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Comparative Evaluation of Carisolv in Removal of Carious Dentin in Primary Molar Teeth: *in vitro* Study

Avaliação Comparativa do Carisolv na Remoção da Dentina Cariada em Molares Decíduos: Estudo *in vitro*

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RESUMO

Objetivo: Avaliar e comparar a eficiência e efetividade do Carisolv na remoção de tecido cariado em molares decíduos.

Método: Trinta molares decíduos cariados foram seccionados mesio-distalmente e obtidos 60 espécimes. O Carisolv foi utilizado para remoção do tecido cariado nas 30 seções as quais foram denominadas de Grupo Experimental (GE) e nas 30 seções restantes executou-se a remoção convencional, sendo denominado de Grupo Controle (GC). O tempo gasto para a remoção foi registrado (em minutos) e comparado entre os grupos. Todas as amostras foram analisadas quanto à quantidade de dentina desmineralizada remanescente sob estereomicroscópio. Os valores foram registrados em microns. A quantidade de tecido cariado remanescente foi verificada por meio da aplicação de corantes detectores de cárie. Em seguida, a dureza da dentina remanescente foi analisada através da dureza Vicker's, sendo realizada a comparação entre os grupos através do uso do Teste T de Student.

Resultados: Verificou-se que os valores médios para a remoção da dentina cariada mostraram-se estatisticamente significante e maiores para o Carisolv (GE) quando comparado à remoção convencional (GC). Ademais, observou-se que a remoção com o Carisolv deixa muito mais quantidade de dentina desmineralizada e a camada de dentina apresenta menor dureza quando comparada à remoção convencional.

Conclusão: Carisolv mostrou-se menos efetivo e eficiente quando comparado à remoção de tecido cariado convencional que demanda maior tempo para remoção do tecido cariado. Além do mais, a remoção com Carisolv deixa maior quantidade de dentina desmineralizada, a qual possui menor dureza do que as amostras obtidas com a remoção convencional.

ABSTRACT

Objective: To evaluate and compare the efficiency and effectiveness of Carisolv in caries removal in human primary molars.

Method: 30 primary molar carious teeth were sectioned mesio-distally, to obtain 60 specimens. Out of 60 specimens, Carisolv was used for excavation of caries on the 30 halves which served as the Experimental Group and conventional hand excavation was used for excavation of caries on other 30 halves which served as the Control Group. The time taken for excavation was noted down (in mins) and compared for each group. All the samples were mounted on wax bases to check the amount of remaining demineralized dentin under stereomicroscope. The values were noted down in microns. The amount of remaining caries was also checked with the application of caries detector dye with which the carious dentin gets stained as pink. Finally, the hardness of the remaining dentin was checked by recording its Vicker's hardness number and comparison was done between the two groups. The values obtained were calculated and compared by using student's 't' test.

Results: Mean value of time taken for removal of caries was found to be statistically significant and much more for carisolv (experimental) group as compared to conventional hand excavation. Moreover it was found that excavation with carisolv leaves behind much more amount of demineralized dentin and a dentinal layer which is less hard as compared to conventional hand excavation when analyzed statistically.

Conclusion: Carisolv was found to be less effective and efficient as compared to conventional hand excavation as it took much more time for excavation of caries. Moreover, excavation with carisolv leaves more amount of demineralized dentin which had much less hardness number than the hand excavated samples.

DESCRITORES

Cárie dentária; Dente decíduo; Carisolv; Preparo cavitário.

DESCRIPTORS

Dental caries; Tooth, Deciduous; Carisolv; Dental Cavity Preparation.

INTRODUCTION

Dental treatment is very often associated with pain and fear. It is estimated that 80% of all dental patients are apprehensive¹. Often this apprehension is due to pain/discomfort experienced with the use of drill during caries removal. Moreover, the use of drill equally removes infected and affected dentin, resulting in excessive loss of healthy tooth structure². In recent years, with the advent of adhesive restorative materials and the subsequent development in minimal cavity design, the widely accepted principle of "Extension for prevention" proposed by G.V Black, in operative treatment of carious lesions has been challenged and is now considered a very destructive method for caries removal³. The minimal removal of infected carious dentin, together with use of therapeutic restorative material is a fundamental requirement of modern operative dentistry. This concept of minimal intervention dentistry not only eliminates the pain associated with the removal of caries but also instills a positive attitude in children towards dentistry.

