ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Papacarie® containing papain: A Natural Chemomechanical Caries Removal Agent

Amit Bhardwaj, Shalu V Bhardwaj

SGT Dental College, Gurgaon, Haryana; Private dental practitioner, Gurgaon

ABSTRACT

Chemomechanical caries removal (CMCR) is a non-invasive technique eliminating infected dentine via a chemical agent. This is a method of caries removal based on dissolution. Instead of drilling, this method uses a chemical agent assisted by an atraumatic mechanical force to remove soft carious structure. It was introduced to dentistry as an alternative method of caries removal and is mainly indicated to overcome the inconvenience of using burs and local anesthesia, causing less discomfort to patients and preserving healthy dental structure, there by complying the concept of the minimal invasive dentistry (MID).Various agents with their methods have been used in the past for CMCR, but only a few have got into a stable clinical practice. Among them we have the Carisolv, which is the most successful and commonly used agent while Papacarie® gives the promising result as CMCR agent of the future. Carisolv came into use at the end of 20th century. It consists of two component mixtures (mainly amino acid and hypochlorite), forming an active gel. Papacarie® is an emerging CMCR agent of the 21st century. Papacarie® is composed basically of papain, chloramines and toluidine blue. Papain interacts with exposed collagen by the dissolution of dentine minerals through bacteria, making the infected dentine softer, and allowing its removal with non cutting instruments without local anesthesia and burs. Papacarie® seems to be a valuable alternative for caries removal especially in fear demonstrating and pediatric patients.

Keywords: chemomechanical caries removal, papcarie, papain.

Corresponding author
Email:amitmds1980@rediffmail.com

ISSN: 0975-8585

INTRODUCTION

Dental caries is an infectious and contagious disease that determines the localized destruction of mineralized tissues, through the metabolism of fermentable carbohydrate 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 contaiminated 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].

Minimally invasive dentistry adopts a philosophy that integrates prevention, remineralization and minimal intervention for the placement and replacement of restorations. Minimally invasive dentistry reaches the treatment objective using the least invasive surgical approach, with the removal of the minimal amount of healthy tissues. It includes the following different techniques:

(1) Air abrasion (Myers, 1954)[6].
(2) Atraumatic restorative technique (Frencken et al.,1996)[7].
(3) Sono abrasion (Banerjee et al., 2000)[8].
(4) Laser (Keller et al., 1998)[9].
(5) Chemomechanical caries removal (CMCR) (Ericson et al., 1999)[10].

Among all these techniques, atraumatic restorative technique is the most documented alternative to traditional drilling for dentine caries removal but Chemomechanical caries removal (CMCR) holds a lot of promise as an effective alternative to the traditional method. It involves the application of a chemical solution to the carious dentine followed by gentle removal with hand instruments. Chemomechanical caries removal is a method for minimally-invasive, gentle dentine caries removal based on biological principles (Zinc et al., 1988)[11].

Review of chemomechanical caries removal agents

The earliest attempts to remove caries involved the use of a hand drill which was soon surpassed in 1871 by James Morrison's treadle instrument, developed from the mechanism of Isaac Singer's sewing machine. Modern high speed drills are the latest development of this

more than a century old technique (Ring, 1985)[12]. Conventional caries removal and cavity preparation entail the use of the burs. Disadvantages of this system include:

(1) The perception by patients that drilling is unpleasant.
(2) Local anesthesia is frequently required.
(3) Drilling can cause deleterious thermal effect combined with the use of pressure for caries removal, causing pulpal effects.
(4) The use of a hand piece may result in removal of softened, but affected dentine, resulting in an excessive loss of sound tooth tissue.

As a result of these disadvantages, there is a growing demand for procedures or material that facilitates caries management without the above mentioned disadvantages. Chemomechanical caries removal is a noninvasive technique eliminating infected dentine via a chemical agent. This process not only removes infected tissues, it also preserves healthy dental structure, avoiding pulp irritation and patient discomfort. This is a method of caries removal based on dissolution. Instead of drilling, this method uses a chemical agent assisted by an atraumatic mechanical force to remove soft carious structure. With newer material getting introduced for CMCR, there is renewed interest in this procedure which selectively removes carious dentine but avoids the painful and unnecessary removal of sound dentine. Restoration of cavities prepared by this technique requires materials such as composite resins or glass ionomer which bond to the dentine surface rather than materials such as amalgams which involve cutting a cavity designed to mechanically retain the restoration (Goldman et al., 1976)[13]. It has the following advantages over traditional drilling:

(1) Less perception of pain and more comfortable for patient.
(2) Less fear and anxiety to method, leads to less discomfort to patients especially in children.
(3) Removes only infected layer and leads to more tissue preservation.
(4) No pulpal irritation.
(5) Well suited to the treatment of deciduous teeth, dental phobic's and medically compromised patients.
(6) Better removal of caries in uncooperative patients.
(7) Useful in physically handicapped patients.
(8) Useful in patients with T.B like infectious diseases (prevent droplet infection).

