

**NEW TRENDS IN TREATMENT OF DENTAL CARIES IN OUTREACH PROGRAMME –
CARISOLV**¹Raju H.G¹Associate Professor , Department of Preventive and community Dentistry, Navodaya Dental College, Raichur, Karnataka.**ABSTRACT**

Dental caries is a global disease that affects almost everyone. The presence of untreated (unfilled) carious lesions is quite common in rural areas among school going children. Poor awareness about oral health, lack of dental manpower, lack of required infrastructure and lack of political will are some possible reasons which have contributed to this picture. Conventional caries treatment is carried out with a high speed hand piece to gain access to the lesion and low speed hand piece to remove caries. This is found to be unpleasant by many patients. The new technique chemo-mechanical caries removal more documented alternative to traditional drilling. This compendium is about Carisolv a chemo-mechanical system for non-invasive, gentle dentine caries removal based on biological principles through the use of an active gel and special hand instruments that preserve healthy tissue and increase patient comfort. Carisolv gel is applied to the caries affected area of the dentine where it softens the diseased portion of the tooth. Healthy tissue is preserved. The softened carious dentine is removed with special Carisolv instruments and filled with adhesive material (i.e GIC) the treatment is quick and effective. Many patients and dentists call it "a silent revolution". Clinical studies have shown that Carisolv reduces or eliminates pain in association with caries removal. The reduced need for local anesthesia and drills also lead to minimized post-operative pain or discomfort. All these aspects prompt more patients treated with Carisolv to return to the dentist if caries reappears. A quick review of dentine caries will clarify the requirements of an effective, chemo-mechanical caries removal system.

KEY WORDS: CMCR, Cariodex, Carisolv, Dental Caries.**INTRODUCTION**

Dental caries is a global disease that affects almost everyone. Although its prevalence strongly varies from country to country, on average about half of the children in the world have caries before they receive their permanent teeth. By the time they are 12 years old, 44-76% of all children have caries. The decayed/missing/filled teeth (DMFT) score then continues to increase with age. By the time an individual reaches the age of 65, the oral health has continued to deteriorate and on average 14-22 teeth are affected by the disease. It can be found on World Health Organisation's (WHO) data.

The main factors that correlate with caries prevalence are saliva levels of S mutans and lactobacilli, frequency of sugar consumption, oral hygiene and salivary secretion rate.¹ The treatment traditionally includes drilling to remove caries and make the cavity suitable for a filling material. Using drills to remove caries is a functional treatment approach that is about 100 years old. The main difference now vs then is that the drills have

become more sophisticated and go faster. Unfortunately the treatment is frequently associated with pain, which has caused many people to fear going to the dentist. Due to the non-selective nature of drilling, the treatment can also be associated with unintentional removal of healthy tissue in order to assure that all caries is removed.

Tissue preservation and prevention

The current odontologic era is characterised by increased efforts toward less invasive treatment and preventive dentistry. One example involves the use of fluoride. Another relates to reduced invasiveness through the use of new filling materials. It is understood that original tissue preservation enhances the prognosis of the individual tooth. New techniques aimed at less traumatic caries removal have emerged, for example lasers and air abrasion. Tissue preservation and non-invasiveness also form the fundamental base of Carisolv.

Dentine caries

Dentine is a vital mineralized tissue that surrounds the pulp. The tissue is formed in a collagen network and has dentinal tubules that radiate from the pulp to the enamel. Contrary to the enamel, only half of the dentinal tissue volume consists of hydroxyapatite. The crystals are smaller and contain more carbonates.²

As a bacterial acids come in contact with the vital dentine, the odontoblast processes in the dentinal tubules begin to deposit mineral. New dentine is also formed on the walls of the pulp.³ As the bacterial acids gradually dissolved the mineral, the collagen network is exposed and the dentine softened. The crystals become smaller during the dissolution process and porous areas are formed. Re- and remineralization also lead to deposition of irregular crystals in the tubules and the dentine. At this stage, the deeper (inner) carious layer is slightly dematerialized, but contains an intact organic matrix with sound collagen fibers and some apatite crystals bound to the fibers. The intact collagen framework of the inner layer has the potential to reorganize and remineralise if the acid challenge is discontinued^{2,4}, whereas recalcification does not occur in the outer carious layer.³

If the disease progresses, the collagen exposed to the bacterial acids becomes less resistant to enzymatic degradation and the demineralization is no longer reversible. As the mineral dissolves, enzymes break down the collagen⁵ and eventually the dentinal structure in the necrotic part of the lesion is lost. Continued progression of the disease results in destruction of the pulp and apical periodontitis.

