

# EFFECT OF CHEMOMECHANICAL EXCAVATION (CARISOLV™) ON RESIDUAL CARIOGENIC BACTERIA

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## Abstract

The chemomechanical excavation approach fits the "adhesive cavity" design criteria by producing a rounded internal outline of cavity walls. However, such a relatively new and conservative approach should be at least as effective as conventional bur excavation in the removal of residual caries.

**Objectives:** The aim of the present study was to test the effect of Carisolv™ chemomechanical excavation on caries removal and residual cariogenic bacteria as compared with conventional bur excavation using simple chair-side methods.

**Methods and Materials:** A total 15 patients (mean age 42.7±11.3), presenting with a number of isolated class V carious lesions, were selected for the study. The carious lesions in each patient were randomly assigned to one of the excavation methods: (i) caries removal with Carisolv™ (n=22), (ii) conventional excavation with a bur (n=24). The carious lesions were measured before and after excavation by laser fluorescence, using DIAGNOdent®, and the presence of cariogenic bacteria was evaluated using a microbial assay (Replica test).

**Results:** Both methods yielded similar results in DIAGNOdent® readings (9.9 and 7.9 for chemomechanical and bur excavation, respectively) and microbial assay (2.8 and 2.9% for chemomechanical and bur excavation, respectively). No significant difference was observed between the two excavation methods (p>0.05).

**Conclusions:** This suggests that the efficacy of chemomechanical excavation in carious removal and cariogenic bacterial reduction equals that of conventional bur excavation.

**Short title:** Chemomechanical effect on cariogenic bacteria

**Key Words:** Chemomechanical excavation, Cariogenic bacteria, Replica test

## Introduction

Recent developments in adhesive dentistry over the last decades have dramatically changed the clinical approach to cavity preparation. These changes paved the way for more minimalistic means of cavity preparation in which sound tooth structure is preserved<sup>1</sup>. Traditionally, carious may be removed mechanically with burs, hand excavators, and air-abrasion, or chemomechanically<sup>2</sup>. Whereas, diamond and tungsten carbide burs simultaneously and indiscriminately remove caries-infected and caries-affected dentine, the chemo-mechanical technique (Carisolv™) aims to both preserve tooth structure and excavate

caries on the basis of biological principles. The existence of two layers of carious dentine has been shown previously<sup>3,4</sup>. This technique is based on the ability of sodium hypochlorite combined with three amino acids (Glutamic acid, Leucine, and Lysine) to selectively remove already denaturated collagen fibers in the outer layer of the carious lesion<sup>5</sup>. The use of this technique has also improved the process of residual caries diagnosis, which has traditionally been carried out visually and relies mainly on tactile probing. Evaluating the cloudiness of the Carisolv™ solution as a measure for the presence of caries in terms of denaturated collagen, offered the clinician an additional tool for caries diagnosis. Combining this approach with digital detection of caries autofluorescence (DIAGNOdent®) was shown to be an effective and promising method<sup>6</sup>.

However, despite these improvements in caries diagnosis and treatment, the question of residual cariogenic bacteria still remains a major point. It has been well reported in the literature that the presence of cariogenic bacteria around and beneath restorations is the most important factor in restoration

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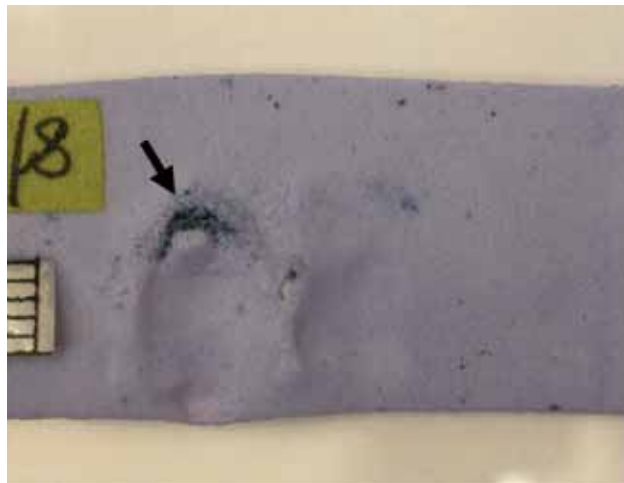
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*Fig. 1. Shows the results of a typical replica test. An imprint of the sampled tooth is presented following incubation in a liquid mutans streptococci selective medium at 37°C for 24 h. The bacterial colonies, stained dark blue are clearly visible (arrow).*

failure. In a comprehensive survey of prospective studies on the clinical performance of posterior resin composites it was found, that secondary caries was one of the main reasons for failure <sup>7</sup>. An accurate and reliable antimicrobial approach is important for effective long term treatment success.

