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Evaluation And Comparison of Microleakage And Shear Bond Strength of Cention N, Nano- Filled Composite And Ketac Molar For Restoration of Primary Molar Teeth.

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Abstract

Aim: To comparatively evaluate microleakage and shear bond strength of Cention N(ivoclar vivadent), Nano- filled composite(3M Corp., Minnesota, USA) and Ketac molar(3M Corp., Minnesota, USA) in primary molar teeth.

Materials and Methods: Sixty extracted primary molars were randomly divided into 3 groups(n = 20) based on the restorative material used. Each group was subdivided into 2 for checking microleakage (A) and shear bond strength (B). After procuring sound primary molars, class V cavities were prepared on the buccal surface and were subjected to thermocycling after restoration. Thirty samples were stained with 0.1% Methylene blue for 24hours to evaluate dye penetration for microleakage under stereomicroscope and thirty samples were prepared to determine shear bond strength using Zwick Universal testing Machine. Results were analyzed statistically.

Results: Group 3A (Cention N) showed least microleakage whereas Group 2A (Nano- filled composite) and Group 1A (Ketac molar) exhibited similar scores and values were statistically significant (p=0.005). Of all groups tested, Cention N (3B) showed highest shear bond strength (p=0.0001).

Conclusion: Cention N has least microleakage and highest shear bond strength when compared to Nano-filled composite and Ketac molar and can be recommended for use in primary dentition.

Keywords: Dental leakage, glass ionomer cements, nano composites and shear strength

Introduction

Restoration of primary teeth is challenging due to their morphology, thin enamel walls, greater incidence of proximal and cervical caries along with associated factors such as lack of child cooperation, etc. The use of glass ionomer cement for primary teeth restorations is widely accepted due to its benefit of easier handling

characteristics, chemical bonding to tooth, fluoride release and cost effectiveness.[1]However, application of this material in moisture sensitive areas, proximal lesions and anterior cervical lesions has shown to have potential for microleakage and due to their low mechanical strength, the restorations are not durable. [2, 3]

Ketac molar is a modification of GIC, having improved mechanical properties, packable consistency and greater radiopacity. It has a higher powder acidity that leads to greater concentration of acid in the cement, resulting in increased cross-reaction and improved mechanical values without affecting initial viscosity. **Arribas and Nagano** stated that Ketac molar shows lesser solubility than other comparable cements.[4]

Composites and their corresponding dentin bonding systems have become popular alternatives for restorative materials as they exhibit low viscosity, good esthetic properties and better marginal sealing. [2]Polymerisation shrinkage is a drawback of composite resin which results in marginal discrepancy causing microleakage. This often leads to post- operative sensitivity, marginal discoloration and secondary caries.[3, 5] Therefore, in order to reduce this shrinkage Nano- filled composites which constitute of nanofiller technology were introduced.

Recently there have been numerous advancements in restorative materials and Cention N is one of them. It is a resin-based, alkasite, where alkasite refers to filling material, which like compomer or ormocer materials, is a subgroup of composite materials. It utilizes alkaline filler capable of releasing acid-neutralizing ions. Cention-N is available as powder and liquid of which liquid has dimethacrylates and initiators and powder is composed of various glass fillers, initiators and pigments. This is a self-cure filling material with the option of light curing and is stated to be useful for bulk placement in class I, II and V restorations. In primary teeth, it can be used with or without adhesive, depending upon the retentive nature of the cavity preparation.[3]

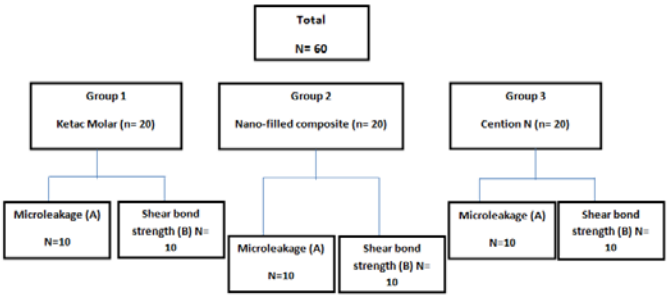
Thus, the present study was conducted with the aim to compare the microleakage and shear bond strength of Cention N with Ketac molar and Nano- filled composite resin in class V cavities of primary molars.

Materials & Method

1.1 Ethical clearance for this in vitro study was obtained from the ethical committee of the Institute of Dental Studies and Technologies, Ghaziabad.

