

**A NATURAL CHEMO-MECHANICAL CARIES REMOVAL
AGENT- PAPACARIE****R.PRADEEP KUMAR.****Reader, Department of Public Health Dentistry, Saveetha Dental College, Saveetha University, India.***ABSTRACT**

Researchers are more interested in developing alternative methods for cavity preparation and caries removal for several years. The chemo-mechanical caries removal is a non-invasive technique for caries removal which aims at the elimination of infected dentin. Papacarie is an emerging chemo-mechanical caries removal agent which on interaction with the exposed collagen causes dissolution of dentin minerals and makes the dentin softer and hence facilitates removal of caries. It has bactericidal, bacteriostatic and anti-inflammatory characteristics. It is extracted from the latex of leaves and fruits of the adult green papaya (*Carica papaya*). Papain can safely be used as a method for caries removal when employed along with conventional adhesive systems. With the available reference the chemo-mechanical caries removal has so far been the most promising method as alternative treatment procedures especially for children, anxious and medically compromised patients.

KEY WORDS: Chemo-mechanical caries removal, *Carica papaya*, Papacarie, Papain**R.PRADEEP KUMAR.****Reader****Department of Public Health Dentistry,
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INTRODUCTION

The invention of rotary instruments in operative procedures of carious lesions has resulted in removal of considerable amount of tooth structure¹. Since GV Black in 1893, proposed the 'Principle for prevention, the techniques used in caries removal has undergone a lot of development. He had initially proposed that the removal of sound tooth structure at sites that would otherwise lead to accumulation of plaque (like occlusal pit and fissure, approximal contacts, etc.) would minimize caries formation. However, with the application of adhesive materials for restorations, and the advent of minimal cavity design this principle has been reframed and is now considered being too destructive to the tooth structure during caries removal². Minimally invasive dentistry is based on the principle of prevention, remineralisation and minimal intervention for the placement and replacement of the restoration. The advantages of minimally invasive dentistry are less patient discomfort –especially in paediatric, anxious and medically compromised patients, non invasive – reduces the use of conventional drilling and local anaesthesia, preservation of healthy dental structure. Various minimally invasive dentistry procedures are Air Abrasion (Myers, 1954)³, Atraumatic Restorative Technique (Frencken et al., 1996)⁴, Sono Abrasion (Banerjee et al., 2008)¹, LASER (Keller et al., 1998)⁵ and Chemo Mechanical Caries Removal (CMCR) (Ericson et al., 1999)⁶

Chemomechanical caries removal technique

Chemomechanical caries removal is a technique of eliminating infected dentin via a chemical agent. This method of treatment has high acceptance especially among children and patients with dental anxiety.⁷ It is a process that only removes the infected tissues, preserving the healthy dental structures, avoiding pulp irritation and patient discomfort.⁸ The chemo-mechanical removal method has been a solution for the treatment of patients seeking alternatives to conventional methods. The key advantages offered by the chemo-mechanical method are its proven effectiveness with no pulpal

irritation, safety, the elimination of local anesthesia and bur, less perception of pain and more comfortable for patient hence lowers the anxiety built in patients, and removes only infected layer of dentin and leads to the conservation of the sound tissue, useful in patients with infectious diseases like Tuberculosis, Herpes. It is indicated in very deep carious lesions (potential pulp exposure may be reduced), Cervical, buccal or root caries. But it is contraindicated in pit and fissure caries that are not deep where rotary preparation is needed suffice to remove caries.⁷ Several chemo mechanical methods for dental caries removal have been developed, beginning with the use of 5% Sodium hypochlorite (NaOCl), which was shown to be an easily way to remove carious lesions.^{9,10} The solution was called GK-101 or n-monochloroglycine composed of: sodium hydroxide (NaOH), sodium chloride (NaCl), glycine, and 0.05% of NaOCl was efficient at removing carious lesions.^{10,12} and later modified by the addition of an ethyl group renamed GK-101E or N-monochloro-D,L-2-aminobutyrate, which was shown to be more efficient. It was given the brand name Caridex and applied using the same technique used for GK-101.^{10,12} In 2003, a research project in Brazil by Sandra Kalil Bassadori et al led to the development of "Papacarie" (a word that means "eating caries"). This advent allowed a reduction in costs, due to the use of low-cost Brazilian raw materials.¹³ The gel is applied to the contaminated dentin and its proteolytic, chlorinating, and oxidating properties act on the affected collagen,¹⁴ without acting on the sound dentin. It is indicated in removal of radicular decays. In children, with deep decay it eliminates the decayed dentin, preserving the healthy tissue without the need of local anaesthesia or rotary cutting instruments. In deep cavities it reduces the risk of pulp exposure. The aim of this review is to critically elaborate the composition, mechanism of action, method of application, advantage and its various clinical studies.

