

Clinical and Radiographic Study of Chemical-Mechanical Removal of Caries Using Papacárie: 24-Month Follow Up

Bussadori SK * / Guedes CC ** / Bachiega JC *** / Santis TO **** / Motta LJ *****

Background: The chemical-mechanical removal of caries involves the chemical softening of the infected dentin, following by the mechanical removal of the softened tissue using non-cutting manual instruments. Papacárie® (Fórmula&Ação, Sao Paulo, Brazil) is a product in gel form used for the chemical-mechanical softening of the affected tissue. **Objective:** The purpose of the present study was to evaluate the effectiveness of Papacárie®. **Methods:** Clinical and radiographic evaluations were performed on 14 young permanent molars treated with Papacárie® and restored with glass ionomer cement (VitroMolar, DFL Ind. Com LTDA, Rio de Janeiro, Brazil) 24 months following intervention. **Results:** Success was achieved in 13 of the 14 cases. **Conclusion:** Papacárie® was effective in the treatment of carious lesions and constitutes a conservative alternative that offers benefits to patients.

J Clin Pediatr Dent 35(3): 251–254, 2011

CLINICAL RELEVANCE

Clinical and radiographic follow up in dentistry is important to determining the success of new forms of treatment. The present article contributes scientific evidence regarding a minimally invasive intervention of easy administration in order to address the need for reliable data for use in oral healthcare units.

INTRODUCTION

In recent years, different types of treatment have been established for the removal of carious tissue while maintaining the maximal preservation of the healthy dental structure.¹⁻³ Enamel lesions may be controlled with the use of high-concentration fluoride combined with the control of biofilm and a suitable diet. Dentin lesions, however, remain a cause of concern, especially in relation to infected dentin tissue.

According to Fusayama,⁴ carious lesions in dentin occurs

in two layers that have different morphological, biochemical, bacteriological and physiological characteristics. The first is a more surface layer characterized by intense decalcification, degenerated collagen fibers, the absence of odontoblasts and the presence of bacteria. In such cases, re-mineralization is physiologically impossible, as these conditions are irreversible and the region receives the denomination *infected dentin*. The second layer, denominated *affected dentin*, exhibits intermediate decalcification, unaltered collagen fibers and odontoblast processes, with the absence of bacteria. In such cases, re-mineralization is possible.^{4,5} Clinically, the main objectives of the removal of carious dentin tissue are the elimination of infected and necrotic tissue in order to control the progression of the lesion and the removal of softened dentin in order to offer adequate support to the restoration.⁶

The partial removal of carious tissue is a procedure in which a layer of affected carious dentin is intentionally left on the pulp. This is an alternative in situations in which the complete removal of the de-mineralized infected dentin could result in the exposure of the pulp and consequent need for a root canal intervention.

Among the more conservative alternatives for the removal of infected carious tissue, chemical-mechanical removal is a non-invasive method involving the application of a natural or synthetic chemical agent.⁶⁻⁸ This agent assists in the removal of the lesion by softening the contaminated tissue while preserving the healthy dentin structures and consequently avoiding pulp irritation and patient discomfort.^{1,6-8}

One such product for this chemical-mechanical removal is Papacárie®, which is a papain-based gel employing natural enzymes extracted from papaya husk that promote the softening of the dentin. When associated with other

* Sandra Kalil Bussadori – Professor, Rehabilitation Sciences Master Degree Program, Nove de Julho University.

** Carolina Cardoso Guedes – Professor, Pediatric Dentistry and Cariology Department, Braz Cubas University

*** Joanna Carolina Bachiega – Professor, Pediatric Dentistry Department, Braz Cubas University.

**** Tatiana Oliveira De Santis – Post Graduate Student, Rehabilitation Sciences Master Degree Program, Nove de Julho University.

***** Lara Jansiski Motta – Professor, Pediatric Dentistry Department, Nove de Julho University.

Send all correspondence to: Joanna Carolina Bachiega, Avenida Walkir Vergani, 240, loja 16, Boissucanga-São Sebastião-São Paulo, Cep: 11600-000

Phone: + 55 12 38652247.

Email: jocarolina72@gmail.com

Removal of Caries Using Papacárie

components, the gel acts upon the contaminated dentin and has an effect on local bacteria. The product is also biocompatible and has neutral pH. Together, these factors allow the obtainment of favorable clinical results, as the softening of the tissue is associated with the use of curettes, which scrape the tissue rather than cut it, making the treatment more comfortable to patients, as it most often eliminates the need for high-speed rotation instruments and local anesthesia.^{1,3,6-10} Moreover, this method is of easy application.

