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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF BEHAVIOUR OF CHILDREN AND TIME TAKEN BY THREE TECHNIQUES OF CARIES REMOVAL: CHEMOMECHANICAL CARIES REMOVAL, CARIES REMOVAL WITH SMART BURS AND CONVENTIONAL CARIES REMOVAL- A CLINICAL PROSPECTIVE STUDY

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Abstract

Background: Many chemomechanical caries removal (CMCR) agents have been introduced and marketed since 1970s, with each new one being better and effective than the previously introduced. CMCR and Smart Burs (mechanical caries removal) are minimally invasive treatment approaches which selectively remove caries-infected tissue while leaving intact caries-affected tissue-conserving tooth structure.

Aim: to compare the effectiveness of different caries removal techniques in primary teeth using the BRIX-3000, conventional caries removal, and Smart Burs in removing dentinal caries. The time taken for caries removal, the efficacy of caries removal and patient acceptance will be evaluated for clinical success with different caries removal techniques.

Materials and methods: the study will be carried in thirty primary teeth in children aged 5-10 years with asymptomatic carious lesion. The teeth will be randomly divided into three groups depending on type of caries removal method used.

Results: There was statistically significant difference among the groups with respect to child's behaviour, time taken and efficiency of caries removal

Conclusion: The time taken to remove caries by Conventional method was observed to be significantly lower as compared to that taken by smart burs and Brix - 3000. The clinical efficacy of caries removal was highest with conventional method followed by almost comparable effectiveness by smart burs and Brix-3000. However, Patient acceptance during caries removal was found to be highest with Brix - 3000 followed by Smart burs and least by Conventional method.

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Introduction:-

Dental caries is one of the most common infectious diseases of mankind. Caries is a biofilm (plaque) induced acid demineralization of enamel or dentin, mediated by saliva. It has consequences upon oral and general health of individuals (pain, impairment of function, reduced quality of life).¹

According to Takao Fusayama's 1980 description, the carious lesion consists of two layers. The 'outer layer' is an acidic, irreversibly demineralized, touch sensitive layer that contains high levels of bacteria, and therefore can be

removed without the need for local anaesthesia. The 'inner layer' is a partially demineralized, less contaminated layer that contains collagen fibrils in the dentinal tubules.²

CMCR and Smart Burs (mechanical caries removal) are minimally invasive treatment approaches which selectively remove caries-infected tissue while leaving intact caries-affected tissue-conserving tooth structure.³

Smart Burs are made of a polyamide resin having polymer shaft and blades in three different sizes – 004, 006, 008 used in slow speed rotary handpiece at 500–800 rpm which can easily remove soft carious dentin but when they come in contact with hard dentin they blunt out.³

In 2012, the BRIX-3000 was released, a chemicalmechanical agent, also papain-base, with a proteolytic enzyme obtained from leaves latex and fruits of green papaya (*Carica Papaya*) that acts as a chemical debrindant. The differential of this product according to the manufacturers is the amount of papain used (3,000 U/mg in a concentration of 10%) and the bioencapsulation thereof by EBE technology, which gives the gel the ideal pH to immobilize the enzymes and liberate them at the moment of exerting its proteolysis on the collagen.⁴

Materials and Methods:-

The study was conducted in the Department of Pedodontics and Preventive Dentistry, Government Dental College and Hospital Srinagar. Ethical approval was obtained from Ethical Committee of Government Dental College and Hospital Srinagar.

The inclusion criteria were :

1. Healthy children of both sexes from 5 to 10 years of age who are willing to participate in the study
2. Patients with asymptomatic carious lesions with distinct dentin involvement, which was verified by radiograph in relation to mandibular primary molars
3. Carious lesions without any pulpal involvement.

The exclusion criteria included:

1. Uncooperative
2. Grossly decayed teeth
3. Deep carious lesions with pulpal involvement.

The selected subjects were assigned to three groups according to the caries removal technique

Each group comprises of 10 carious primary mandibular molars.

After caries removal, the cavity will be restored with glass ionomer cement.

Group 1 - caries removal using BRIX-3000

Group 2 - caries removal with Smart Burs

Group 3 - caries removal using conventional technique

Materials:-

Cotton rolls

Mouth mirror

Explorer

Brix-3000 gel

Smart burs

Conventional round carbide bur

Glass ionomer cement

Method:-

Group 1 procedureThe involved tooth will be isolated with cotton rolls, and BRIX-3000 gel will be applied to the carious lesion. After 60 s the gel will be removed with a moistened cotton pellet and softened carious dentin will be scrapped off using spoon excavator. Caries removal will be verified by probing with explorer. The tooth will be restored with glass ionomer cement.



