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RESEARCH ARTICLE
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COMPARISON OF EFFICACY OF CHEMO-MECHANICAL CARIES REMOVAL (CARISOLV) WITH THAT OF CONVENTIONAL DRILLING METHOD.

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Abstract

Introduction: Dental procedures are frequently linked to discomfort and anxiety due to the use of high and low speed drills. The objective of the study was to evaluate the clinical effectiveness of chemo-mechanical caries removal using Carisolv and compare it with conventional caries removal methods (drilling technique)

Materials and Methods: A total of 50 children between the ages of 9 and 12, who had cavities bilaterally and affecting only the dentine but not affecting the pulp, were selected. The removal of caries was accomplished using conventional drilling techniques or by employing carisolv. A gel was used to apply over the decayed dentine, and the softened decay was carefully eliminated using specifically specialised hand instruments. A cavity's caries-free status was determined by an independent assessor using clinical criteria.

Results: The results indicate that the caries removal using the carisolv method was highly effective, with a success rate of 94%. The average duration for caries removal using carisolv is 7 ± 2.40. According to a verbal rating scale, 66% of participants reported experiencing no discomfort when using carisolv. The children found the scent and taste sensations to be satisfactory and acceptable.

CONCLUSION: Carisolv successfully removes caries without causing discomfort.

The Chemo-Mechanical Caries Removal by carisolv is acceptable and more comfortable for patients, reducing pain, anxiety with no requirement for a local anaesthetic. This could be considered as a potential alternative treatment modality.

Keywords: Carisolv, Chemo-mechanical caries removal, Patient perception, drilling, pain perception, Visual analogue Scale.

Introduction:

Dental procedures are frequently linked to discomfort, anxiety, and the sound produced by the high and low-speed drills with approximately 80% of dental patients are believed to experience dental anxiety[1]. A significant number of patients find caries removal to be highly unpleasant. This unease

arises from the experience of pain, discomfort and the prolonged loud noise with utilisation of a drill during the process of caries removal. The use of a dental drill for removing dental cavities might potentially cause trauma to the pulp as a result of pressure, heat damage, and vibration. Using either a high or low speed hand piece during a dental procedure causes the removal of both infected and uninfected dentine, leading to the unnecessary loss of healthy tooth tissue[2].

As a result of the limitations of the drill and local anaesthesia, there is an increasing interest in the development of alternative treatments that are more comfortable and protect the integrity of healthy dental tissues and create smaller, aesthetic and minimally uncomfortable dental restorations[2]. Caries removal using chemo-mechanical requires an agent with capability to degrade partially destroyed collagen[3]. It is thought that the deep layers of the dentine are preserved and only the infected layers will be removed[4]. Caridex Caries Removal System for removal of caries was introduced as an alternative to the mechanical excavation of carious dentin and consisted of a solution (GK-101E), reservoir, heater, pump, handpiece, and an applicator tip attached to the handpiece. The tip was used for delivery of solution heated to approximately 37^0 C, and had an excavator to remove loosened carious dentin through a gentle abrasion technique[5]. It was expensive and had a limited duration of storage, requiring additional time along with substantial reservoir equipped with a pump and significant volumes of solution.

A novel approach to address the limitations of the technology, a new technique for chemo-mechanical caries removal was devised (Carisolv™, Medi Team Dentalutveckling AB, Savedalen, Sweden). Carisolv is available in a gel form which does not require any delivery system or heating as compared to Caridex[6]. Carisolv™ consists of a red gel (containing glutamic acid, leucin, lysine, sodium chloride, erythrocin, carboxymethylcellulose, water, sodium hydroxide) and transparent fluid (0.5% sodium hypochlorite). The two components are mixed at a ratio of one to one and applied to the carious dentin[7].

The Carisolv instruments are equipped with a sharp edge and a blunt cutting angle, specifically designed for scraping rather than cutting. This scraping action is said to preserve all the good tissue of the tooth. Using these specially designed hand instrument the gel is then applied onto the exposed carious dentine and left for 60 seconds[8]. This is followed by gentle yet firmly abrading away of the softened dentine till a hard caries-free cavity is left. with alkaline pH of 11, the positively and negatively charged groups on the amino acids become chlorinated and further disrupt the collagen cross linkage in the matrix of the carious dentine[8].

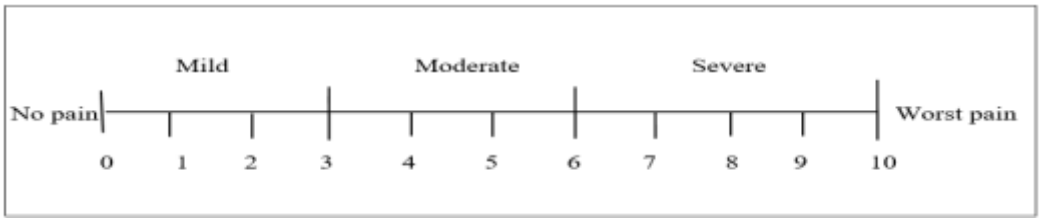
To understand the acceptance of Carisolv as an alternative to drilling procedures this study was undertaken to examine two procedures for the elimination of decayed dentin and assess the patient's reactions to this system.