Papacarie®

In Brazil 2003, Formula eacao by Sao Paulo, first time introduced papain gel as papacarie for chemomechanical caries removal agent (Bussadori et al., 2005)[14]. Papacarie is a national product; patented, registered and approved by ANVISA in Brazil. Its main components are papain, chloramine and toluidine blue.

Papain

(1) Papain is an enzyme extracted from the latex of leaves and fruits of the adult green papaya,Carica papaya.
(2) It is an endoprotein similar to the human pepsin which has a bacteriocidal, bacteriostatic and antinflammatory activity, and debriding agent.
(3) It does not damage healthy tissue, but accelerates the cicatricial process and has bacteriostatic and bactericidal action.
(4) Acts by cleaving collagen molecules partially destroyed by the action of caries, and is able to digest dead cells and eliminating the fibrin coat formed by the caries process.
(5) Acts only on carious tissue which lacks the plasmatic protease inhibitor alpha-1-antitrypsin, but its proteolytic action is inhibited on healthy tissue, which contains this substance (Bussadori et al., 2008)[15].

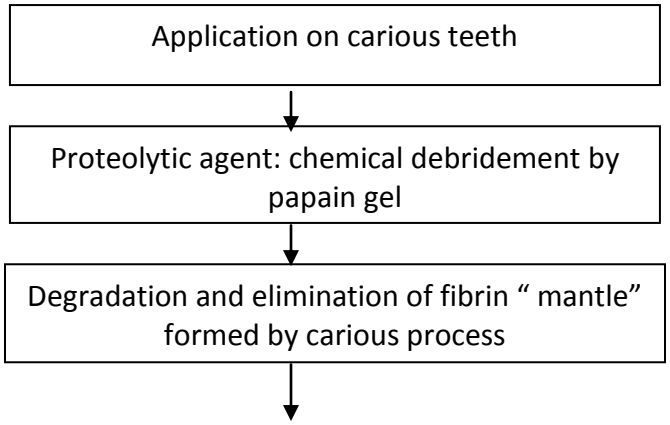
Chloramine

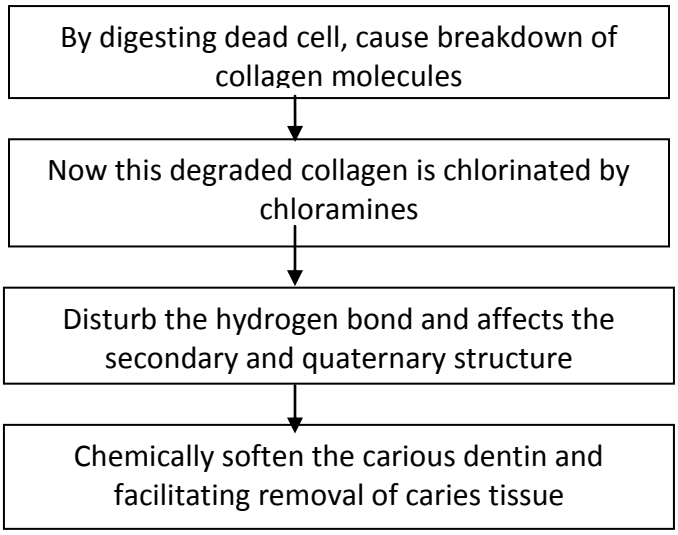
(1) A compound comprised by chlorine and ammonia has bactericidal and disinfectant properties.
(2) Widely used as an irrigating solution of radicular canals in order to chemically soften the carious dentine.
(3) The degraded portion of the carious dentine collagen is chlorated by the chloramine and is easily removed with excavator.

Toluidine blue

(1) Initially, the malachite green was used as colouring agent, however, after a few studies toluidine blue was found highly effective against Streptococcus mutans.
(2) It is a photosensitive pigment that fixes into the bacterial membrane.

Mechanism of action of Papacarie®





Advantages of papain gel

(1) Papacarie® is a biocompatible gel with antibacterial properties that eliminates the need for anesthesia, removes only the compromised tissue, and preserves the healthy tissue better.
(2) The formation of a smear layer is not observed after using the gel.
(3) The gel combines an atraumatic treatment with antibacterial properties without affecting healthy tissue and causing pain.