In the light, it becomes clear that an effective, chemo-mechanical dentine caries removal system should identify the border between remineralisable and non-remineralisable dentine and only influence the latter. The surface that remains after caries removal should be hard and etchable to support a filling.

TREATMENT OF CARIES LESIONS

Drills

Conventional caries treatment is usually carried out with a high-speed hand-piece to gain access to

the lesion and a low-speed hand-piece to remove the caries. The low-speed removal procedure is found particularly unpleasant by many patients.⁶

Local anaesthesia is often required and the injection can generate patient anxiety.⁷ Drilling can cause deleterious thermal and pressure effects on the pulp.^{8,9} Therefore a water coolant is often used to reduce damage to the pulp-but the appliance of cool fluid to the dentine can be associated with pain. Due to the non-specific nature of drilling, it can result in rapid removal of uninfected dentine. i.e., excessive loss of healthy tissue.¹⁰

Advantages with the method involve quick and efficient caries removal and a high treatment acceptance by both dentists and patients.

Lasers

Laser technology involves a "non-touch application" of energy impulses. The latest instruments can also remove hard tissue with the laser beam. Impulses are passed directly to the treatment point via a flexible fiber.

Advantages compared to regular drilling involve less pain, noise and pressure. Lasers are also suggested to reduce vibrations and provide a sterile cut surface. The main disadvantages relate to the high price and that the method cannot be used on intra-oral metals.

Air abrasion

During air abrasion, an air-powered stream of for example aluminium oxide is blasted on the tooth. The stream is applied with incremental pressure from 40 to 150 psi. It can be used for cleaning of crowns and bridges as well as to gain access to and remove caries. The equipment comes in many shapes and price categories.

The procedure is claimed to be soundless and painless. It has also been suggested that air abrasion enhances bonding to the excavated surface. But air abrasion has proved to be less effective on soft, spongy carious tissue compared to hard enamel. It is also recommended that neighbouring teeth are covered with rubber dam, which makes the procedure more complicated than traditional drilling.

Atraumatic restorative treatment

Atraumatic Restorative Treatment (ART) involves both prevention and treatment of dental cares. The ART procedure is based on excavating and removing cares with hand instruments alone. The tooth is then restored with an adhesive filling material, i.e. glass ionomers.¹¹ WHO endorsed the approach back in 1994¹² due to the potential the method offers in third world countries.¹³

In the mid 1980's, ART work pioneered in Tanzania. The studies were followed by several community field trials conducted in Thailand, Zimbabwe and Pakistan in 1991, 1993 and 1995. Results of the studies in Thailand and Zimbabwe have shown that 71% and 85% - respectively, of the ART restorations remained intact after 3 years.^{14,15} The use of ART in third world countries continues to increase. A major concern relating to ART involves the risk of leaving infected carious dentine. It has also been pointed out that complete removal with hand instruments alone can be difficult.¹⁶

Chemo-Mechanical Caries Removal

Chemo-mechanical caries removal (CMCR) is the most documented alternative to traditional drilling. In summary, the procedure involves the application of a chemical solution to the carious dentine followed by gentle removal with hand instruments. This implies minimal removal of sound teeth structure, less cutting of open dentinal tubules, reduced risk for pulp irritation and less pain compared to conventional mechanical methods.¹⁷ CMCR is currently the only approach that includes a selective caries softener.

The first step toward CMCR

Sodium hypochlorite is a non-specific proteolytic agent that effectively removes organic components at room temperature.¹⁸ The seed of the first chemo-mechanical caries removal system was planted after one of its development had used sodium hypochlorite to remove organic matter from dentine. He experimented further by placing a carious tooth in 5% sodium hypochlorite with the result that all carious tissue was removed.¹⁹

The sodium hypochlorite proved to be too unstable and aggressive on healthy tissue. It was therefore incorporated into a solution of Sorensen's buffer, which contained a mixture of sodium

hydroxide, sodium chloride and glycine. This first formula, called GK101, consisted of N-monochloroglycine 9NMG). It proved to be more effective than sodium hypochlorite alone.²⁰ It was invented by CM Habib, J Goldman and M Kronman, who published the first report in 1975.²¹

GK 101 turned out to act slowly and additional efforts to speed up the procedure resulted in GK 101E. Based on GK 101E, a caries removal system called Caridex gained FDA acceptance in 1984. It was introduced on the US market in 1985 by National Patent Medical Products Inc, a pharmaceutical company in New Jersey. Research was carried out documenting clinical efficacy and safety. Eventually shortcoming with Caridex became apparent:

- Efficacy and speed of caries removal needed improvement.
- It was expensive.
- Large quantities were required for intermittent use during excavation.
- The solution had to be heated.
- A large reservoir with pump was needed for application and the product was delivered in large containers.
- The shelf-life of an opened container was short.
- The hand instruments were not optimal.
- The product was launched in an era when new dentine bonding agents were not considered reliable-instead mechanical undercuts created by drilling were needed for retention.