Group 2 procedure The involved tooth will be isolated with cotton rolls, Caries will be excavated with Smart Burs in slow speed handpiece with circular movements starting from the periphery to the center of the lesion. Caries removal will be verified by probing with explorer and then the tooth will be restored with glass ionomer cement



Group 3 procedure The involved tooth will be isolated with cotton pellets. Caries will be excavated with conventional method using slow speed handpiece with circular movements starting from the periphery to the center of the lesion. Caries removal will be verified by probing with explorer and then the tooth will be restored with glass ionomer cement.

The following observations were noted:

1. The time taken will be recorded from the start of caries removal procedure till the placement of glass ionomer cement restoration
2. Efficacy of caries removal will be evaluated by assessing the amount of remaining caries left by following scores given by Ericson et al.
 - 0 - Caries removed completely
 - 1 - Caries present in base of the cavity

- 2 - Caries present in base and/or wall
 3 - Caries present in base and/or two walls
 4 - Caries present in base and/or >2 walls
 5- Caries present in base, walls, and margins of cavity.

To know the patient acceptance of the respective procedure after caries removal, pain rating will be assessed with the help of Wong–Baker Faces pain rating scale.

- 0 - No hurt
 2 - Hurts little bit
 4 - Hurts little more
 6 - Hurts even more
 8 - Hurts whole lot
 10 - Hurts worst.

Statistical Methods:

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Continuous variables were expressed as Mean±SD and categorical variables were summarized as percentages. Analysis of variance (ANOVA) was employed for comparison of continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. Graphically the data was presented by bar diagrams.

Results:-

Time taken :

Taking into consideration the mean time taken by group 1 , 2 3 was 404.5 sec , 285 sec ad 205.9 seconds respectively. Thus it was minimum for group 3 i.e; conventional method of caries removal.

Table 1:- Time taken for the procedure (seconds) among three groups.

Time (Seconds)	N	Mean	SD	Range	Comparison	P-value
Group 1	10	404.5	23.86	375-455	Group 1 vs Group 2	<0.001*
Group 2	10	285.0	29.25	240-340	Group 2 vs Group 3	<0.001*
Group 3	10	205.9	8.03	195-220	Group 3 vs group 1	<0.001*

*Statistically significant (P-value<0.05)