1.2 **Distribution of samples**

Sixty primary molars, having no caries, or white spot lesion and intact crown structure, indicated for extraction or exfoliated, were collected and randomly assigned in 3 groups on the basis of the restorative material used.



For evaluation of Microleakage

Preparation of samples

- After procuring the teeth, class V cavities measuring 5 millimetres in length (mesio-distally), 2 millimetres in width (occluso-gingivally), and 1.5 millimetres in depth were prepared on buccal surfaces of the teeth.
- Restoration of cavities:
- **For Group 1A,** the powder and liquid of Ketac molar were mixed in a ratio of 3:1. The mixed material was loaded onto the plastic filling instrument and condensed into the cavity. The excess cement was removed and a layer of petroleum jelly was applied over the set restoration.

- **For Group 2 A,** the cavity was cleaned and etched for thirty seconds, washed and dried followed by application of bonding agent on enamel and dentin which was cured for twenty seconds. The cavity was restored with Filtek Z250 XT composite and light cured for forty seconds.
- **For Group 3A,** after cleaning, the cavity was etched for thirty seconds followed by washing, drying and application of bonding agent which was cured for twenty seconds. The powder and liquid of Cention N were mixed on the mixing pad in the ratio of 1:1. The cement was loaded onto the spatula and the cavity was restored. Excess cement was removed. Finally, the cement was light cured for forty seconds.
- The sample of 30 teeth was labeled according to the groups and subjected to thermocycling for 250 cycles between 5°C and 55°C with a dwell time of thirty seconds and three seconds transfer time between beakers in a controlled water bath using a thermostat.

To evaluate dye penetration under stereomicroscope

- The entire crown structure was coated with two layers of nail varnish, leaving the restored cavity and a 1 millimetre window around the cavity margins. Root apices were sealed with sticky wax and samples were kept in a solution of 0.1% Methylene blue for 24 hours for staining.
- After removal of the samples from the dye solution, the surface was rinsed in water and nail varnish was removed with a BP blade.
- The teeth were sectioned longitudinally in a buccolingual direction through the centre of the restorations using a water cooled low speed diamond disc.
- Dye penetration in the samples was studied under the stereomicroscope and scoring was done accordingly.

Scoring criteria used for dye penetration **(by khera & Chan)**[6]

0 = No dye penetration.

1 = Dye penetrating is to the lesser than and up to one half of the depth of the prepared cavity.

2 = Dye penetrating is to more than one-half of the depth of the prepared cavity but not up to the junction of the axial and occlusal or gingival wall.

3 = Dye penetrating up to the junction of the axial and occlusal or gingival wall but not including the axial wall.

4 = Dye penetration including the axial wall.

Determination of shear bond strength

Sample preparation

- Thirty primary molars were used to determine shear bond strength. The teeth were sectioned bucco-lingually and embedded in an acrylic block. The buccal surface of the molars was roughened with grit wet silicon carbide paper and rinsed and dried.
- The prepared teeth were divided in 3 equal groups and a layer of restorative material was placed on the roughened surface of the primary molars according to the groups 1B, 2B and 3B.
- The prepared samples were placed in distilled water bath at 37°C for 24 hours. The specimens were then subjected to thermocycling for 250 cycles between 5°C and 55°C with a dwell time of thirty seconds and three seconds transfer time between beakers in a controlled water bath using a thermostat.
- Using the Zwick Universal testing Machine these samples were tested at crosshead speed of 5 millimetre/ minute with 110 kilogram load cell until fracture.

Statistical Analysis: One-way ANOVA with post hoc Bonferroni tests were used for statistical analysis for microleakage and shear bond strength in which the P = 0.05 was considered as statistically significant level.

Results

Microleakage Analysis

Out of the 30 samples examined for microleakage, Cention N had the least mean microleakage values (1.10+ 0.31) as compared to Ketac molar and Nano- filled composites, both of which had similar microleakage (table 1). The difference between the groups was statistically significant with the p value of 0.011. [refer Table 3]

Shear Bond Strength (SBS) Analysis

The result of this study showed that Cention N has the highest SBS (718.24 MPa) when compared to other restorative materials. The results indicate that the teeth restored with Ketac molar (421.50 MPa) exhibited inferior numerical values of SBS in relation to the groups restored with Nano- filled composites (516.62 MPa). [refer Table 2]

The mean SBS values of all groups revealed that there was a significant difference between Ketac molar and Cention N at p> 0.0001. No significant difference existed in mean SBS values between Ketac molar and composite (p= 0.041).Whereas Cention N and composite exhibited significant difference in SBS values (p= 0.0001). [refer Table 3]

Discussion

Microleakage

The effects of bacterial leakage upon the dental tissues are well documented. The main causes of microleakage are poor adaptation between the restorative material and tooth structure, volume changes of the material and low wear resistance of the material. [7]For long term success of a restoration it is imperative to reduce its microleakage.

