-mechanical removal agent. Most often, the procedure can be performed without the use of anesthesia and without complaint of pain. Once this happened, the patient experienced a positive dental experience associated with a minimal intervention and maximum preservation of healthy dental structure, removing only the tissue with irreversible impairment, was done.

The chemical-mechanical agent selected was BRIX-3000, a papain based gel (3,000 U/mg at a concentration of 10%), which is bioencapsulated by EBE technology. EBE Technology is a unique bio-encapsulation technique from Brix Medical Science that immobilizes proteolytic enzymes, conferring stability and releasing them only at the moment of exerting proteolysis on degraded collagen, increasing their enzymes activity by 50% to 60%. The papain is an endoprotein, similar to human pepsin, that has antibacterial,

bacteriostatic and anti-inflammatory activity, accelerating the cicatricial process.²⁶ It acts only in the injured tissue, since plasma has no antiprotease alpha-1-anti-trypsin, responsible for the inhibition of protein digestion in normal tissues. In damaged tissues, papain acts by "breaking" the collagen molecules partially degraded by the action of caries, due to its capacity of digesting dead cells.²⁰

The indication of the chemical-mechanical agent follows the philosophy of minimally invasive treatment, in the case of cavitation injuries, without pulp involvement.²⁷ This citation is in agreement with the data obtained by the anamnesis, clinical and radiographic examination: absence of periapical lesions, absence of pulsed pain, positive sensitivity test, and presence of sufficient tooth structure. The outermost layer, denominated the infected dentin tissue, is irreversibly denatured, infected, incapable of remineralization and dead. The innermost layer, denominated the affected dentin tissue, is reversibly denatured, slightly infected or noninfected, capable of remineralization, sensitive and vital. In minimally invasive treatment, the former layer should be removed and the latter should be preserved.^{4,5,28} The great difficulty during removal of the dentin is determining when to stop the excavation. This technique consists in the use of solutions that interact directly with degraded pre-collagen from the injury, favoring tissue removal caries through the use of tools manuals.²⁷

After application of the gel on carious dentin there is a formation of oxygen bubbles on the dentin surface with higher turbidity of the gel, indicating the breakdown of collagen molecules and signaling that the removal of the infected dentin tissue can be started. This point occurs between 1-2 minutes after gel application, according to the manufacturer. When the infected tissue was removed after this time by dentin excavator, it was verified that the cavity presented enamel prisms without dentin support and undercut enamel, thus was necessary to use rotating cutting instruments to enlarge the cavity in the occlusal region and remove enamel prisms without dentin support and reapply the gel. At this moment, there was soreness complaint by the patient, thus confirming the presence of affected dentin. The vitreous aspect of the dentin tissue at the bottom of the cavity evidences the complete removal of the infected tissue. The chemical mechanical agent BRIX-3000 has selective action, because the infected dentin does not have alpha-1-anti-trypsin, an antiprotease that prevents the proteolytic action.⁶ Thus, when applying the gel for the second time, it only acted on infected dentin below the undercut enamel, preserving the affected dentin layer on the pulp wall. According to the manufacturer, the gel can be reapplied as many times as necessary until there is no more soft tissue, occurring on average of 2-3 applications. There is no need to wash or dry the cavity between the applications, however it can be done if the professional want to check the caries removal. Torresi and Bseremi²⁹ verified the efficacy of BRIX-3000 for the removal of carious tissue comparing

75 patients treated with the mechanical chemical agent (BRIX3000) and 75 by the traditional rotary method. It was found that the gel was effective for 62 patients (82.7%) with a single application of the product.

Face scales have become a common instrument for pain measurement since the 1980s, especially in pediatric populations. Some of these scales have extensive empirical validation, and are pointed out in systematic reviews of the literature as valid measures of pain intensity by self-report.³⁰ A Wong Baker Faces Pain Rating Scale (FACES)¹⁸ is composed of six faces of pain rated 0-10, being the same taken as object of the present study. Several characteristics contributed to the use of such scale as: applicability, low cost, attractiveness in the eyes of children, parents and health professionals. The child was instructed to point to the image that represented their level of discomfort during the treatment, and it indicated score 1, mild pain for both treatments (dental element 64 and 65), being the same pointed during the excavation in dentin affected.

3 Conclusion

It can be concluded that the use of enzymatic papaine gel-based was an efficient alternative for caries removal, easy to use, and preserve to the maximum the dental structure healthy, showing promise to be used as atraumatic caries removal technique (ART). It also demonstrates potencial to lead with traumatized patients, reestablishing confidence during dental treatment.

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