Papacárie® has selective, conservative properties, thereby reducing the risk of pulp exposure.¹⁰ As it does not produce a smear layer, does not affect adhesion and only acts on the carious tissue, the use of the gel for the removal of caries improves the adhesion of the restorative material and consequently increases the longevity of the restoration.^{1,11,12} Moreover, the chemical-mechanical removal of caries with the use of Papacárie® reduces patient anxiety and discomfort, thereby allowing its satisfactory acceptance in clinical practice.^{7,9}

The purpose of the present study was to carry out a clinical and radiographic follow up (after 24 months) of carious lesions in young permanent molars treated with Papacárie® and restored with glass ionomer cement.

MATERIALS AND METHOD

The present prospective, clinical and radiographic study with a 24-month follow-up received approval from the local Ethics Committee (CEP-UNIMES n° 004/2005). Fourteen permanent molars were assessed in patients ranging from 10 to 16 years of age in treatment at the dental clinic of the State of Sao Paulo Dentists' Union. The procedures were carried out following authorization by parents/guardians, who signed terms of informed consent.

The inclusion criteria were the presence of average occlusal cavity involving 1.3 and 1.4 dentin based on the Mount and Hume¹³ classification in young permanent upper and lower molars with sufficient opening for the application of the gel and introduction of curettes. Teeth were excluded when exhibiting pulp exposure, a history of pain, presence of fistula and radiographic evidence of compromised pulp with forked and/or apical lesion.

For the removal of the carious dentin with Papacárie® and manual scrapers, the following steps were performed:

- Initial periapical and interproximal radiograph;
- Relative isolation (cotton rolls and saliva ejector);

- Application of Papacárie® gel to the cavity, followed by a 30-to-40-second pause in order to allow the action of the product;
- Removal of gel-softened carious dentin by scraping with non-cutting curettes;
- Second application of the gel in cases in which there were still signs of infected carious dentin to be removed;
- Clinical evaluation by means of an inspection of the texture of the remaining dentin using an exploratory probe with a rounded tip;
- Cleaning the cavity with 2% chlorhexidine digluconate;
- Protection with calcium hydroxide cement;
- Restoration with glass ionomer cement (Vitro Molar, DFL).

After 24 months, clinical evaluations and radiographic control were performed. Periapical and interproximal radiographs were taken with the use of a positioner at intervals of one month and 24 months following the intervention. The assessments included signs of compromised or degenerated pulp. At intervals of six and 12 months, the patients were contacted to determine whether there were any complaints or problems related to the procedures.

The following evaluation scores (based on Frencken *et al*¹⁴) were employed (Table 1):

Table 1. Evaluation scores proposed by Frencken *et al.*¹²

Codes	Description
0	Present, in good condition
1	Present, slight marginal defect, no repair is needed
2	Present, marginal defects 0,5mm – 1,0mm, repair is needed
3	Present, marginal defects > 1,0mm, repair is needed
4	Not present, restoration partly or completely missing
5	Not present, restoration replaced by another restoration
6	Tooth is missing, exfoliated or extracted
7	Present, slight wear, no repair is needed
8	Present, wear >0,5 mm, repair is needed

RESULTS

Regarding the clinical evaluation, an acceptable condition was observed in 13 of the 14 molars evaluated (Frame 1). In the single case considered unacceptable, the restorative material was no longer present one month following the

Frame 1. Clinical and radiographic evaluation . Y= Yes; N=No

Clinical cases	Interval	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Clinical evaluation b(scores)	1 month	0	0	1	1	0	0	8	1	1	0	1	1	0
	24 months	7	1	7	7	7	1	-	7	7	1	7	7	1
Radiographic sign (compromised pulp)	1 month	N	N	N	N	N	N	Y	N	N	N	N	N	N
	24 months	N	N	N	N	N	N	-	N	N	N	N	N	N

treatment, which led to contamination, followed by pulp necrosis. After 24 months, the 13 other cases were examined radiographically, at which time it was determined that the lamina dura was intact and there was a radiolucent image, with radiopaque points denoting the presence of affected dentin (Figure 1), thereby demonstrating no compromised pulp or progression of the lesion. In some cases, there was a need to repair the glass ionomer cement restorations, with no need for a complete replacement of the restoration. The decision for radiographic follow up after 24 months was based on the criteria proposed by Pitts.¹⁵ Chart 1 displays the scores of the clinical evaluation:

DISCUSSION

The partial removal of carious tissue is addressed in the literature in different scientific studies.^{1,2,3,7,8,16,17} Chemical-mechanical removal is an alternative that allows the removal of infected, de-mineralized dentin while preserving the healthy dental structure by means of minimally invasive procedures. A further benefit is the avoidance of the use of local anesthesia or high-speed rotation devices.^{1,3,7-9,16} One such agent employed to soften infected carious tissue for subsequent mechanical removal is Papacárie®, which is a papain-based gel.^{1,5-9,12,18}



Figure 1. After 24 months, presence of affected dentin demonstrating no compromised pulp or progression of the lesion.



