

EFFICACY OF CHEMO-MECHANICAL METHOD (CARISOLV) OF CARIES REMOVAL WITH THAT OF HAND CUTTING AND ROTARY CUTTING INSTRUMENTS

¹ jaya sankar

²Vasundhara shivanna

³Dhanya kumar .N.M

¹ Reader,

²Professor and Head,

³Professor

¹ Department of Conservative Dentistry and Endodontics, Yogita Dental College, Khede, Ratnagiri, Maharashtra, India.
^{2,3} Department of Conservative Dentistry and Endodontics, college of Dental sciences, Davangere, Karnataka. India.

ABSTRACT:

Background and objectives : To evaluate the efficacy of chemo-mechanical method (carisolv) of caries removal with that of hand cutting and rotary cutting instruments with the help of knoop hardness measurements of the cavity floor. **Method :** The 45 carious molars were subjected to caries detector (Kavo DIAGNOdent) to assess the extent of the lesion before and after the study. The selected samples was divided into 4 groups of 15 teeth each. The first 3 groups were taken as study group Group I (Carisolv), Group II (Hand excavation), Group III (Carbide bur), and Group IV (Control). The treated cavities were cross-sectioned perpendicularly along the long axis of the tooth through the middle of the treated cavity and then subjected to knoop hardness test. **Results :** The knoop hardness of the remaining dentin thickness was least for group II (hand excavation) and highest excavation for control group IV (normal dentin), group I (carisolv) and group III (carbide bur) showed KHN values that was not statistically significant when compared to group IV. On comparing group I with group III the KHN of remaining dentin thickness of group III was more than group I but this was not statistically significant. **Conclusion :** It was thus concluded that group II (hand excavation) showed the least knoop hardness value and group I (carisolv) and group III (bur) showed similar to that of normal dentin although values of group III was more than group I but it was not statistically significant.

KEYWORDS: Carisolv; DIAGNOdent; knoop hardness.

INTRODUCTION

"Dental caries is defined as an infectious microbiologic disease of the teeth that results in localized dissolution of the calcified tissues".- sturdevant¹

In every field of dentistry, an awareness of the importance preserving tooth tissue, combined with a patient friendly approach is becoming self-evident. It has been shown that operative treatment often leads on an increasing scale to further operative and more invasive treatment. Wherever possible, tissue should be preserved, invasive treatment should be kept to a minimum and natural tissue should be replaced with artificial substitutes only when it is absolutely unavoidable. The best way to ensure a maximum life for the natural tooth is to respect the sound tissue and protect it from damage by using minimally invasive techniques in restorative dentistry. Removal of caries is done by various methods like hand excavation, rotary bur, carisolv gel, sono-abrasion, air-abrasion, ultrasonics, lasers and polymer burs etc. The current odontological era is characterised by an increasing move towards less invasive treatment and towards preventive dentistry. It is understood that preservation of original tissue enhances the prognosis of the tooth.²

Conventional method for caries removal is usually carried out with a high-speed hand-piece to obtain access to the lesion and a low-speed hand-piece with round bur to remove the caries. A water coolant is often used to reduce damage to the pulp.

The first report of a chemo-mechanical system for caries removal was published in 1975 by Habib et al and marketed under the trade name of caridex. Chemo-mechanical caries removal (caridex) involves the use of the sodium hypo chlorite, a non-specific proteolytic agent removing organic components at room temperature, however long working time and inappropriate instruments prevented caridex from achieving clinical success. A new patented method for chemo-mechanical caries removal has been developed, called carisolv. Carisolv gel is a two component mixture. Equal parts of the two are mixed to form the active gel substance. One of the components primarily contains three amino acids (Glutamic acid, leucine, and lysine) and sodium hydroxide. The other fluid contains the reactive hypochlorite component. Chemo-mechanical caries removal (CMCR) is the most documented alternative to traditional drilling for dentine caries removal.²