Sodium hypochlorite is commonly used as a disinfecting agent due to its antimicrobial activities <sup>8</sup>. This antimicrobial agent has been shown to be effective against bacteria in dental infections <sup>9</sup> and cariogenic bacteria <sup>10</sup>. The sodium hypochlorite incorporated into the chemomechanical excavation gel was found to maintain these antibacterial properties <sup>11</sup>.

Laboratory detection of cariogenic bacteria is fairly accurate but requires the use of elaborate microbiological techniques <sup>12</sup>. Dentine sampling is the most commonly used method for evaluating the presence of cariogenic bacteria within the carious dentine <sup>12,13</sup>. However, these methods are complicated and hardly suitable as a chair-side procedure. A method for imprint sampling of cariogenic bacteria from tooth surfaces was reported by Rosenberg et al. <sup>14</sup>. According to this method an imprint of the tooth surface (or cavity) can be taken using sucrose-containing impression material (chewing gum) and incubated in a selective medium for cariogenic bacteria. In the present study, we implemented this simple chair side technique for the detection of cariogenic bacteria on the tooth surface before and following cavity preparation, using a conventional bur or chemomechanical excavation.

The aim of the present study was to evaluate the effect of Carisolv™ chemomechanical excavation on caries removal and residual cariogenic bacteria as compared with that of conventional bur excavation.

## Materials and Methods

### Study Population

Fifteen patients (mean age 42.7+11.3) presenting with a number of isolated class V carious lesions were selected from the Hadassah Dental Faculty Patient list. Informed consent was

obtained and the experiment protocol was approved by the Institute's Helsinki Committee. All the patients received professional teeth cleaning and oral hygiene instructions one week prior to the experiment.

### Experimental Protocol

The carious lesions (active lesions, vital teeth) in each patient were randomly assigned to one of the excavation methods: (i) chemomechanical excavation with Carisolv™ (Medi Team, Dentalutveckling AB, Savedalen, Sweden) (n=22), (ii) conventional excavation with a bur (n=24). Chemomechanical excavation was conducted according to the manufacturer's instructions using the hand tools and gel supplied in the kit. Bur excavation was conducted using low speed round burs. The treatments were performed by three experienced dental practitioners. Caries excavation was monitored twofold, before and after excavation, by a single operator blinded to the mode of excavation assigned to each tooth. Measurements included DIAGNOdent® (Kavo, Biberach, Germany) readings of the carious lesion and the microbial contact assay (Replica Test; 14) for the detection of mutans streptococci on tooth surfaces. The measurements are described in detail below.

### Microbial Assay

The replica test, using an impression matrix, was carried out by pressing a commercial gum containing sucrose (West, banana chewing gum, ION, Greece) against the buccal tooth and cavity surface. An imprint of the sampled teeth was obtained for further bacterial cultivation <sup>14</sup>. The imprinted matrix was immersed in a liquid mutans streptococci selective medium (composed of tryptose, proteose peptone, trypan blue, gentian violet, potassium tellurite and bacitracin) and incubated at 37°C for 24 h. The bacterial colonies, stained dark blue, were clearly visible (Fig 1). After 24 hrs incubation, the imprints were photographed using a digital camera (Coolpix 5000, Nikon, Japan). Cariogenic bacterial growth was evaluated by