Materials and methods:

The research was conducted at six primary schools in Bangalore city, which were chosen randomly. Prior to performing the study, approval was acquired from the relevant authority in the institution and informed consent was gained from the parents or guardians. The study methodology was also described to the students. The Ethical clearance was obtained from the institution. The students in the age range of 9 to 12 years were assessed and selected based on criteria as mentioned. Each child having minimum of two carious lesions in both deciduous and permanent molars bilaterally with distinct dentine involvement were included in the study. Medically compromised and uncooperative children were excluded from the study.

The study was conducted via a standardised proforma comprising of two sections. The data was collected through a bilingual interview conducted in English and Kannada. Demographic information about the patient, such as age, gender, and background, as well as details on their dental hygiene practices and food habits, were documented. This included asking questions relating to the treatment method. Pain perception during the cavity preparation was evaluated using both the verbal analogue scale and the visual analogue scale.

Pain perception during the cavity preparation was assessed based on the verbal analogue scale and visual analogue scale.
The visual analogue scale[9] assessed the pain perception on the scale on 0-10.



The visual analogue scale (VAS), utilizes a line anchored at the 2 extremes with descriptors "no pain" and "worst pain" indicating the absolute minimum and the absolute maximum of pain one can experience. Scores "0" indicates no pain, scores "1", "2"and "3" indicated mild pain. Scores "4", "5" and "6" indicated moderate pain. And score "7" , "8" and "9" indicated severe pain. Score 10 stands for worst pain.
The pain perception based on verbal analogue scale[10] was classified as
0- No pain
1- Mild pain
2- Moderate pain
3- Severe pain.

The taste perception was noted as being
0 - No taste
1- Tolerable
2- Unacceptable
3- Not able to tell

The smell perception was noted as
0- No smell
1- Tolerable
2- Unacceptable
3- Not able to tell

Instruments used:
A set of specially designed hand instruments were used for application of the gel and for removal of caries in the chemo-mechanical caries removal group. They scrape rather than cut to facilitate the removal of softened carious dentine without affecting the normal dentine.
A total sample size of 50 patients was decided after conducting a pilot study.
Treatment procedures:
Chemo-mechanical caries removal was done using carisolv gel. Immediately before the treatment one tube containing L-glutamic acid, L-leucin, L- lysine, NaCl erythrosine and carboxymethycellulose was mixed with one tube of NaOCl . The pH is 11. The gel was mixed in a dappen dish and the gel remained active for a period of 20 min. After that new gel was prepared. Specially designed hand instruments with 90 degrees of edges were used for application of gel and to facilitate the removal of softened carious dentine without affecting the normal dentine.
The dentinal caries was first covered with gel, after 30 seconds dentine was gently scraped with hand instruments to remove softened carious tissue. At application the fresh gel was clear, but became opaque or cloudy with debris and subsequently removed from the lesion. When the gel was heavily contaminated with debris, it was removed with the instrument pellet and fresh gel was applied. The procedure was repeated until the gel no longer became cloudy and contaminated with debris and the

surface felt hard with the instruments. The cavity was checked for remaining caries using an explorer. The completeness of caries removal was judged by the clinical criteria that a sharp explorer should not stick in the dentine, and did not give a 'tug-back' sensation.

Drilling

Caries was removed using rotary instruments (micromotor) following the ususal procedures employed by the operator. The cavity designed as per the principles of G V Black were followed. The cavity was checked for remaining caries with an explorer using the same criteria as above. The efficacy of the removal of caries was evaluated by an independent co-investigator using the same criteria as above.

The treatment time required for caries removal with carisolv and with conventional drilling was recorded. The taste perception and smell perception with carisolv was also recorded. The teeth treated with carisolv were filled using GIC fuji 9. The teeth treated with conventional drilling were restored with Silver amalagam.

Statistical analysis:

The statistical software namely SPSS 14.0 were used for the analysis of the data. The p value was taken as significant when less than 0.05 (Confidence interval of 95% was taken). Student t test (two tailed, dependent) has been used to find the significance of study parameters on a continuous scale within each group.

Results:

Total 50 subjects participated in the study among which 27 were males and 23 were females. According to a verbal rating scale, 66% of participants reported no pain during caries removal while using carisolv as compared to 98% of individuals experienced pain when utilising conventional drilling procedures. On a visual analogue scale, 58% of participants reported the caries removal procedure by carisolv as painless and 42% reported experiencing minor pain. During caries removal using the standard drilling approach, 88% of participants reported experiencing moderate pain, to severe pain during the process.