Carica papaya

Carica papaya L. is a herbaceous plant, belonging to the family "Caricaceae"

originated in Central America. *Carica papaya* has the great potential against a number of health diseases viz. tissue burns, bacterial, fungal, helminthic and protozoan infections. It has antioxidant, immunomodulatory, insecticidal and molluscicidal activity.¹⁵ The phytochemical analysis of carica papaya showed presence of protein, carbohydrate, flavonoids, glycosides, steroids and reducing sugar. Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection and they have been found to be antimicrobial substances against a wide array of microorganisms *in vitro*.¹⁶

Papacarie

It consists of papain, chloramines, toluidine blue dyes, deionised water, salts and thickeners (carbopol), preservative (propyl-p-hydroxybenzoate).

Papain

It is a endoprotein/proteolytic enzyme similar to human pepsin. It has bactericidal, bacteriostatic and anti-inflammatory characteristics. It is extracted from the latex of leaves and fruits of the adult green papaya (*Carica papaya*). *Carica papaya* has antibacterial property against both gram positive and gram negative bacteria. It does not damage the healthy tissue and acts by cleaving collagen molecules partially destroyed by the action of caries and is able to digest dead cells and eliminates the fibrin coat formed by the caries process. It acts only on carious tissue which lacks the plasmatic protease inhibitor α -1-anti trypsin, but its proteolytic action is inhibited on healthy tissue, which contains this substance⁹. According to Mandelbaum, papain is indicated in all phases of the cicatricial process; dry or exudative wounds, colonized or infected, with or without areas of necrosis. Papain promotes (i) chemical debridement, (ii) granulation and epithelialization, which hastens the phases of cicatrization, and (iii) stimulation of the tensile strength of the scars.¹⁷

Chloramines

Chloramines are formed during a reaction between chlorine and ammonia. Chloramines are amines which contain one chlorine atom which is directly bonded to nitrogen atoms. It

has bactericidal and disinfectant properties and shown to be effective against both gram positive and gram negative bacteria. It is widely used as a solution of radicular canals in order to chemically soften the carious dentin. The degraded portion of the carious dentin collagen is chlorated by the chloramines and is easily removed with excavator. Tonami reported that the application of chloramines resulted in the opening of dentinal tubules in the outer layer of carious dentin and occluded dentinal tubules were seen after sodium hypochlorite application.¹⁶

Toluidine blue

Initially the malachite green was used as colouring agent however after a few studies toluidine blue was found highly effective against streptococcus mutans. It is a photosensitive pigment that binds into the bacterial membrane.

