

Caries Removal by Chemomechanical (Carisolv™) and Conventional (Airotor) Methods – Comparative In-Vitro Study

Dr. Sivakumar Pydi¹, Dr. Vikramsimha.B², Dr. Sirisha.N.R.³, Dr. Srinivas.R⁴,
Dr. Narayana Rao.V⁵, Dr.Krishna.V⁶

Abstract:

Aim: To compare the caries removal efficacy between chemomechanical method (Carisolv™) and conventional method (airotor) in freshly extracted molars.

Materials And Methods:

100 freshly extracted molars with dentinal caries on the occlusal surface were selected. Of which, 50 teeth were treated with chemo-mechanical (Carisolv™) and in the other 50 teeth by conventional (airotor) method. Completeness of caries removal and the amount of operating time taken were assessed for evaluating the efficacy of caries removal. Student 't' test was used for comparing the efficacy between chemomechanical method and the conventional method.

Results: There was a highly significant ($p=0.000$) difference observed for the mean operating times between complete caries removal using chemo-mechanical method (5.38 ± 0.93 minutes) and conventional method (2.92 ± 0.52 minutes). All of the 50 teeth had no decay in the cavity after the preparation with conventional method, whereas only 44 teeth out of 50 teeth were without decay when treated with chemo-mechanical method. The observed difference between the two methods was statistically significant ($p=0.027$).

Conclusion: Chemo-mechanical method can be used as an effective clinical alternative operating procedure for the removing occlusal dentinal caries in cavitated teeth, which has controlled removal of tooth structure and helps in increasing the patients' compliance.

Keywords: Dental caries, Chemomechanical caries removal, Carisolv, Efficacy, Conventional method.

I. Introduction

Advances evolved in the field of dentistry made conservation of tooth structure to a maximum. Minimally-invasive dentistry is the one which comprises biologically oriented procedures. The precise treatment with care results in long lasting outcomes without any complications and meets the demands of the people. Removal of caries by chemo-mechanical method is one such minimally invasive procedure, which has a significant weightage in caries management techniques in terms of conserving the sound tooth structure.¹ This is a method of caries removal based on dissolution.^(M. Ganesh and Dhaval Parikh) The removal of caries with this chemo-mechanical method is less threatening than conventional method using airotor, which can be advantageous in children and apprehensive patients and can be used as an alternative to conventional airotor method.² Increased compliance of patients was observed with the use of chemo-mechanical caries removal over conventional airotor method.³

Many invasive techniques have been evolved through years for removal of caries. Hand instruments were the most primitive of them, where the procedure was painful and tiresome. Over a period of time evolution of rotary instruments from low speed to ultrahigh speed took place to overcome the disadvantages in using hand instruments. But, the major drawback with these rotary instruments was thermal and pressure effects on pulp which produced pain. Other alternative techniques like air abrasion, ultrasonic instrumentation, lasers and chemomechanical approach to caries removal were developed to reduce the insults to the pulp. Because of the economic concerns, these, air abrasion, sono abrasion, ultrasonic instrumentation, lasers are less often used.^{4,5,6,7}

Chemomechanical method involves application carisolv (weak sodium hypochlorite and a blend of lysine, leucine and glutamic acid) to the carious lesion. Selective softening of the carious dentin occurs, which can be gently scraped off with the hand instruments. Hence, this method is harmless to sound dentin by preserving the affected dentin. Thus carisolv which is a gel-based caries removal method, serves as a minimally-invasive procedures.⁸ Many in-vivo studies^{9,10,11,12} have documented the suitability of Carisolv for the dentin caries excavation but the in-vitro study comparisons are few. Since there is an alarming increase in the prevalence of dental caries globally, clinical efficiency of the operative procedures for the treatment of dental caries needs to be assessed.

The purpose of this study was to compare the caries removal efficacy between chemomechanical method (Carisolv™) and conventional method (airotor) in freshly extracted molars based on the time needed and completeness of caries removal.

II. Materials And Methods

The present clinical trial was conducted in the Department of Public health Dentistry in a dental institution in AndhraPradesh, India.

Out of the total 152 freshly extracted permanent first and second molars with occlusal dentinal caries, 100 teeth which have met the inclusion criteria were selected for the trial. The teeth with carious lesion that have extended till the dentin, without extensive coronal destruction were included. Teeth with incipient carious lesion on the enamel or deep lesions close to the dental pulp or involving pulp were excluded. Radiographs were taken to verify the caries involvement.

The extracted teeth were rinsed with sterile water immediately after extraction and were kept frozen in -20°C until further procedures in a small container. The teeth were thawed at room temperature overnight before the experiment. The teeth were mounted before starting the procedure. Information regarding the tooth number, time needed for caries removal and completeness of caries removal by each technique was recorded in a proforma.

Inter examiner calibration was done with a gold standard examiner for the assessment of caries removal, in which both the time taken by each technique and complete caries removal during the procedure were included. Kappa co-efficient value for inter-examiner and intra-examiner reliability were 0.80 and 0.89 respectively which signify almost perfect agreement.¹³ Ethical clearance was obtained from institutional review board (IRB).