Figure 2. Permanent teeth with lesions in the dentin

Papacárie® was used in the present study on permanent teeth with deep lesions in the dentin. During the procedure (Figure 2), no high-speed rotation devices or anesthesia were employed and there was no need for absolute isolation, which corroborates the results described in previous studies.^{1,5,7-9} This form of treatment preserves healthy dentin tissue and causes less patient discomfort.⁶⁻⁹ The non-traumatic characteristics and action of the agent on bacteria make Papacárie® an effective alternative for the treatment of caries, especially deep lesions^{6,8} (Figure 3). This likely occurs due to the presence of papain in its formulation, which is a biocompatible agent that facilitates the cleaning of necrotic tissue and secretions, thereby reducing tissue repair time and causing no harm to the healthy tissue surrounding the lesion.

Compared to conventional carious lesion removal methods employing burs, a number of studies have found that tissue removal with Papacárie® causes no painful sensitivity in most cases.^{6,9} The present study obtained a similar result; even when working on deep dentin lesions (I.3 cavity) in the 14 young permanent molars assessed, no patient required the use of local anesthesia or reported discomfort during the removal of the carious tissue. This is likely associated to the use of non-cutting curettes, the local action of papain favoring the repair process and the neutral pH of the gel.

Regarding the only case of a lack of success, the failure occurred because the restoration material was no longer in the cavity one month following the treatment. This consequently led to the contamination of the tissue, followed by pulp necrosis.

Glass ionomer cement is currently being used as a permanent restorative material. It has desirable physical and biological properties, including the release of fluoride, a linear thermal expansion coefficient similar to teeth and low polymerization contraction. It should be stressed that, in some *in vitro* and *in vivo* studies, glass ionomer cement has demonstrated a certain degree of toxicity and can also cause pulp injury.^{19,20} Thus, in the cases of deep lesions in the present study, the cavity was cleaned with 2% chlorhexidine digluconate and calcium hydroxide cement was employed



Figure 3. Deep lesion in the dentin



Removal of Caries Using Papacárie

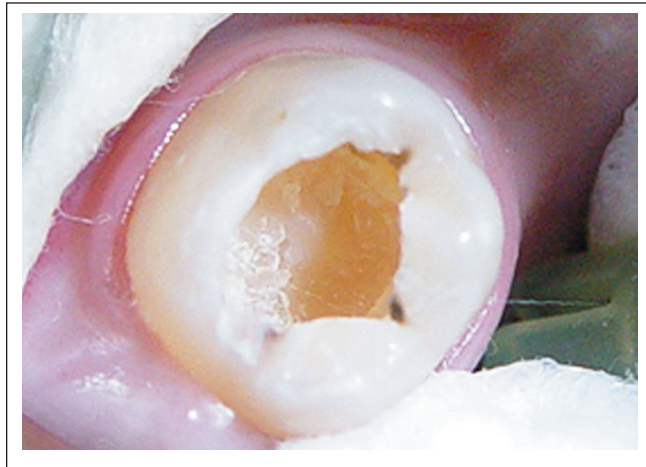


Figure 4. Employment of calcium hydroxide

(Figure 4) in order to favor the environment in terms of reparation due to the bacteriostatic properties and alkaline pH of the product. It is likely that the use of the gel associated to protection with calcium hydroxide and subsequent restoration with glass ionomer cement contributed toward the favorable results in young permanent molars after 24 months. Further desirable properties of glass ionomer cement include its chemical adhesion to the dental structure and low marginal infiltration, even in cases of wear.

As high-viscosity glass ionomer cement offers low resistance to wear, despite being better than conventional glass ionomer cements, eight cases in the present study achieved a score of 7, with wear occurring on the surface of the material (Figure 5). The decision was made to complement the restoration with a composite resin rather than completely replace it. This was achieved using a combined technique and without scoring the glass ionomer cement. Despite the wear occurring on the glass ionomer cement in these eight cases that achieved a score of 7, the clinical and radiographic evaluation denoted clinical success. Therefore, the effectiveness of the procedure in the removal of the carious tissue was demonstrated, as was the use of the restoration material, thereby proving the procedure to be a minimally invasive alternative for deep carious lesions.