In the end, the Caridex method proved to be too expensive with too many drawbacks. National Patent Medical Products discontinued the project. The shortcomings of the Caridex system were addressed in the development of Carisolv.

Carisolv

Background: During the 1980's studies aimed at finding effective and tissue preserving methods for chemo-mechanical caries removal were initiated by Swedish scientists at the dental departments of universities in Malmo, Huddings and Goteborg, as well as Chalmers Technical University in Goreborg. Christer Hedward started Medi Team initiated joint collaborations with biochemist Lars Strid at Chalmers. Lars Strid was the first to discover the shortcomings relating to the single amino acid of Caridex.

Independent of Lars Strid and Christer Hedward, efforts aimed at improving Caridex were carried out during the 1980's by Dan Ericson and Rolf Bornstein. A joint collaboration was initiated between the parties in 1990. Their work resulted in the development of a new, patented system for chemo-mechanical caries removal called Carisolv.

Carisolv has been approved for clinical dental use by the Swedish counterpart to the US FDA and currently sold in most European countries.

Description of Carisolv²²

Carisolv consists of a red gel and a transparent fluid. Equal parts of the two are mixed to form the active gel substance. The red gel primarily contains three different amino acids (glutamic acid, Leucine and lysine) and sodium hydroxide. The transparent fluid contains the reactive hypochlorite component (NaOCl). Carisolv gel is available in two different package; Carisolv gel multimix and Carisolv gel single mix.

Multimix contains gel and hypochlorite sufficient for 10-15 treatments. Only the amount of gel needed for each individual treatment is mixed. Single mix is delivered in a pack of five and designed for five separate treatments.

Mode of action

When the gel and fluid are mixed in the syringe, the amino acids bind chlorine and form chloramines at a high pH. The three amino acids are differently charged, which allows for an electrostatic attraction to different areas of the proteins in the carious dentine. The information of chloramines reduces the reactivity of the chlorine without altering its chemical function. The chemical result of these processes is breakdown of degraded collagen characteristically found in the dematerialized portion of carious lesion. The gel only softens the carious dentine while healthy tissue is unaffected. The degraded collagen has an open structure and is therefore more susceptible to further breakdown by chloramines. The porous nature of dematerialized dentine allows for penetration of Carisolv. The unaffected collagen is more resistant to degradation, but the framework of degraded collagen in the porous minerals is broken down and can easily be scrapped off.

Hand instruments for caries removal

When the lesion has been accessed and the dematerialized dentine softened, special hand instruments are used to remove the carious tissue layer by layer. The instruments are available with permanent or interchangeable tips designed to access different types of lesions. Most of the Carisolv instruments have a sharp edge and blunt cutting angles, resulting in a large area of support against the underlying surface coupled with controlled and effective cutting depth. Other drills and excavators tend to work their way into materials in a non-precise manner due to their aggressive cutting angles and smaller support areas.

Evaluating a caries-free surface

The common guideline to assuring that a surface is caries-free after drilling is that the probe should not stick to the lesion once it is excavated.²³ This also applies to Carisolv; and it is time to check with the probe when the gel is no longer cloudy and a scraping sound from the instruments indicate a hard surface. Note that when Carisolv has been used, the remaining surface is rougher than a drilled cavity since the healthy tissue remains intact.

Cariou lesion prepared with a drill

The cavity is symmetrical and follows the contours made by the drill. The structure of the dentine indicates that even sound tissue has been removed and that the pulp has been exposed.

Cariou lesion prepared with Carisolv

The cavity is uneven and follows the spread of the lesion. The dentine has a different structure and no healthy dentine has been removed.

Conclusion of chemo-mechanical characteristics.

- Only demineralised dentine is affected. The three amino acids react with the NaOCl to form chloramines. This modifies the chlorine reactivity, i.e. neutralizes its aggressive behavior on healthy tissue.
- The gel is applied at room temperature, which reduces the risk for pain sometimes associated with the use of cool liquids used with other caries removal procedures.

- The gel consistency simplifies control of the application and reduces the risk for a spill.
- The hand instruments are available with permanent or interchangeable tips that have different sizes and shapes. The unique designs enable efficient caries removal and access in hard-to-reach areas. The non-cutting characteristics of the instruments assure ultimate tissue preservation.
- It requires minimal hand instruments hence treatment carried to the remote areas is easier.(i.e. camps)
- Public at large can be treated in minimum amount of time hence this technique is accepted by WHO.
- Nowadays art procedure with carisolv technique is mostly preferred hence it is accepted by many public health professionals.

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