In the present study, Cention N had been investigated to determine whether its properties are better than other currently used materials for pediatric patients. Class V cavity was chosen in this study due to its complex morphology.

According to the results of present study, Cention N showed the least microleakage [refer Table 1, Figure 3] compared to Nano- filled composite and Ketac molar. It has been stated that Cention N exhibits a high polymer network density which enables polymerization over the complete depth of restoration.[5] The patented isofiller acts as a shrinkage stress reliever and the cross linking methacrylate monomers along with stable self-cure initiators helps in minimizing microleakage in Cention N.[3]These properties enable this material to adapt well to tooth surface leading to less microleakage. [5]

The results of the present study were in accordance to the study conducted by **Samanta et al** who compared microleakage in class V cavities filled with Flowable Composite resin, Glass ionomer cement and Cention N. [5]

Nano- filled composites exhibit lesser polymerization shrinkage as compared to other composite resins. They constitute of nanofiller technology and long term studies have reported good clinical efficiency in all its parameters. In a study by **Dodiya P et al** they found Cention N to be as effective as Tetric N Ceram (Nano- filled composite) in terms of gross fracture and marginal integrity till 6 months.[8]

Shear Bond Strength

Durability of a restoration is related to the adhesiveness of the restorative material to the tooth structure. Shear bond strength (SBS) is resistance to forces that lead to sliding fracture of the restoration. As proximal caries is frequently restored in primary teeth, there is a need for a restorative material to have adequate strength, wear resistance and easy placement with good adhesion to tooth structure so that longevity of the restorations can be ensured. [1]

In the present study, Cention N exhibited the highest shear bond strength followed by Nano- filled composite and

Ketac Molar [refer Table 2]. The presence of an Isofiller, high polymer network density, high flexural strength (110MPa) and degree of polymerisation over complete restoration depth makes Cention N a more suitable alternative for primary teeth restoration. [5]

In a study by **Mazumdar et al,** Cention N was also found to have a better bond strength as compared to Nano hybrid composite.[9]On the contrary in a study by **Feiz et al** the microtensile bond strength in primary teeth dentin , Giomer showed better results than Cention N, RMGI and Zirconomer.[10]

Nano- filled composites are formulated with nanomer and nanocluster filler particles. This reduces the filler particles spacing and increase filler volume, for better strength and improved retention. [11]

In the present study, Ketac molar showed the lowest shear bond strength value as compared to Cention N and Nanofilled composite.

In a study by **Murthy et al** the shear bond strength (SBS) of Ketac Molar, Miracle Mix and Amalgomer CR in primary teeth was evaluated where Ketac Molar showed lowest SBS (4.84MPa) though its microleakage was better. [1]

The present study is the first study to test both microleakage and shear bond strength of Cention N in class V cavities in primary molars.

Conclusion

Within the limitations of the study design, Cention N is better than Ketac Molar and Nano- filled composite both in terms of microleakage and shear bond strength.

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Legends Figure and Table

Table 1: Table showing the extent of **microleakage** in the samples

Groups	**Samples**	**Microleakage Scores**					**Mean ± SD**
		Score 0	**Score 1**	**Score 2**	**Score 3**	**Score 4**	
1A	10	0	0	4(40%)	4(40%)	2(20%)	2.80± 0.84
2A	10	0	0	4(40%)	4(40%)	2(20%)	2.80± 0.84
3A	10	2(20%)	6(60%)	2(20%)	0	0	1.10± 0.71
ANOVA F= 8.526; p= 0.005, Significant							

Table 2: Mean **shear bond strength** of the groups in MPa

Groups	**Number of samples**	**Mean score**	**S.D.**
1B	10	421.50	71.46
2B	10	516.62	51.46
3B	10	718.24	20.34
ANOVA		F=8.526, p=0.0001, Significant	

Table 3: Intergroup comparisons of microleakage and shear bond strength using post hoc Bonferroni

