

Chemomechanical Methods of Caries Removal: An Innovative Approach of Caries Removal

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Abstract: Caries is a 'localized post erupted pathological process of external origin, involving softening of hard tooth tissue and proceeding to the formation of a cavity.' Conventional caries removal and cavity preparation involve bur usage and air-rotor but there are several limitations to it. In this era of minimal intervention dentistry, the changing concept of cavity preparation and the introduction of reliable adhesive materials have led to the development of alternative methods of caries removal. Chemomechanical caries removal (CMCR) is a non-invasive technique eliminating only the infected dentine. Instead of drilling, this method uses dissolution by a chemical agent assisted by an atraumatic mechanical force to remove soft carious structure and leaves the affected dentine as it is.

Keywords: Caries, Chemomechanical, Painless, Affected Dentine, Infected Dentine

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I. Introduction

The word 'caries' is derived from the Latin word meaning 'Rot' or Decay. According to the World Health Organization (WHO) definition, Caries is a 'localized post erupted pathological process of external origin, involving softening of hard tooth tissue and proceeding to the formation of a cavity.' Conventional caries removal and cavity preparation involve bur usage and air-rotor but there are several limitations to it such as

- 1) The perception that drilling is unpleasant
- 2) Local anesthesia is frequently required
- 3) Drilling can have deleterious thermal effects on pulp.
- 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.¹

In this era of minimal intervention dentistry, the changing concept of cavity preparation and the introduction of reliable adhesive materials have led to the development of alternative methods of caries removal. Chemomechanical caries removal (CMCR) is a non-invasive technique eliminating only the INFECTED DENTINE. Instead of drilling, this method uses dissolution by a chemical agent assisted by an atraumatic mechanical force to remove soft carious structure and leaves the affected dentine as it is.¹

CMCR agents act by causing degradation of the partially degraded collagen in the infected dentine, without causing any damage to normal dentinal tissues. The technique involves applying of solution/gel to the carious dentin, allowing it to soften the tissue, and, finally, scraping it off with special hand instruments.



Pic.1 Pictorial representation explaining Infected and Affected Dentin

DEVELOPMENT OF CMCR AGENTS:

Like any scientific process, the development of CMCR agents has been a long process. The first used chemo mechanical caries removal agent was Sodium hypochlorite, which is a nonspecific proteolytic agent. It

effectively removes organic components at room temperature. Effects of sodium hypochlorite as a chemo mechanical caries removal agent were studied by Habib C M, J Goldman and M Kronman, by placing a carious tooth in 5% sodium hypochlorite with the result that all carious tissue was removed. However it proved to be too unstable and aggressive on the healthy tissue. It was therefore incorporated into the solution of Sorensen's buffer, which contains a mixture of sodium hydroxide, sodium chloride and Glycine in an attempt to reduce the deleterious effects. This first formula, called GK101 consisted of N-MONOCHLORO GLYCINE (NMG), which proved to be more efficient than the sodium hypochlorite. GK 101 acted slowly and efforts to speed up the procedure resulted in emergence of GK101E. In this system, amino butyric acid replaced glycine; the product was named as N-monochloroaminobutyric acid (NMAB), and designated as GK101E.²

CARIDEX:

Based on GK101E, a caries removal system called Caridex was given FDA acceptance in 1984. It was introduced in the US market in 1985 by National Patent Medical Products Inc.; a New Jersey based pharmaceutical company.