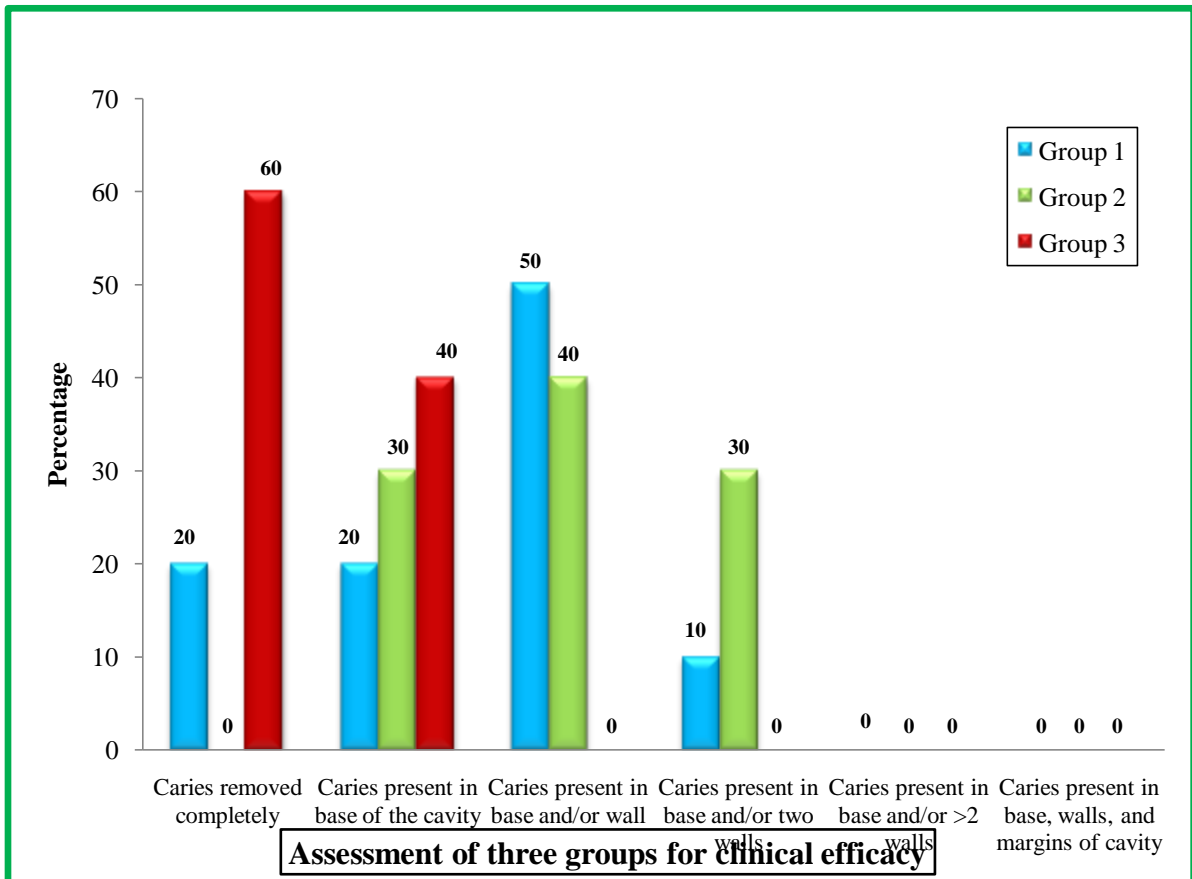
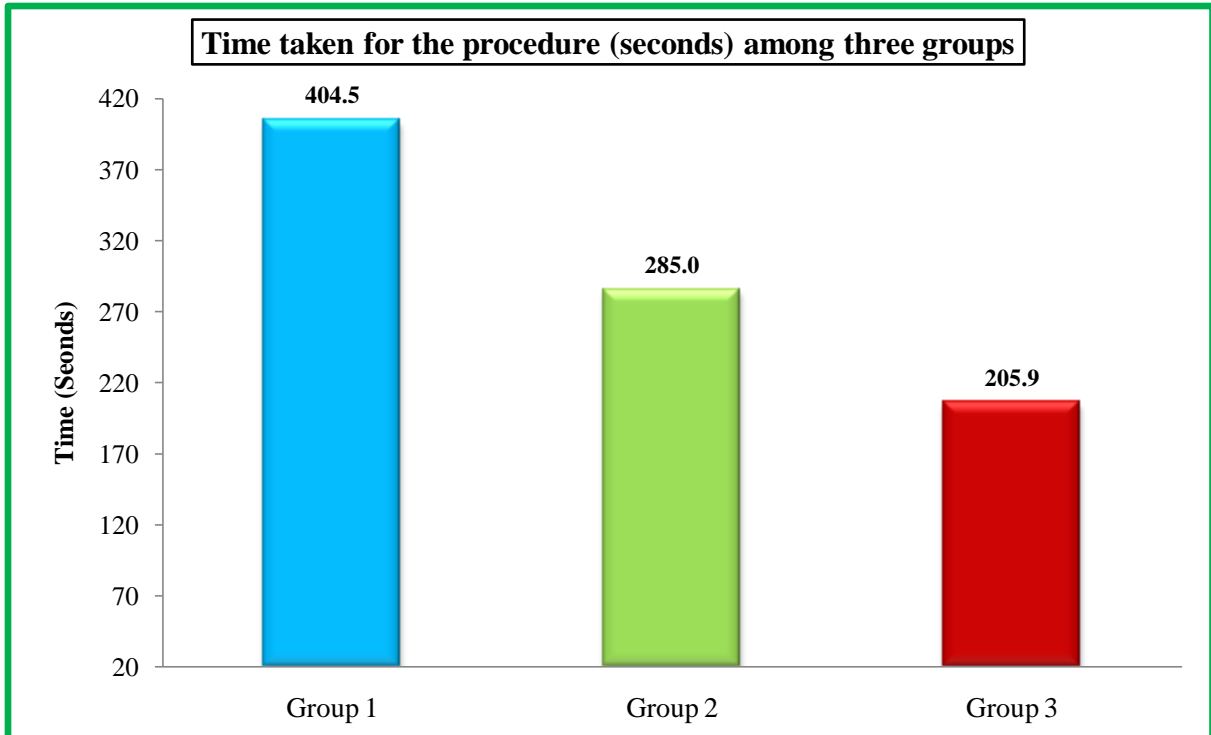
Clinical efficiency :

Caries removal was efficient in group 3 i.e; conventional method compared to other groups . there was statistically significant difference between group 2 and group 3.