The average duration for caries removal utilising the carisolv method was 7.91± 2.40 minutes and by conventional drilling was 11.36 ± 2.83 minutes. The disparity was shown to be statistically significant. The teeth that underwent caries removal using the carisolv method were repaired with GIC fuji 9, while the teeth that were treated with conventional drilling for caries removal were repaired using silver amalgam. The average time required for restoring teeth treated with GIC Fuji 9 was 5.68±1.47 minutes, while the average time for restoring teeth with silver amalgam was 4.13±2.99 minutes.

The effectiveness of caries removal with carisolv and conventional drilling was compared with the assistance of a skilled researcher. Caries was found in 6% of individuals, whereas the remaining 94% participants in the carisolv group were determined to be free of caries. Around 36% of children experienced some flavour while undergoing treatment with carisolv and 8% reported experiencing a mild smell.

Discussion:

The current study utilised the verbal rating scale to measure pain perception and it was found that around 66% of the participants reported complete absence of any discomfort during caries removal using Carisolv as compared to the conventional drilling technique in which 98% of participants experiencing mild to severe pain. The research conducted by Nadanovsky *et al* (2001)[11] and Ericson *et al* (1999)[1] where 68% and 55% of the individuals did not experience any pain. Fure *et al* (2000)[12] and Munshi *et al* (2001)[13] treated deciduous teeth and reported that all the children found treatment with carisolv pleasant and acceptable. As the technique of caries removal by carisolv eliminates the necessity for local anaesthesia, thus preventing the onset of pain and anxiety associated with the

trauma of the injection operation and the apprehension of the needle. As a result, the patients do not experience discomfort during excavation.

In the present study the effectiveness of caries removal by carisolv was evaluated by an independent examiner with help of probe. Caries was detected in 6% of the total teeth treated with carisolv. In the studies conducted by Kakaboura *et al* (2001)[14] and Hosein *et al* (2008)[15] caries was detected in 10% of the total teeth using carisolv for chemo-mechanical caries removal whereas it was as low as 0.94% in study by Ericson et al (1999)[1]. Multiple studies Bohari *et al*. (2012)[16], Goomer *et al.* (2013)[17], Ammari *et al*. (2014)[18], Pathivada *et al*. (2016)[19] and Asal *et al.* (2021)[20] have demonstrated that Carisolv is equally effective in removing caries compared to the traditional drilling method, while also providing greater comfort to patients. The Chemo-mechanical caries removal approach effectively and selectively eliminates decayed dentin while avoiding the unneeded removal of healthy dentine thereby causing unintentional pulp exposure. This minimally infected arrested carious dentine may be safely retained, contingent upon the sufficient bonding of the restorative material to the tooth surface.

In the present study the mean time for caries removal after using carisolv is 7 ± 2.40 with conventional drilling is 11.36±2.83. However, Ericson *et al* (1999)[1], Fure *et al* (2000)[12], Maragakis *et al* (2001)[21], Nadanovsky *et al* (2001)[11] Kakaboura *et al* (2003)[14] Kavvadia *et al* (2004)[22] and Pandit *et al* (2007)[23] reported a difference in the time for caries removal by the two methods and concluded that carisolv takes prolonged time.

When the study participants were asked about taste perception 62% of them did not experience any taste, which was similar to the study conducted by Ericson *et al* (1999)[1], Kakaboura *et al* (2003)[14] and Burke *et al* (1999)[24]. However, 38% of participants did experience some kind of unpleasant taste. Maragakis *et al* (2001)[21] found that majority of the young children of 7-9 years did not like the taste of carisolv and described that it had a chlorine taste/odor. In this study 90% participants did not experience any smell. Similar findings were observed in the study conducted by Ericson *et al* (1999)[1] (83% no smell) and Burke *et al* (1999)[24] (97%- no smell). Carisolv can be effectively used in young children's as it painless procedure with acceptable taste and smell.

Researchers Bohari et al. (2012)[16], Ammari et al. (2014)[18], Dhamija et al. (2016)[24] have pointed out that due to high cost, short duration of effectiveness, requirement for refrigeration, unpalatable taste and odour, and the necessity for specialised curettes there may be limited utility of Carisolv. But in combination with the atraumatic restorative treatment of dental caries in large populations it can prove to be very effective.

Summary and Conclusion

Carisolv can conservatively remove the infected carious dentine and the pain perception according to verbal rating scale in carisolv method was found to be less when compared to conventional drilling method. Taste and smell perception with respect to carisolv was acceptable among children. The adhesive restorative techniques together with chemomechanical caries removal reduces patient's discomfort and decrease the unnecessary removal of sound dentinal tissue. It can serve as a viable option in numerous circumstances, particularly when treating children, worried individuals, and patients with allergies.

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