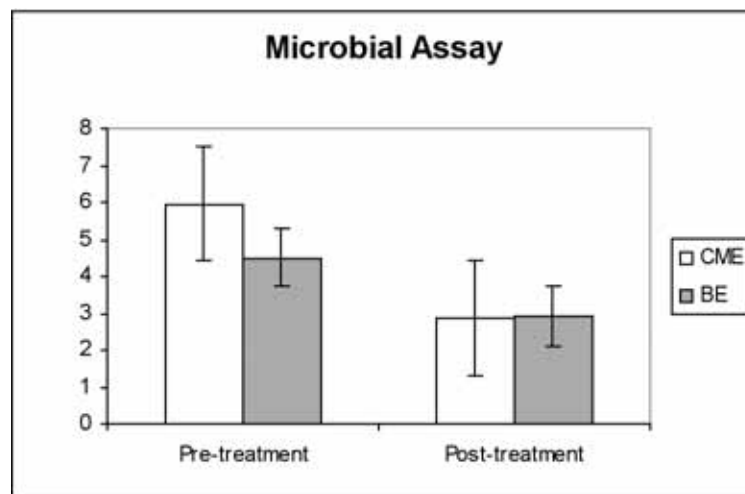


Fig. 2. Mean result and standard deviation of the % of cariogenic bacteria CFU stained area as measured using the replica test before and after caries removal by chemomechanical (CME) or bur (BE) excavation.

quantifying the amount of blue color produced on the imprint of the sampled tooth surface/cavity using digital images analyzing Software, (ImageJ NIH).

#### Fluorescence caries measurement

The DIAGNOdent® laser fluorescence system (Kavo, Biberach, Germany) was used to measure the carious lesion before and after excavation<sup>15</sup>. Measurements were performed by a single operator according to the manufacturer's instructions. The probe tip for smooth surfaces (B) was selected and the device was calibrated against a porcelain reference object and sound tooth surface. The device was held against the carious lesion and the maximal reading was recorded.

#### Statistical Analysis

The mean results and standard deviations of the various parameters were compared using ANOVA. P value of 0.05 or less was considered statistically significant.

#### Results

The results are shown in Figures 2 and 3. No statistical difference was observed between the two excavation methods before and after treatment both in terms of the microbial assay (ANOVA,  $p=0.31$  and  $p=0.71$ , pre and post treatment, respectively) and the laser fluorescence readings (ANOVA,  $p=0.34$  and  $p=0.26$ , pre and post treatment, respectively).

Both excavation methods showed a similar efficacy in reducing cariogenic bacterial concentration, resulting with mean bacterial concentration (expressed as percentage of stained area within the total cavity area) of less than 3% ( $2.8\pm 2.9$  and  $2.9\pm 2.3\%$  for chemomechanical and bur excavation, respectively) for both methods. Laser fluorescence readings as measured by the DIAGNOdent® were significantly reduced by both methods to mean readings of less than 10

( $9.9\pm 6.3$  and  $7.9\pm 5.2$  for chemomechanical and bur excavation, respectively) levels defined by the manufacture as "no caries".

#### Discussion

Both traditional bur excavation and the chemomechanical excavation used in this study showed a similar efficacy in caries removal, as measured using DIAGNOdent®, and by the reduction in the amount of cariogenic bacteria, as measured using the replica test. These results are in agreement with those of other investigators<sup>12,16-18</sup>, who used different bacteriological methods, mainly cultures of dentine samples.

Dentine sampling is traditionally carried out by sampling the deepest dentine within the carious lesion or cavity preparation, using a sterile low speed round bur. These samples are later processed and evaluated for their bacterial content. The microbial assay used in this study (i.e. Replica test) is a simple chair-side method that does not require extensive microbiological expertise. In contrast to the dentine sampling techniques commonly used in this type of investigation, the replica test does not require sampling dentine for laboratory analysis, thus eliminating the need for healthy tissue removal once the cavity preparation has been completed. Furthermore, this method helps to overcome a problematic aspect of dentine sampling, i.e. variations in sample volume. These variations were attributed to diverse factors, such as the differences in dentine consistency, sampling procedures and drying time<sup>12</sup>.

However, despite its many advantages the replica test used in this study still requires incubation and growth of the bacteria and suffers from the same drawbacks as the traditional cultivation methods in comparison with molecular methods (i.e. PCR), especially in underestimating the number of bacteria.