Table 2:- Assessment of three groups for clinical efficacy.

Score	Inference	Group 1		Group 2		Group 3	
		No.	%age	No.	%age	No.	%age
0	Caries removed completely	2	20	0	0	6	60
1	Caries present in base of the cavity	2	20	3	30	4	40
2	Caries present in base and/or wall	5	50	4	40	0	0
3	Caries present in base and/or two walls	1	10	3	30	0	0
4	Caries present in base and/or >2 walls	0	0	0	0	0	0
5	Caries present in base, walls, and margins of cavity	0	0	0	0	0	0
Comparison		Group 1 vs Group 2		Group 2 vs Group 3		Group 3 vs group 1	
P-value		0.346		0.004*		0.034*	

*Statistically significant (P-value<0.05)



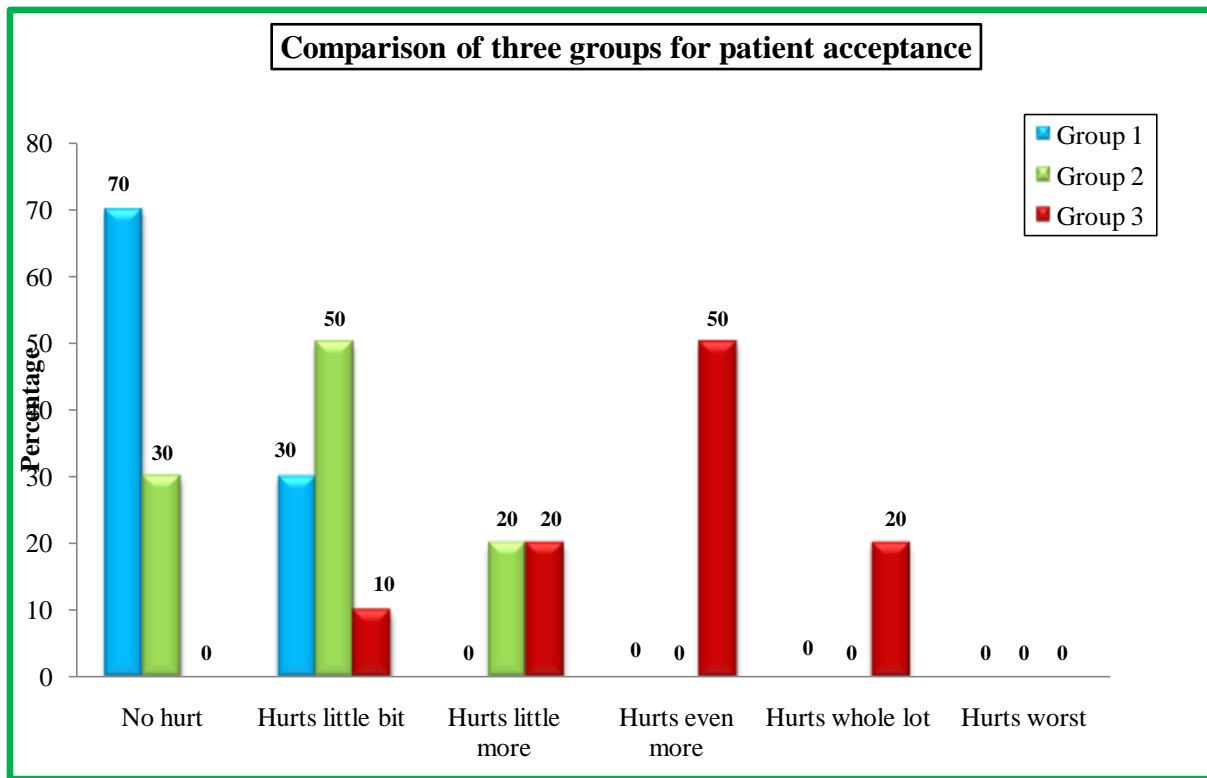
Patient acceptance :

Patient acceptance during caries removal was found to be highest with Brix - 3000 followed by Smart burs and least by Conventional method.

Table 3:- Comparison of three groups for patient acceptance.