Materials and methods

Forty five freshly extracted human permanent molar teeth with class I dentinal caries and 15 freshly extracted non carious human permanent molar teeth were selected for the study. Each carious lesion was analysed according to the color and hardness of the lesion. Carious lesions with a brown-to-black color and medium consistency (it was resistance to probing but readily penetrated when tested with a sharp probe) were selected for this study. All lesions had no "Enamel" coverage, and dentin was easily accessible through the cavity openings. The extent of the carious lesions was further assessed by means of KaVo DIAGNOdent 2095 (KaVo Dental GmbH, Jena Germany) that provided a pulsed 655-nm laser beam was directed into the tooth (Fig.1). When the incident light encountered a change in tooth substances, it stimulated fluorescent light of a different wavelength. This was translated through the hand piece into a number from 0 to 99 for the selection of carious dentin in this study, had the following criteria suggested by Ross (1999) were used : that is

1. if 0-20 means no caries,
2. if it is 20 and above means the caries is deep into the enamel and/or dentin.



Fig.1. DIAGNOdent

Carious lesions that scored higher than 26 with this laser ray were used. (Tapered fiber-optic tip A) for measurements, before obtaining the values, the DIAGNOdent was calibrated against a ceramic standard following the manufacturers instructions.

These 45 carious molars were divided into 3 groups of 15 teeth each and 15 non carious molars was taken as control

Group I consisted of 15 carious molar teeth subjected for chemo-mechanical method of caries removal , carisolv system was used according to the manufacturers instructions. Carisolv applied on the surface of the carious lesions for 30 seconds and excavation done with specified carisolv instruments until the gel was clear.

Group II consisted of 15 carious molars were caries removed by hand instrument using spoon excavator (Hufriedy).

Group III consisted of 15 carious molars were caries removed by rotary cutting number ½ round carbide bur (SS WHITE) and slow speed contra angled micromotor handpiece (NSK EC, made in Japan)

Group IV consisted of 15 non carious molars taken as control group.

All the samples were checked with DIAGNOdent and the cavities were cross sectioned perpendicularly to the tooth axis through the middle of the treated cavity with sectioning unit (Fig.2. and Fig.3.) and then subjected to knoop hardness test by micro hardness testing device (Fig.4. and Fig.5.)

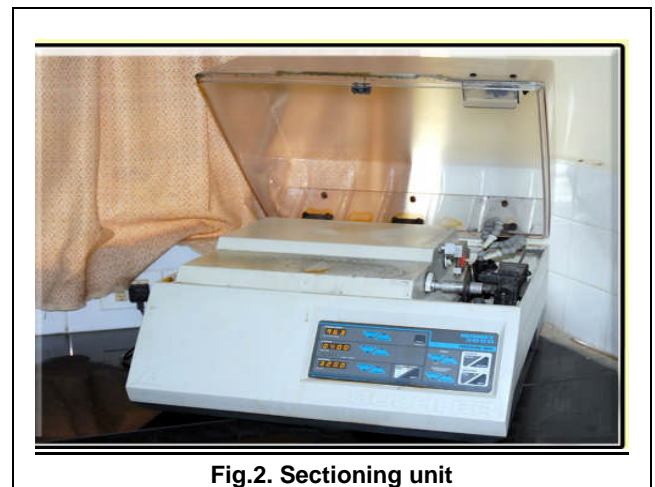


Fig.2. Sectioning unit

Knop hardness measurements of the cavity floor

Previous studies have indicated that the determination or completely remove carious dentin is difficult with the carisolv treatment and the possibility of remaining caries following the carisolv treatment is a major concern³⁻¹⁴; caries removal with the carisolv leaves upto a mean of 50 µm more carious dentin than round burs¹⁵ (Splieth and others, 2001). Some clinical guidelines are, therefore, necessary to identify residual carious dentin Splieth¹⁵ and others, (2002) and Cederlund and others (1999a) verify caries removal according to the color and hardness of the lesion with a sharp explorer; the hardness of the dentin was checked with a dental explorer until a leather hard