Caries removal was done using chemo-mechanical method (Carisolv™) in the experimental group before restoration with amalgam or GIC. Strict infection control protocol was followed during the study. Manufacturer's instructions were followed during caries excavation with Carisolv™ (Single-mix). It is a mixture of two components. Two equal parts are mixed together in a small plastic cup just before the use, to form an active gel substance. When needed, the cavity is to be opened up to adjust the periphery of the cavity with a round diamond bur mounted (No. 310) on a high speed hand piece. The usage of bur was limited only to remove undermined enamel from dentino-enamel junction and adjustment of the outline form if required to gain access into the carious dentin. Dentinal caries was done using the Carisolv™ gel and specially designed hand instruments provided by the manufacturer.

The carious lesion was allowed to saturate with the Carisolv™ gel using single tufted brush applicator and allowed to act for 30 seconds. Special hand instruments, which are provided with permanent or interchangeable tips designed to access different types of lesions, were used. After excavation of the dental caries, the gel becomes cloudy because of the softened carious tissue. Three-way syringe was used to clear the cloudy residue from the cavity and fresh gel was applied repeatedly until the gel no more turned cloudy. After the complete removal of caries, the completeness of caries removal was assessed by the investigator. Tactile sensation and visual examination were used as guide for complete caries removal.

In Control group, caries removal was carried out with conventional method using a high speed handpiece (airotor) and diamond point No. 310 bur (SS-White).

After the caries removal procedure, the efficacies of both methods were recorded using various parameters such as operating time needed for caries removal and completeness of caries removal. Each prepared cavity was assessed by the operator for evidence of remaining caries using an explorer with a gentle force.

The clinical criteria used to judge the completeness of caries removal were visual examination (to assess the colour and evidence of soft caries) and tactile sensation (to assess the hardness and consistency of dentin). Magnifying lens was used to aid visual examination when needed. The time required for completion of caries removal was recorded using a stopwatch.

Statistical Analysis

Data was compiled using Microsoft excel software and analyzed using SPSS V.20.0. The mean operating time between the chemomechanical method (Carisolv™) and conventional method was compared using student 't' test. Fisher Exact Test was used to compare proportions of the teeth with complete removal of caries between the two groups. The cut-off level for statistical significance was fixed at 0.05.

III. Results

Out of the total 100 freshly extracted teeth, half (50) were allocated to the two groups, which were treated by both the clinical procedures. Table 1 shows the mean operating time between the two methods of caries removal. There was highly significant ($p=0.000$) difference observed between the two groups corresponding to the mean operating time. The mean \pm S.D of the operating time of conventional method was (2.92 \pm 0.52) more than the chemo-mechanical method (5.38 \pm 0.93).

The number of teeth with complete caries removal in both the groups was shown in the table 2. Complete removal of caries was achieved in all the 50 (100%) teeth, which were treated with conventional

method, whereas only 44 (88%) teeth treated with chemo-mechanical method had no decay, remained in the cavity after the preparation. This observed difference was statistically significant ($p=0.027$).

IV. Discussion

The main disadvantage of the concept “extension for prevention” is the removal of sound tooth structure for the cavity preparation. With advancements in dental materials, the concept minimal intervention dentistry has evolved for caries management. Many materials have been developed for preserving the sound tooth structure during the treatment of dental caries.

Carisolv™ is one such material introduced for caries removal with maximum efficiency in caries removal and minimum damage to sound tooth structure. This method of caries removal overcomes the disadvantages of the conventional methods. Several studies proved the efficacy of Carisolv™ in the management of dental caries.

In the present study, caries removal method by Carisolv™ was compared with conventional method based on the operating time and the completeness of caries removal. An in-vitro comparison was made between the two methods in freshly extracted molar teeth.

The mean operating time for caries removal by Carisolv™ (chemomechanical caries removal) was 5.38 ± 0.93 minutes, which is more than the time taken by conventional method (2.92 ± 0.52 minutes). The observed difference in the operating time between the two methods was statistically highly significant ($p=0.000$).

These current findings were in correspondence with several studies. Ericson et al,⁶ observed a significant difference in mean operating time between these two methods. The mean operating time for both chemo-mechanical by Carisolv™ (10.04 minutes) and conventional method (4.46 ± 1.43 minutes) is more than the current study. Nadanovsky et al,⁵ reported 9.2 minutes (± 3.8 SD) with chemomechanical method and 8.6 minutes (± 3.8 SD) in the conventional method. In a study conducted by Kakaboura et al,¹⁴ time taken by Carisolv™ (12 ± 4.1 minutes) is longer than the conventional method (6.8 ± 2.8 minutes). Contrasting results were found in a study conducted by Maragakis et al,¹² where chemo-mechanical method removal by Carisolv™ took lesser time (6.51 minutes) compared to conventional method (11.81 minutes).