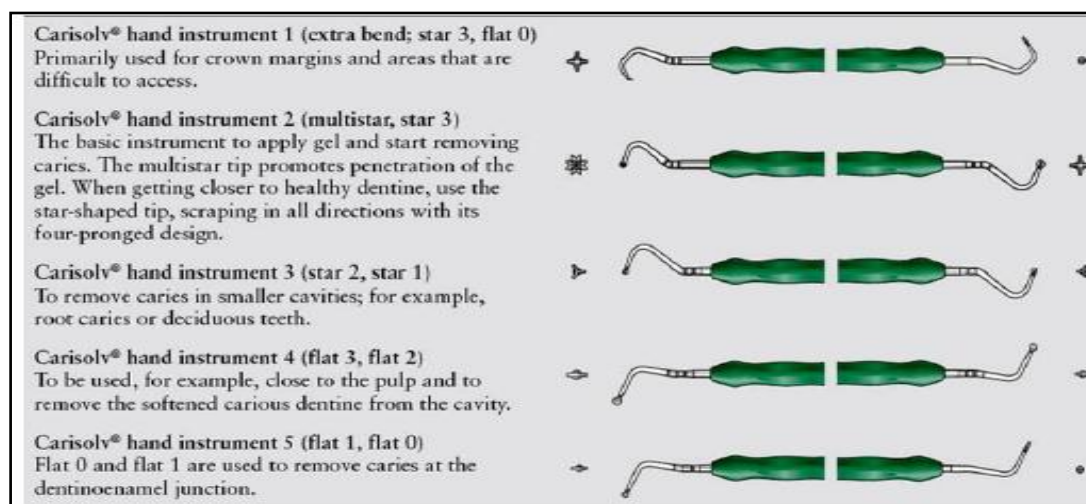
MECHANISM OF ACTION OF CARIDEX:

The mode of action involves the chlorination of partially degraded collagen in the carious lesion and conversion of hydroxyproline to pyrrole-2 carboxylic acid. It may involve cleavage by oxidation of glycine residues, which disrupts the collagen fibrils and makes their removal easier. The application of Caridex selectively removes decayed dentin.

CARISOLV

MediTeam in Sweden developed Carisolv which was in the form of a pink gel that can be applied to the carious lesion with specially designed hand instruments. It is marketed in two syringes, one containing the sodium hypochlorite solution and the other a pink viscous gel which contains three amino acids: Lysine, Leucine and Glutamic acid, together with Carboxymethylcellulose to make it viscous and Erythrosin dye to make it readily visible in use. Because it is a gel, the volume required is less than 1ml, it is much easier to apply, and there is better contact with the carious lesion. It requires neither heating nor a delivery system.³

MECHANISM OF ACTION OF CARIOSOLV is similar to Caridex, except, the replacement of Monoaminobutyric acid by three different charged amino acids. These acids were shown to with different moieties of carious lesion.³



Pic 2. Hand Instruments used for Carisolv¹

PAPACARIE GEL

Bussadori et al introduced Papacarie which consists of papain enzyme (extracted from the latex of leaves and fruits of the green adult Carica papaya tree), Chloramine, Toluidine blue, salts, preservatives, a thickener, stabilizers and deionized water. The mechanism of action depends on the papain enzyme which is a proteolytic enzyme that causes degradation of proteoglycans in the dentinal matrix. It has bactericidal and anti-inflammatory actions. The Chloramine enhances the removal of denatured tissues.⁴

CARIE-CARE

It is a more recent solution developed by Uni-Biotech Pharmaceuticals Private Limited, Chennai, India in collaboration with Vittal Mallya Scientific Research Foundation. Even this is a gel-based formulation containing papain enzyme along with the benefits of Clove oil. Papain breaks peptide bonds and involves deprotonation of Cys-25 by His-159. Clove oil is a natural analgesic and anesthetic.⁵

BIOSOLV

It is an experimental enzymatic chemomechanical caries removal agent which is not commercially available (coded SFC-V and SFC-VIII). Based on the manufacturer's information, it consists of pepsin enzyme in a phosphoric acid/sodium biphosphate buffer. It is claimed that the phosphoric acid can dissolve the inorganic components of caries-infected dentine, while permitting the pepsin to selectively disrupt the denatured collagen fibers. Meanwhile, this softened mass can then be easily removed by the specially designed plastics instruments without affecting sound tissue.²

II. Conclusion

Based on existing evidence, it can be concluded that the currently available chemomechanical caries removal methods can be considered as a viable alternative to conventional rotary caries removal methods. These methods could be extremely useful in very anxious, disabled and pediatric patients.

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