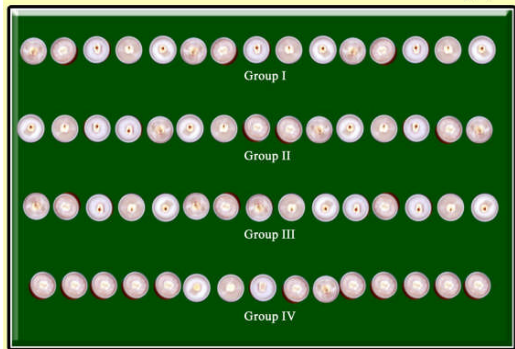


Fig.3. Cross sectioned specimen -acrylic embedded

texture was reached or a sharp scratching sound was heard. As these methods are operator dependent, so we recommend a combination of hardness testing by explorer and DIAGNOdent. In this study, initially, gross caries removal was verified according to the color and hardness of the lesion, with a sharp explorer subsequently, the treated cavity was carefully assessed by means of DIAGNOdent. The usefulness of this device for the assessment of the carious dentin removal has previously been reported³⁻⁶. Further research on the ability of DIAGNOdent to detect dental caries should be performed.



Fig.4. Microhardness Measuring device



Fig.5. Microscopic indentations

The degree of softened dentin removal was determined by KHN measurements of the cavity floor and the adjacent sound dentin as suggested by Aoki and others (1998). The results of KH measurements of the carisolv cavity floor confirmed that the possibility of remaining residual, softened dentin was minimal in this study because no statistically significant differences were noted in microhardness of the carisolv cavity floor dentin and the adjacent sound dentin (reference control)(**Fig.5**). The results further indicate that accurate evaluation of KHN is possible in this methods used in this study, and the efficiency of complete carious dentin removal by the carisolv chemo-mechanical system is no longer difficult when a proper clinical guide is used.

Statistical analysis

Description data that included mean, standard deviation and range values were calculated for each group and were used for analysis. One-way ANOVA was used for multiple group comparisons followed by unpaired t-test for group wise comparisons. A p-value of 0.05 or less was considered for statistical significance.

Results

The amount of knoop hardness in all the groups are summarised in **Table-I** and related information in terms of mean standard deviation and range values are presented in **Table -II**.

Summary of results

It was seen that knoop hardness of the remaining dentin thickness was least for group II (hand excavation) and highest for control group IV (normal dentin). Group I (carisolv) and group III (bur excavation) showed KHN values that was not statistically significant when compared to group IV. On comparing group I with group III, the KHN of the remaining dentin thickness of group III was more than group I but this was not statistically significant . Analysis of the samples after caries removal, by using Kavo Diagnodent indicated the values below 20 indicating adequate caries removal by the procedure.

Table 1. Inter group Microhardness comparison

	Mean ± SD	Range
Gr. I	59.9 ± 0.9	58.0 – 62.8
Gr. II	51.2 ± 1.8	47.6 – 53.2
Gr. III	60.6 ± 2.0	58.0 – 62.8
Gr. IV	60.7 ± 1.2	59.02 – 62.8

Table.2. Comparison of mean standard deviation between different groups

Groups	Mean \pm SD	Difference between groups			
		Groups compared	Mean difference	t*	p
I	59.9 \pm 0.9	I – II	8.7	16.4	< 0.001 (HS)
		I – III	0.7	1.22	0.24 (NS)
		I – VI	0.08	1.93	0.07 (NS)
II	51.2 \pm 1.8	II – III	9.4	13.5	< 0.001 (HS)
		II – IV	9.4	16.7	< 0.001 (HS)
III	60.6 \pm 2.0	III – IV	0.10	0.13	0.90 (NS)
IV	60.7 \pm 1.2				

One way ANOVA, F = 136.8 P < 0.001, HS

* Unpaired "t" test, II < I < III < IV; P < 0.001, HS; P > 0.05, NS

Discussion

It is important to evaluate minimally invasive techniques for caries treatment, which are more acceptable to patients and clinically sound previous studies compared manual techniques with the bur (Anusavice and Kencheloe, 1987; Phantumvanit et al., 1996; Ericson et al., 1999; Banerjee et al., 2000; Fure et al., 2000).^{9,16,17} All of these studies reported that manual techniques were efficacious including chemo-mechanical and mechanical methods.

