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Chemomechnical Caries Removal-CMCR

Medical Science

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ABSTRACT

Now a day caries removal has become more efficient even though the approach of drilling a cavity remains. This is unpleasant to the patients many a time. There may a need for local anesthesia and there can be potential side effects to the pulp due to heat and pressure. There are several ways of removing caries. Chemomechanical caries removal is one non invasive alternative for the removal of carious dentin. It is well suited to the treatment of deciduous teeth, dental phobics and medically compromised patients

Introduction

Chemomechanical caries removal involves the chemical softening of carious `dentin followed by its removal by gentle excavation. The reagent generated by mixing amino acids with NaOCl, N-Monochloroaminoacids are formed which selectively degrade the demineralised collagen in carious dentine. The procedure requires 5-15 minutes but avoids the painful removal of sound dentine thereby reducing the need for local anesthesia. The dentine surface formed is highly irregular and well suited to bonding with composite resin or GIC.[1]

Dentine consists of mineral : 70% weight

H_2O : 10% weight

Organic matrix: 20% weight (18% collagen and 2% non collagenous compounds including proteoglycans, phosphophoryns, and chondroitin sulphate).

Collagen is a protein which contains large amount of proline and one third of amino acid content is glycine. The polypeptide chains are coiled into triple helix which is known as tropocollagen units.[2] These tropocollagen units then orientate side by side to form a fibril. Covalent bonds between the polypeptide chains and between tropocollagen unit's forms cross links and give the collagen fibrils stability, in dentine the fibrils are in the form of a dense meshwork which becomes mineralized.[3]

When caries occurs, acids produced by plaque bacteria by anaerobic fermentation of carbohydrate initially cause solubilisation of minerals in enamel. As the process progresses, dentinal tubules provide access for penetrating acids and subsequent invasion by bacteria which results in a decrease in pH and causes further acid attack and demineralization.[1]

When organic matrix has been demineralised, the collagen and other matrix components are then susceptible to enzymatic degradation mainly by bacterial proteases and other hydrolases. With respect to collagen degradation two zones can usually be distinguished within a lesion. There is an inner layer which is partially demineralised and can be remineralised and in which the collagen fibrils are still intact and there is an outer layer where the collagen fibrils are partially degraded and cannot be remineralised. CMCR reagent must be able to cause further degradation of this partially degraded collagen by cleavage of the polypeptide chain in the triple helix.[1]

Principle on which CMCR is based is on the studies by Goldman and Kronman. They were studying the effect of NaOCl which is a nonspecific proteolytic agent, on removal of caries material from dentine. NaOCl itself however was too corrosive for use on healthy tissue and so they decided to incorporate into Sorenson's buffer (which contains glycine, NaOH, NaCl) in an attempt to minimize problem.[4]

Quite fortuitously a reaction occurred within this product which was more effective in removal of carious dentine. This involved chlorination of glycine to form N-monochloroglycine (NMG) and the reagent became known as GK-1019. They found out that system was more effective, if glycine was replaced by amino butyric acid, the product then being N-Monochloroamino butyric acid (NMAB) designated as GK 101E. [5]

Mechanism of Action: [1]

Originally it was thought that procedure involved chlorination of partially degraded collagen in the carious lesion and the conversion of hydroxyproline to pyrrole-2-carboxylic acid. Recent work suggests that cleavage by oxidation of glycine residues could also be involved. This causes disruption of collagen fibrils which becomes more friable and then can be removed.[6]

NMAB (Caridex) consists of 2 solutions:

Solution - I containing NaOCl

Solution - II - Glycine, amino butyric acid, NaCl and NaOH

The two solutions are mixed immediately before use to give the working reagent (pH approximately 11) which is stable for one hour. A delivery system is available which consists of reservoir for the solution, a heater and a pump which passes the liquid warmed to body temperature through a tube to a handpiece and an applicator tip which comes in various shapes and sizes. The solution is applied to the carious lesion by means of this applicator which is used to loosen the carious dentine by a gentle scraping action; the debris together with the spent solution being removed by aspiration. Application is continued until the dentine remaining is deemed sound by normal clinical tactile criteria with suitable accessible soft lesions, after 5-10 minutes treatment only clinically sound dentine remains.[7]