It was at this point that chemomechanical approach was introduced. This system is based on principle of minimal invasive dentistry which involves application of substances like Caridex and Carisolv and is considered to be non invasive alternative for the removal of carious dentin. Alleged advantages included removal of infected carious tissue only, absence of pain and absence of potential deleterious effects to dental pulp, due to heat and pressure⁴.

Hence this study was undertaken to compare the efficiency (time taken) and effectiveness (microhardness of remaining dentin) of conventional (hand excavation) and chemomechanical (Carisolv) methods of caries removal in extracted human deciduous molar teeth.

METHODOLOGY

Thirty carious human primary molar teeth which were about to shed were extracted and stored in 0.05 M phosphate buffered saline. In an attempt to standardize the lesion depths, teeth with occlusal carious lesions extending till the middle third of dentin were selected.

The selected teeth were sectioned using diamond disk with a water coolant in a mesio-distal direction. The depth of the lesion was checked with William's Graduated Periodontal Probe. Teeth in which the two halves had equal depth were included in the study. After selection of teeth the crowns were separated from the roots.

One half of each tooth was randomly excavated by hand instrument (spoon excavators) and comprised the control group and the other half excavated with Carisolv gel comprised the experimental group.

Carisolv system (single mix) was taken in a Dappen dish and used for chemomechanical removal, according to

the manufacturer's instructions, using Carisolv hand instruments. Access to the cavity was gained and covered with Carisolv gel. After waiting for at least 30 s for the gel to act, the softened dentin was excavated with excavators specially designed for Carisolv excavation. When the gel became cloudy it was removed with moistened cotton together with the dissolved carious dentin. Fresh gel was then applied and the cavity floor was repeatedly scraped until the gel became clear. The total time taken was noted down with stopwatch.

The other half of each section of primary tooth (buccal) where caries were removed by hand instrument constituted the control group. Caries were quickly excavated with Hu-friedly spoon excavator until the cavity floor was felt hard on probing. The total time taken for caries excavation was noted down with the stopwatch.

Caries excavation was judged complete by visual and tactile criterion, when the cavity floor was felt hard on probing. After this the samples were mounted on wax bases and amount of demineralized dentin remaining was measured (microns) under stereomicroscope using a software Image pro-plus⁵. Three values were taken at different points from the cavity floor and there average was calculated for both experimental and control group and comparison was done between two groups. Following these to further confirm the remaining caries present caries detecting dye (caries detector) was used to know any amount of remaining caries. The carious dentin attained pink color after application of caries detecting dye⁶.

The time taken for carious dentin excavation using hand and chemomechanical methods was recorded and compared.

After excavation, tooth halves were embedded in polyester resin, planed in a water-cooled mechanical grinder, using 400-, 600- and 1200-grit Al_2O_3 abrasive paper and polished with cloths using 0.6 to 4.5 mm Al_2O_3 solution. The hardness was tested with Vicker's microhardness tester (at Apollo test house, Bangalore) by making indentations at approx 100 micrometer distance from the cavity floor of all the samples⁷.

The VHN values were derived using the equation $\text{VHN} = 8541.4 \text{ p/d}^2$, where p is the applied load in grams, and d is the indentation length of diagonal, in micrometers.

The VHN numbers for hand excavation and Carisolv excavation were noted and compared. The values will be tabulated and statistically analyzed by Student's t test.

RESULTS

For all the tests, a p-value of 0.05 or less was considered for statistical significance. Mean and standard deviation values of time taken for caries excavation are summarized on Table 1. On comparison the experimental

group took much more time in caries excavation and showed a statistically significant mean difference ($p < .001$) than the control group.

Similarly there was a significant association between the two groups for amount of demineralized dentin remaining after caries excavation ($p = < .001$) where the experimental group left behind much more amount of

demineralized dentin than the control group as summarized in Table 2.

Further, hardness number of remaining dentin also showed a statistically significant difference ($p = < .001$) where experimental group had much lower mean value of hardness number than the control group as demonstrated in Table 3.

Table 1. Descriptive analysis showing the mean \pm sd, range for the time taken to excavate the caries among the experimental and control group.

Groups	N	Range	Mean \pm SD	Mean diff	t*	P value
Control	30	3.0-7.8	5.3 \pm 1.4	2.1	4.88	<.001HS
Experimental	30	3.2-11.0	7.4 \pm 2.0			

t*: unpaired t-test.

Table 2. Descriptive analysis showing the mean \pm sd, range for the amount of demineralized dentin remaining (microns) among the experimental and control group.