Caries removal in decayed teeth has conventionally been performed using the mechanical cutting and drilling system. However, mechanical preparation often induces pain, and local anaesthesia is therefore needed. It is often difficult to establish exactly how much tooth material should be removed, which often leads to overextended cavities. As possible alternatives to the conventional technique, along with these alternatives various methods have been used for the early detection of caries in which DIAGNOdent is the most recent advancement in caries detection it uses a pulsed 655 nm powered visible red laser beam i.e., directed into the tooth. Previous studies have reported several chemo-mechanical caries removal systems for caries removal. Habib, Kronman and Goldman (1975) reported a chemo-mechanical caries removal system, using the pharmacodynamic action of sodium hypochlorite. Caridex system that consists of N-monochloro-DL-2-Aminobutyrate (NMAB) is formed by mixing equal parts sodium hypochlorite and aminobutyric acid, which is used to dissolve the carious dentin. It is high patient acceptance was reported by Zinck and others (1988). Recently developed, Carisolv, which contains sodium hypochlorite and three kinds of amino acids (glutamic acid, leucine and lysine), has shown the capability to minimize the disadvantages of traditional

cavity preparation (Ericson and others, 1998; Ericson, 1999a)⁹. Carisolv does not need a mechanical device and uses specially designed blunt edge excavators used for "gentle excavation".

The present study showed that evaluation of carious dentin before and after examination is using DIAGNOdent, which is highly effective in detecting the caries. The extent of Kavo DIAGNOdent 2095 that provided a pulsed 655-nm laser beam directed into the tooth. When the incident light encountered a change in tooth substances, it stimulated fluorescent light of a different wave length. This was translated through the hand piece into a number from 0 to 99. This finding is supported by other studies.^{11,18,19} The present study also showed that removal of complete carious dentin was not effective by using Hand Excavation with spoon excavator, because of inability to reach inaccessible areas of the tooth and also limited cutting efficiency. This finding is also supported by other studies^{14,15}.

It was also seen that the removal of carious dentin with Carisolv is highly effective than that of Hand Excavation, but slightly less than round carbide bur. It may be because of carisolv which removes only the infected dentin and not the affected dentin.

So the results showed that the Knoop Hardness value is highest for Group IV (control) than comes the Group III (carbide bur) followed by Group I (carisolv) and Group II (Hand excavation).^{8, 16, 19, 20}

A study was conducted to evaluate KHN of remaining dentin removal by carisolv and round carbide bur. The result showed that knoop hardness of remaining dentin

was higher than that of carisolv excavated dentin but this result was not statistically significant¹⁴.

The goal of conservative treatment is to avoid unnecessary loss of tooth structure, so in this study knoop hardness is evaluated after caries excavation to compare with that of affected dentin. Diagnodent is also used as an adjunct to confirm accuracy in excavation of infected dentin only, which aids in preserving affected dentin.

CONCLUSION

Carisolv was effective in removing infected dentine and preserving affected dentin because it removes only denatured dentine and knoop hardness values are near to that of normal dentin. But these results were not statistically significant.

Although round carbide bur was effective in removing carious dentin but it removed affected dentin as well. So the knoop hardness number of remaining dentin was similar to that of normal dentin and more than that of carisolv but these results were not statistically significant. Hand excavation produced least value because of incomplete caries removal. Due to inability to reach inaccessible areas of the tooth, Followed by least cutting efficiency.

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Corresponding Author

DR.JAYASANKAR
 Department of Conservative Dentistry and
 Endodontics ,
 Yogita Dental College,
 Khede, Ratnagiri, Maharastra, India.
 PH:09886382037
 Email:drjaggi77@yahoo.co.in