The criteria for complete caries removal are subjective and open to interpretation by the clinician. In the present study we

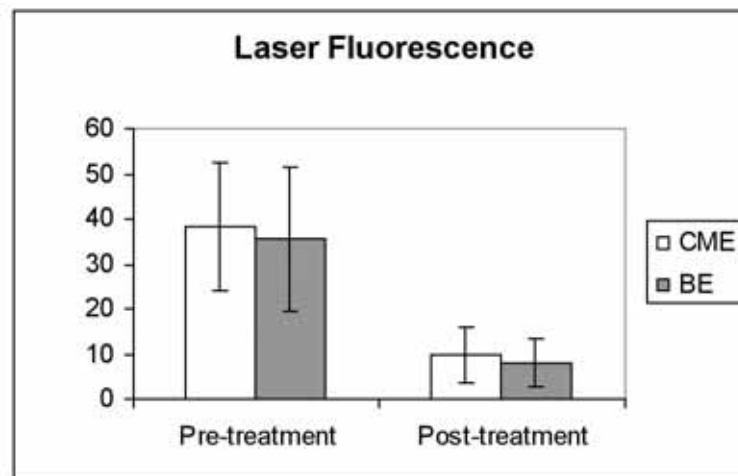


Fig. 3. Mean result and standard deviation of the laser fluorescence readings as measured using the DIAGNOdent® before and after caries removal by chemomechanical (CME) or bur (BE) excavation.

supported these criteria using objective laser fluorescence (DIAGNOdent®) readings. According to the DIAGNOdent® criteria all the cavities were considered caries free following excavation with both excavation methods.

Various studies have shown that clinically caries-free dentine still contains residual cariogenic bacteria and it has been suggested that the small number of persisting cariogenic bacteria is of no clinical significance<sup>13,19</sup>. However, the location of the residual cariogenic bacteria may also be of significance. For instance, bacteria located in the vicinity of the dentine-enamel junction are of more clinical significance with regard to secondary caries formation than those situated in other parts of the cavity<sup>20</sup>. Use of the replica test provides an imprint sample of the entire cavity surface, enabling additional information to be obtained regarding the topographical distribution of the residual cariogenic bacteria within the various parts of the cavity surface.

Other studies have shown that although chemomechanical excavation is more time consuming than traditional bur excavation<sup>21</sup> and can take up to three times longer<sup>22</sup>, the estimated quantity of tissue removed is significantly lower<sup>22</sup>. The approach now gaining acceptance worldwide of treating caries as a disease rather than a lesion<sup>21</sup> places great emphasis on the reduction of the cariogenic bacterial load as part of this treatment. The results of our study indicate that the antimicrobial ability of the chemomechanical excavation enables it to achieve the same reduction in the cariogenic bacterial load as the bur excavation, by using a more minimalistic approach.

### Acknowledgements

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# DENTASA NEWS



## AGM

Our "AGM on steroids" was one of the best ever according to the large numbers of technicians and traders in attendance. The AGM meeting was reduced to a shorter 90-minute version of powerful discussions of all key issues concerning the profession. The speakers addressed a variety of very interesting issues and all feedback from the technicians present was very good.

The following changes will take place in the profession soon:

- All technicians will have to acquire CPD points and the SADTC will be the administrator thereof. The DENTASA has applied to be the facilitator of programs/workshops and will register with SAQA.
- The technician's tariffs will possibly be changed to a National Reference Price Guide, with no minimum prices stipulated.
- Technicians will be allowed to claim directly from the Medical Aids, but are reminded that the Medical Aids only have a contract with the patient and not with the dentist or the technician.

The following lucky members attending the AGM meeting were the winners of the Kruger coins:

**Mr. Clint Davis:** 1/2 Kruger Rand

**Mr. Daniel Swanepoel:** 1/4 Kruger Rand

**Mr. Gavin Atkinson:** 1/10 Kruger Rand

*It pays to be a member of DENTASA, join today!*

At the Awards Dinner, Mr. Edwin Bovill, lecturer at the then Technikon Pretoria was awarded the Merit Award for Outstanding Achievement for his decades of service to dental technology.

*A special word of thanks goes out to the large group of students from The Cape Peninsula University of Technology that made the great trek north to join us for the AGM. It was a great effort, guys, and an example to all technicians!*

**The next AGM will take place on the first weekend in June 2008.**

In closing, a message from the DENTASA Executive:

***"Our comfort zones will be stretched during the next few months: "Man your battle stations" and "Gird your loins" because 2008 will be a watershed year for dental technicians in South Africa".***

Be involved, stay informed, be a DENTASA member!

BREAKING NEWS: ABSA now offers members of DENTASA credit card services at *STUNNING* rates.

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