The reagent selectively removes carious dentine leaving a surface with many overhangs and undercuts. Dentine scales are a frequent feature of the surfaces formed and dentinal tubules will be both patent and occluded. This surface should be well suited to restoration with modern adhesive materials such as GIC.[8]

The procedure avoids the painful removal of sound dentin but is ineffective in the removal of hard eburnated parts of the lesion; removal of eburnated caries however may not be necessary. Recently it has been shown that discoloration in carious dentin results from the **Maillard reaction** which modifies amino acids in collagen thereby making them more resistant to proteolytic attack and inhibiting lesion progression in discolored dentine. [1]

Although Caridex system initially proved to be quite popular, large volumes of solution were needed 200-500 ml and the procedure was slow (time involved 10-15 minutes).[4]

Studies have been carried out on the nature of dentine surface remaining after complete caries removal by CMCR. Electron probe micro-analysis showed that dentine is sound and properly mineralized and that surface formed is highly irregular. [1]

Histological studies have confirmed the irregular nature of dentine surface and also shown that some dentinal tubules contain bacteria but the level of these is no higher than in mechanically prepared cavities.[7]

Because of time required for CMCR treatment, the large volume of solution needed and the fact that the delivery system was no longer commercially available. Use of CMCR, despite its potential became minimal.[6]

One of the recent CMCR Reagent known as CARISOLV hit the headlines in January 1998.

Although this is similar to the Caridex and NMAB systems it is in the form of Pink gel which can be applied to the carious lesion with specially designed hand instruments. Because it is gel, the volume required is less than one milliliter and it requires neither heating nor a delivery system. It is marketed in 2 syringes, one containing NaOCl and the other a pink viscous gel which contains 3 amino acids lysine, leucine, glutamic acid together with CMC (Carboxymethyl cellulose) to make it viscous and erythrocin to make it readily visible in use. The contents of the 2 syringes are mixed by a simple system which involves joining the two together immediately before use as its effectiveness begins to deteriorate after 20 minutes.[6]

The gel is applied to the carious dentine with one of hand instrument and after 30 seconds, carious dentine can be gently removed. More gel is then applied and the procedure repeated until no more carious dentine remains, a guide to this being when the gel removed from the tooth is clear. The time required for this procedure is 10-15 minutes and the volume of gel is only 0.2 - 1.0 ml. [1]

Rotary instruments may still be required however for some cavities but preliminary reports indicate the patient acceptance is very good.

The system is much easier to use than Caridex and because it involves gel rather than liquid there is better contact with the carious lesion. When complete caries removal is achieved by this technique the cavity surface has been shown to be as sound as that remaining after conventional drilling. [1]

Advantages:

- Reduced need for local anesthesia
- Conservation of sound tooth structure
- Reduced risk of pulpal exposure
- Well suited for anxious and medically compromised patients as well as to pediatric and domiciliary dentistry.

Limitations:

Rotary and hand instruments may still be needed for removal of tissue or material other than degraded dentine collagen. This includes access to small or interproximal carious lesions, removal of enamel overlying the caries, removal of existing restorations etc as well as for cavity design when non adhesive restorative materials are used.

ENZYMES:

Studies have examined the possibility that carious dentine might be able to be removed by using certain enzymes. In 1989, **Goldsberg and Keil** successfully removed soft carious dentin using bacterial **Achromobacter collagenase**, which did not affect the sound dentin layer beneath the lesion.[2]

A more recent study has used the enzyme **pronase**, a non-specific proteolytic enzyme originating from **Streptomyces griseus** to help remove carious dentine.

This might have significant clinical implications but further laboratory research is required for validation of this technique.

Conclusion

The main aim of modern dentistry is preservation of tooth structures by minimal invasive procedures. Chemo mechanical caries removal selectively removes demineralised dentin. This technique helps to preserve as much healthy tooth structure as possible and it also ensures Chairside diagnosis and removal. It may be very comfortable for the patient. The disadvantage is the prolonged time factor needed in finishing the procedure. In many cases the use of a bur is almost always needed along with this method. Caries involving enamel and restoration related caries cannot be treated with chemomechanical method alone.

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