The increased operating time taken by chemo-mechanical method can be attributed to the repeated applications of Carisolv™ gel. Based on the size of the carious lesion, an average of 3-4 applications were done for the preparation in our study. Multiple times of inspection (visual examination and tactile sensation) added to this. The cavity was rinsed for inspection, as the cloudy gel made the examination difficult. The absorption of the Carisolv™ components by dentin resulted in the change in consistency of the remaining dentin and also its refractive index. The dull appearance may be due to thinner smear layer left by Carisolv™ treated dentin. The following other reasons can also be cited for increased time for complete caries removal: size of the cavities, type of the teeth selected (permanent first and second molars). On the contrary, in our study there was a direct access to the cavity preparation on mounted teeth, which resulted in less time consumption than previous studies.

Completeness of caries removal by both Carisolv™ and conventional method was also assessed in our study. It was shown that chemomechanical method was as effective as the conventional method in removing decayed tissue (Ericson et al⁶) and that the conventional method had the disadvantage of removing sound tooth structure (Banerjee et al¹⁵).

In our study, complete caries removal was achieved in 88% of teeth after being treated with Carisolv™ gel, which is in agreement with the findings observed by Ericson et al⁶ and Kakaboura et al.¹⁴ In their study they showed complete caries removal in 106 (90%) out of 113 and 41 (90%) out of 45 teeth respectively. On the contrary less number of teeth had achieved complete caries removal in studies conducted by Chaussain-Miller et al¹⁶ (82.5%) and Maragakis et al¹² (62.5%) with Carisolv™.

V. Conclusions

Caries removal by chemo-mechanical method can serve as an alternative to the conventional airotor method in removal of occlusal caries with efficiency. There will be controlled removal of tooth structure, preserving the sound tooth structure. This method can increase the compliance of patients and help in motivating them to receive dental treatment. Caries removal by chemo-mechanical method can be less threatening in children. Further research should focus on chemo-mechanical methods with less operating time and more efficient caries removal.

References

- [1]. Tasleem Hosein, Arshad Hasan. Efficacy of chemomechanical caries removal with Carisolv. Jour of College of Physicians and Surgeons Pak 2008; 18 (4): 222-25.
- [2]. Venkataraghavan K et al. Chemomechanical Caries Removal: A Review & study of an indigenously developed agent (Carie Care™ gel) in children. J int Oral Health 2013; 5(4):84-90.
- [3]. Ericson D, Bornstein R, Gotrick B, Raber H, Zimmerman M. Clinical multicentre evaluation of a new method for chemomechanical caries removal. Caries Res 1998; 32 (3):308.
- [4]. Yip HK, Samaranayake LP. Caries removal techniques and instrumentation: a review. Clin Oral Invest 1998; 2: 148–54.
- [5]. Nadanovsky P, Cohen Carneiro F, Souza de Mello F. Removal of caries using only hand instruments: A comparison of mechanical and chemo-mechanical methods. Caries Res 2001; 35 (5):384-89.
- [6]. Ericson D, Zimmerman M, Raber H, Gotric B, Bornstein R. Clinical evaluation of efficacy and safety of a new method for removal of caries. Caries Res 1999; 33:171-77.
- [7]. Pandit. K. Srivastava, Gugnani N, Gupta. M, Verma L. Various methods of caries removal in children. A comparative clinical study. J Indian Soc pedod prev dent 2007; 25 (2): 93-96.
- [8]. Yazici R, Atilla P, Ozgunaltay G, Muftuoglu S. In vitro comparison of the efficacy of Carisolv™ and conventional rotary instrument in caries removal. J Oral Rehab 2003 (12):1177-82.
- [9]. Daniel Ziskind, Ari Kupietzky, Nurit Beyth. First-choice treatment alternatives for caries removal using the chemomechanical method. Quintessence Int. 2005; 36 (1): 9-14.
- [10]. Katerina Kavvadia, Vassiliki Karagianni, Argy Plychronopoulou, Lisa Papagiannouli. Primary teeth caries removal using the carisolv chemomechanical method: A clinical trial. Pediatr Dent. 2004; 26 (1):23-8.
- [11]. Irena Balciuniene, Ruta Sabalaite, Inga Juskiene. Chemomechanical caries removal for children. Stomatoloj, Baltic dent and Maxillofaci Jour 2005; 7: 40-54.
- [12]. Maragakis GM, Hahn P, Hellwing E. Clinical evaluation of Chemomechanical caries removal in primary molars and its acceptance by patients. Caries Res 2001; 35: 205-10.
- [13]. WHO. Oral health surveys, basic methods. 5th ed. Geneva. World Health organization; 2013.
- [14]. Afrodite Kakaboura, Costas Masouras, Olga Staikou, George Vougiouklaki. AComparative clinical study on the Carisolv™ caries removal method. Quintessence Int 2003; 34 (4): 269- 71.
- [15]. Banerjee, Watson TF, Kidd EAM. Dentine caries excavation: a review of current clinical techniques. Br Dent J 2000; 188 (9): 476-82.
- [16]. Chaussain-Miller C, Decup F, Domejean S, Gillet D, Kaleka R, Laboux O. Clinical evaluation of the Carisolv chemomechanical caries removal technique according to the site/stage concept, a revised caries classification system. Clin Oral Invest 2003; 7: 32-7.