DISCUSSION

Papain is an enzyme that is similar to human pepsin and is used in food technology, pharmaceuticals and cosmetic industry. Guzman and Guzman performed clinical studies on patients with skin lesions caused by burns and observed that the enzymatic action of papain was excellent in areas with necrotic and purulent processes [16].

According to Flindt, papain acts only on damaged tissue due to the absence of an anti-plasmatic protease, alpha-1-antitrypsin, that hinders its proteolytic action in tissues considered normal [17].

The absence of alpha-1-antitrypsin in infected tissues allows papain to break the partially degraded molecules. Dawkins showed that papain has bactericidal and bacteriostatic properties which inhibit the growth of gram positive and gram negative organisms [18].

Papacarie® was evaluated *in vitro* for cytotoxicity in fibroblasts culture at different concentrations (2, 4, 6, 8 and 10%). It was concluded that for its development, any of the papain concentrations was feasible and Papacarie® was safe, not cytotoxic *in vitro* fibroblast culture, and it is biocompatible to the oral tissues (Slive et al., 2004)[19].

Jawa et al., suggested that removal of carious tissue with Papacarie® was efficient, easy to perform, comfortable, and less destructive to the dental tissues [20].

Sapna et al., studied the efficacy Papacarie® for caries removal and proved it to be promising alternative treatment procedure for caries removal in pediatric patients [21].

CONCLUSION

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

Clinical Significance

Fear and anxiety are known barriers to the receptivity of dental treatment and in detriment to oral health. In children, it is difficult to differentiate between fear and anxiety-originated behavior problems. Thus, changes in dentistry routines such as the chemomechanical caries removal, sedation with nitrous oxide, and general anesthesia are becoming necessary. The chemomechanical caries removal method was developed specifically to overcome these barriers and to preserve the healthy dentine tissue. Papacarie® could be an effective caries removal method to treat children, particularly those present with early childhood caries or management problems. This method may be desirable in pediatric dentistry since it allows minimally invasive techniques to be applied, considered to be less painful, noise and vibration free, and patients were more comfortable than with the conventional technique.

REFERENCES

[1] Guzman AV, Guzman MGS. J Int Coll Surg 1953; 20: 695-702.
[2] Beeley JA, Yip HK, Stevenson AG. Br Dent J 2000; 188:427-30.
[3] Lopes MC, Mascarini RC, Da Silva BM, Florio FM, Basting RT. J Dent Child 2007; 74:93-7.
[4] Carrea FN, Rocha RO, Soares FZ, Rodrigues- Filho LE, Rodrigues CR. Eur Arch Paediatr Dent 2008; 9:126-29.
[5] Carrea FN, Rocha RO, Soares FZ, Rodrigues- Filho LE, Muench A, Rodrigues CR. J Clin Padiatr Dent 2007; 31:187-92.
[6] Myers GE. Br Dent J 1954; 97:291-95.
[7] Frencken JE, Pilot T, Sangpaison Y, Phantumvanit P. J Public Health Dent 1996, 56: 135-40.
[8] Banerjee A, Watson T, Kidd A. Br Dent J 2000; 188: 476-81.
[9] Keller U, Hibst R, Guertsen W, Schilke R, Heidermann D, Klacber B, Raab W. J Dent 1998; 26: 649-56.
[10] Ericson D, Simmerman M, Raber H, Götrick B, Bornstein R. Caries Res 1999; 33: 171-77.
[11] Zinc JH, McInnes-Ledoux P, Capdeboscq C, Weinberg R J Oral Rehab 1988;15: 23-33
[12] Ring ME (1985). Dentistry; an Illustrated History. pp. 250-251.New York: Abrams.
[13] Goldman M, Kronman JH. J Am Dent Assoc 1976; 93: 1149-1153.

[14] Bussadori SK, Castro LC, Galvão AC. J Clin Pediatr Dent 2005; 30:115-119.
[15] Bussadori SK, Guededs CC, Ram D. J Clin Pediatric Dent 2008; 32: 177-180.
[16] Guzman AV, Stein De Guzman MG. J Int Coll Surg 1953; 20: 695-702.
[17] Flindt M. Process Biochem 1979; 13:3-7.
[18] Dawkins G, Hewitt H, Wint Y, Obiefuna PC, Wint B. West Indian Med J 2003;52:290-92.
[19] Silva LR. Rev Paul Odontol2004; 16: 4-8.
[20] Jawa D, Singh S, Somani R, Jaidka S, Sirkar K, Jaidka R. J Indian Pedod Prevent Dent 2010;28:73-77.
[21] Sapna K, Pallavi U, Sunil R. World J Dentistry 2011; 2:183-86.