Mechanism of action

When applied on a carious tooth, due to the proteolytic agent there is chemical debridement by papain gel. Anti-trypsin inhibits protein digestion but infected tissues do not usually show anti-trypsin. Since papain can digest only dead cells, it acts breaking the partially degraded collagen molecules, contributing to the degradation and elimination of the fibrin "mantle" formed by the carious process. This leads to necrosis of the dead cells, causes breakdown of the collagen molecules. The degraded collagen is chlorinated by chloramines. There is disturbance in the hydrogen bond, secondary and quaternary structures. After the degradation, oxygen is freed, bubbles appear on the surface, and a blurring of the gel is thus indicating chemical softening of the carious dentin and thereby facilitating removal of carious tissue.¹³

Method of Application

Papacarie is available in the form of a gel in a 3ml syringe. It should be kept in a cold storage and taken out of the refrigerator some minutes before its use, so that it reaches the room temperature. Radiograph of the target tooth should be taken. Prophylaxis of the teeth using rubber cup and slurry of pumice is done followed by rinsing with air/water spray or cotton pellet with

water; the tooth is isolated and then Papacarie is applied and allowed to work for 30 to 40 seconds. Then the softened carious dentin is removed using the opposite side of the excavator and promoting a pendulum movement. The softened tissue must be scraped, but not cut. The cavity is considered caries free when there is no change in the colour of papacarie. The vitreous aspect of the cavity appears when the cavity feels free from caries. The cavity is then rinsed with 0.12%, 1% or 2% chlorhexidine or water spray and dried with moisture-free and oil-free air. Finally, restored with a suitable filling material according to manufacturer's instructions.¹³

DISCUSSION

Conventional drilling is the most common procedure for caries removal, but it generates pain, fear, discomfort, and anxiety in children.¹⁹ Papacarie a new chemo mechanical caries removing method is desirable and recommended as a simple, efficient, easy to manipulate, antibacterial, biocompatible gel that eliminates the need for anaesthesia, removes only the compromised tissue and preserves the healthy tissue, no need for special devices, cost effective, comfortable and less destructive for the patient seeking an alternative to the conventional method. The dentinal carious lesion is divided into two zones. An outer layer of infected dentin, in which the collagen fibres are partially degraded and cannot be remineralised, and an inner layer of affected dentin, which is partially demineralised with intact collagen fibres and cannot be remineralised. A chemo mechanical caries removing method, acts by causing further degradation of the partially degraded collagen, in the infected dentin²⁰. Guzman and Guzman²¹ conducted clinical studies on subjects with skin lesions caused by burns and observed the enzymatic action of papain, and concluded that papain is effective in areas with necrotic and purulent processes. Udok and Storujuk²² also confirmed that papain aided cleansing of the necrotic tissue and secretions reduced the healing period. Flindt,²³ proposed that papain acts only on damaged tissue due to the absence of an

anti-plasmatc protease, alpha-I-antitrypsin, that hinders its proteolytic action in tissues considered normal. The lack of alpha-I-antitrypsin in infected tissues allows papain to break the partially degraded molecules. According to Dawkins²⁴ papain has bactericidal and bacteriostatic properties that inhibit the growth of gram positive and gram negative organisms. An *in vitro* study by Bussadori and Martins²⁵ of Papacarie cytotoxicity using fibroblast culture in different concentrations (2, 4, 6, 8, and 10%) of papain led to the conclusion that the same was not cytotoxic. Bussadori¹⁴ also observed through an electronic scanning microscope that in conventional techniques for decayed tissue removal in permanent teeth with caries, dentin surfaces showed a residual smear layer, whereas while using Papacarie there was more preservation of dentin structure and bacterial removal. Michelle C L et al showed that the use of a papain-based gel to remove dental caries did not interfere in the bond strength of restorative materials to dentin.²⁶ The restoration met functional needs, and is an easy and inexpensive solution in the case of very apprehensive patients. With the available reference the chemo-mechanical caries removal has so far been the most promising method as alternative treatment procedures especially for children, anxious and medically compromised patients.

CONCLUSION

This paper has discussed and reviewed an extensive literature on use of (Papacarie) *Carica papaya* for of removing caries and cavity preparation. This new dimension of treating caries involves painless selective removal of soft caries dentin without the removal of sound dentin. It can be recommended for patients where local anaesthetics are contra-indicated. Further clinical studies have to be performed to add evidence to the existing literature for their efficiency and extent of removal of carious dentine.

CONFLICT OF INTEREST

Conflict of interest declared none.

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