Score	Inference	Group 1		Group 2		Group 3	
		No.	%age	No.	%age	No.	%age
0	No hurt	7	70	3	30	0	0
2	Hurts little bit	3	30	5	50	1	10
4	Hurts little more	0	0	2	20	2	20
6	Hurts even more	0	0	0	0	5	50
8	Hurts whole lot	0	0	0	0	2	20
10	Hurts worst	0	0	0	0	0	0
Comparison		Group 1 vs Group 2		Group 2 vs Group 3		Group 3 vs group 1	
P-value		0.129		0.013*		0.002*	

*Statistically significant (P-value<0.05)



Discussion:-

In restorative dentistry, caries removal methods were developed to be more conservative and in biological direction. The CMCR method became an area of concern, because of its conception of tissue preservation, by which only the carious dentin is removed while the painful removal of the hard (sound) dentin is avoided, and hence, the need for local anesthesia is reduced^{6,7,8,9}. Brix 3000, introduced CMCR agent, was preferred in this study as it was a gel prepared from papain that prepares the cavity with maximum preservation of the healthy tooth structure. It provides a synergistic action to facilitate the removal of the caries with highly antimicrobial effect. The results of the previous studies had proved that the CMCR method was effective and more comfortable for the patients than the conventional treatment with the rotary instruments or excavator.¹⁰

The clinical efficacy of group III was higher than groups II and I, both of which had almost comparable efficacy to each other. These results of the present study were in accordance with the studies of Banerjee et al, Maragakis et al,

Yazici et al, Peters et al, who found the similar results when conventional caries removal method was compared to chemomechanical system. The efficacy of removing caries with Airotor was the highest because it tended to over-prepare the cavities because of lack of sensitivity of tactile feedback. This resulted in gross rapid removal of tissue with reduced control over the whole process.¹¹ Smart Burs lead to under-preparation due to self-limiting nature of the bur that will not cut affected dentin, if a greater force is applied then it will wear away rather than cut sound dentin.

But, few other studies by Ericson et al¹² and Fure et al¹³ concluded almost comparable clinical efficacy of conventional and chemomechanical caries removal systems

El Nasri et al in 2015 evaluated the efficacy of caries removal by hand excavation (ART), chemo-mechanical caries removal agent (carisolve) and polymer bur (smart bur II). The results of El Nasri study showed that smart bur II had significantly lower caries removal efficiency when compared to either carisolve, or hand excavation (ART), the lower caries removal efficiency of smart bur II reported by El Nasri is in agreement with our results.¹⁷

Celiberti et al in 2006 assessed caries removal effectiveness of 4 different dentin excavation methods, one of them was polymer bur in primary molars. The study revealed that polymer bur and Er:Yag laser left the largest amount of decayed tissue unexcavated in agreement with our results.¹⁸

The study conducted by Jawa et al indicated that mean time for complete caries excavation with chemomechanical method was 328.5 seconds as compared to that of 124.6 seconds with convention caries excavation method which was in accordance with present study.

Kochhar et al. observed mean visual analog scale (VAS) scores for airotor group, spoon excavator group, Carisolv group, and concluded Carisolv was the least painful method for caries removal than drilling.

Soni et al. observed mean VAS scores for the air-rotor group, spoon excavator group, Carisolv group, polymer burs, and concluded that Carisolv group was the least painful method for caries excavation followed by polymer burs, spoon excavators, and air-rotor group.

In addition, Kleinknecht et al. in 1973 reported that dental anxiety was mainly associated with the highly invasive procedures such as "injections" and "drilling", while neither of these procedures is usually needed with the papain gel approach for caries removal.⁵

Similar results were observed in this study which means pain rating scores using Wong–Baker Faces pain rating scale with Brix-3000 was the least painful and the most acceptable method followed by polymer burs.

Other studies conducted by Rafique et al¹⁴ LozanoChourio et al¹⁵ and Pandit et al¹⁶ showed the similar results concluding that chemomechanical caries removal (CMCR) method was more acceptable than conventional drilling method.

Conclusion:-

Based on the findings of the study, following conclusions were drawn:

1. The time taken to remove caries by Conventional method was observed to be significantly lower as compared to that taken by smart burs and Brix – 3000
2. The clinical efficacy of caries removal was highest with conventional method followed by almost comparable effectiveness by smart burs and Brix-3000
3. Patient acceptance during caries removal was found to be highest with Brix - 3000 followed by Smart burs and least by Conventional method

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