Groups	N	Range	Mean \pm SD	Mean diff	t*	P value
Control	30	16.65-43.90	31.65 \pm 8.16	33.70	14.9	<.001HS
Experimental	30	42.05-82.49	65.35 \pm 9.89			

t*: unpaired t-test.

Table 3. Descriptive analysis showing the mean \pm sd, range for vicker's hardness test among the experimental and control group.

Groups	N	Range	Mean \pm SD	Mean diff	t*	P value
Control	30	37.1-67.7	53.8 \pm 8.5	16.7	6.85	<.001HS
Experimental	30	20.0-59.4	37.1 \pm 1.03			

t*: unpaired t-test.

DISCUSSION

Philosophies of dental treatment change with time and now there is more than ample evidence provided by research for a reappraisal of traditional approaches to caries treatment³.

Recently, the concept of minimally invasive dentistry has been introduced on removing caries with methods that minimize the loss of sound enamel and dentin⁸. With the advent of newer adhesive restorative materials, that show dentinal bonding, the need to remove sound enamel and dentin is no longer essential. This led to resurgence of interest in alternative methods of caries removal and an evolution of chemomechanical method of caries removal. Moreover, caries removal with carisolv is known to be a less painful method and is therefore known to produce less anxiety and fear especially in children. Hence, the present *in vitro* study was undertaken to evaluate the efficiency and the effectiveness of chemomechanical carious dentin excavation using the Carisolv system in comparison to conventional hand excavation in human primary molars.

Molar teeth were selected because they are most prone for caries attack. The study was done to check the efficiency on Primary molars because children more commonly suffer from anxiety and fear of pain due to local anesthetic injections and carisolv appears to fulfill the promise of absence of pain.

Because natural lesions were used, it was not possible to standardize all variables of the sample, e.g. shape and activity status of the lesions. Therefore, split-tooth methodology was used to minimize these variables as the source of carious dentin, thus allowing for comparisons to be made between different, paired excavation methods^{7,9}.

On comparing, the results of our study showed that the carisolv assisted excavation takes longer time for caries removal than the conventional hand excavation method. This longer time was justified as the manufacturer does not specify the minimum application time, but rather states that the cavities should be treated until the gel becomes clear to be considered caries free⁷. Multiple applications of the carisolv gel for complete caries removal may also be a reason for the increased time needed. However, it is necessary because the gel becomes blurred during the procedure and inspection of the cavity is difficult without rinsing it off. In addition, the dull appearance of the dentin cavity walls left after each carisolv rinse-off may cause difficulties in caries removal evaluation. The dull appearance may be due to a thinner smear layer left on the carisolv treated dentin as well as the rougher surface produced¹.

In our study also it was found that carisolv excavation leaves more amount of demineralized dentin as compared to hand excavation. This may be attributed to the chemical

nature of carisolv and its high pH which may cause more collagen destruction thus leading to increased porosity and decreased hardness of the remaining dentin which was also confirmed by the third parameter of the study in which hardness of the remaining dentin was checked using Vicker's hardness tester and it was found that the hardness number was significantly lower for the carisolv excavated group, suggesting that it is less mineralized than the underlying sound dentin. Thus we can say that conventional hand excavation leaves much harder dentin as compared to carisolv excavation.

In our study we adopted the hardness and color checking method for determining the amount of carious (demineralized) dentin remaining. This was done with the help of stereomicroscope using software (image pro-plus) which provided a magnified view of the remaining dentin⁵. To prevent any bias an average of three readings was taken at different points from the cavity floor.

Hand excavation and Carisolv gel-assisted excavation removed similar quantities of tissue and appeared to be more selective than burs for carious dentin removal. An *in vitro* study has shown that the Carisolv system left up to 50 µm more carious dentin on average, as compared to the use of a round bur⁹.

Further studies also concluded chemomechanical caries removal is still not in a position to replace the rotary instruments and did not remove the decay completely and is much slower technique of caries removal; additionally, it had a chlorine taste/odor which patients disliked⁴.

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CONCLUSIONS

- 1) The caries excavation with carisolv is less efficient as compared to hand excavation;
- 2) The hardness of the remaining dentin after carisolv excavation is much lower as compared to the hand excavation;
- 3) Extrapolating the results of our study we recommend use of carisolv only in very young children who are very anxious and fear local anesthetic injection as it promises painless removal of carious dentin.

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