CONCLUSION

Thus, the use of Papacárie® and restoration with glass ionomer cement was effective in the removal and treatment of carious lesions in young permanent teeth and constitutes a conservative alternative that offers benefits to patients.

REFERENCES

1. Motta LJ, Martins MD, Fernandes KPS, Bussadori SK. Aesthetic restoration of deci duos anterior teeth after removal of carious tissue with Papacarie. *Indian J Dent Res*, 20(1): 117–20, 2009.
2. Maltz M, Oliveira EF, Fontanella V, Bianchi R; A clinical microbiologic and radiographic study of deep caries lesion after incomplete caries removal. *Quintessence Int*, 33(2): 151–59, 2002.
3. Banerjee A, Kidd EA, Watson TF. In vitro validation of carious dentin removed using different excavation criteria. *Am J Dent*, 16(4): 228–30, 2003.



Figure 5. Restoration with glass ionomer cement

4. Fusayama T. Two Layers of Carious Dentin: Diagnosis and Treatment. *Oper Dent*, 4(2): 63–70, 1979.
5. Piva E, Ogliari FA, Moraes RR, Corá F, Henn S, Correr-Sobrinho L. Papain-based gel for biochemical caries removal: influence on microtensile bond strength to dentin. *Braz Oral Res*, 22(4): 34–70, 2008.
6. Bussadori SK, Guedes CC, Hemida Bruno ML, Ram D. Chemo-mechanical removal of caries in an adolescent patient using a papain gel: case report. *J Clin Pediatr Dent*, 32(3): 177–80, 2008.
7. Carrilo CM, Tanaka MH, Cesar MF, Camargo MA, Juliano Y, Novo NF. Use a papain gel in disabled patients. *J Dent Child (Chic)*, 75(3): 222–8, 2008.
8. Bussadori SK, Castro LC, Galvão N. Papain Gel: new chemo-mechanical caries removal agent. *J Clin Pediatr Dent*, 30: 115–19, 2005.
9. Abdelnur JP, Cerqueira DF, Castro GF, Copple Maia L, Ivete PRS. Strategies for addressing restorative challenges in HIV-infected children. *J Dent Child*, 75: 69–73, 2008.
10. Jawa D, Singh S, Somani R, Jaidka S, Sirkar K, Jaidka R. Comparative evaluation of the efficacy of chemomechanical caries removal agent (Papacárie) and conventional method of caries removal: An in vitro study. *J Indian Soc Pedod Prevent Dent*, 28 (2): 73–7, 2010.
11. Gianini RJ, do Amaral FL, Flório FM, Basting RT. Microtensile Bond strength of etch-and-rinse and self-etch adhesive systems to demineralized dentin after the use of a papain-based chemomechanical method. *Am J Dent*, 23 (1): 23–8, 2010.
12. Bittencout ST, Pereira JR, Rosa AW, Oliveira KS, Ghizoni JS, Oliveira MT. Mineral content removal after Papacárie application in primary teeth a quantitative analysis. *J Clin Pediatr Dent*, 34 (3): 229–31, 2010.
13. Mount GJ, Hume WR. A revised classification of carious lesions by site and size. *Quintessence Int*, 28 (5): 301–03, 1997.
14. Frencken JE, Makoni E, Sithole WD. Atraumatic restorative treatment and glass ionomer cement sealants in school oral health program in Zimbabwe. Evaluation after 1 year. *Caries Res*, 30(6): 428–36, 1996.
15. Pitts NB. The diagnosis of dental caries: 2. The detection of proximal, root surface and recurrent lesions. *Dent Update*, 18: 436–42, 1991.
16. Silva LR, Murillo JH, Santos EM, Guedes-Pinto AC, Bussadori SK. Utilización del gel de la papaya para la remoción de la caries. *Acta Odontológica Venezolana*, 43 (2): 155–58, 2005.
17. Yip HK, Stevenson G, Beeley JA. – An improved reagent for chemo-mechanical caries removal: an *in vitro* study. *J Dent*, 23: 197–04, 1995.
18. Lopes MC, Mascarini RC, Silva BMCG, Florio FM, Basting RT. Effect of a papain-based gel for chemomechanical caries removal on dentin shear bond strength. *J Dent Child*, 74(2): 93–97, 2007.
19. Nicholson JW, Czarnicka B. The biocompatibility of resin modified glass ionomer cements for dentistry. *Dent Mater*, 24(12): 1702–8, 2008.
20. Ribeiro DA, Marques ME, Salvadori DM. Biocompatibility of glass ionomer cements using mouse lymphoma cells in vitro. *J Oral Rehab*, 33(12): 912–17, 2006.