(I)Group	**(J) Group**	**Mean Difference (I-J)**	**Significance**
Microleakage*			
1A	2A	0.00	1.00
	3A	1.80	0.011*
2A	3A	1.80	0.011*
Shear Bond Strength*			
1B	2B	95.12	0.041
	3B	-201.62	0.0001*
2B	3B	-296.74	0.0001*
*The mean difference is significant at 0.05 level			

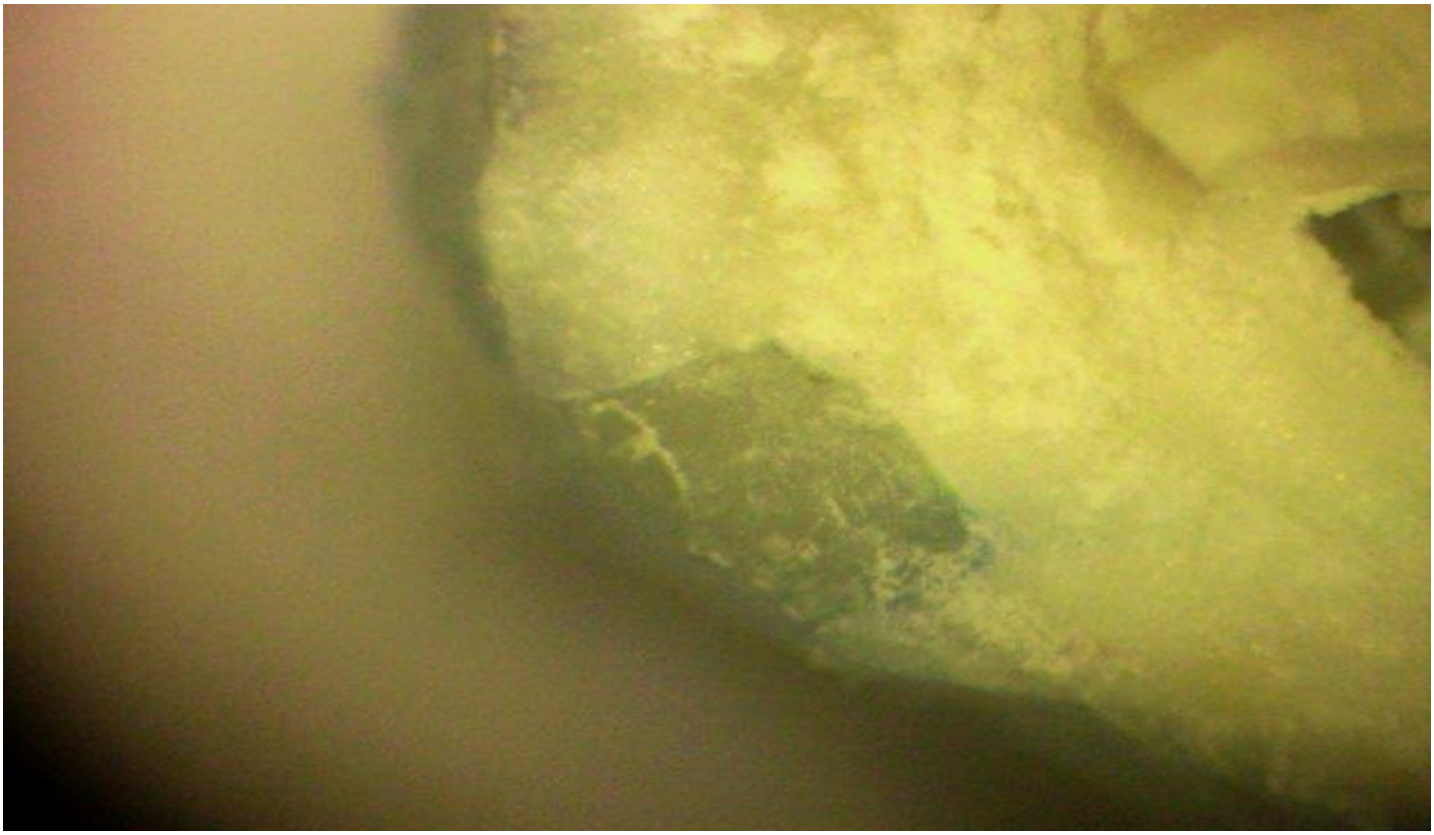

Figure 1: showing dye penetration score 3

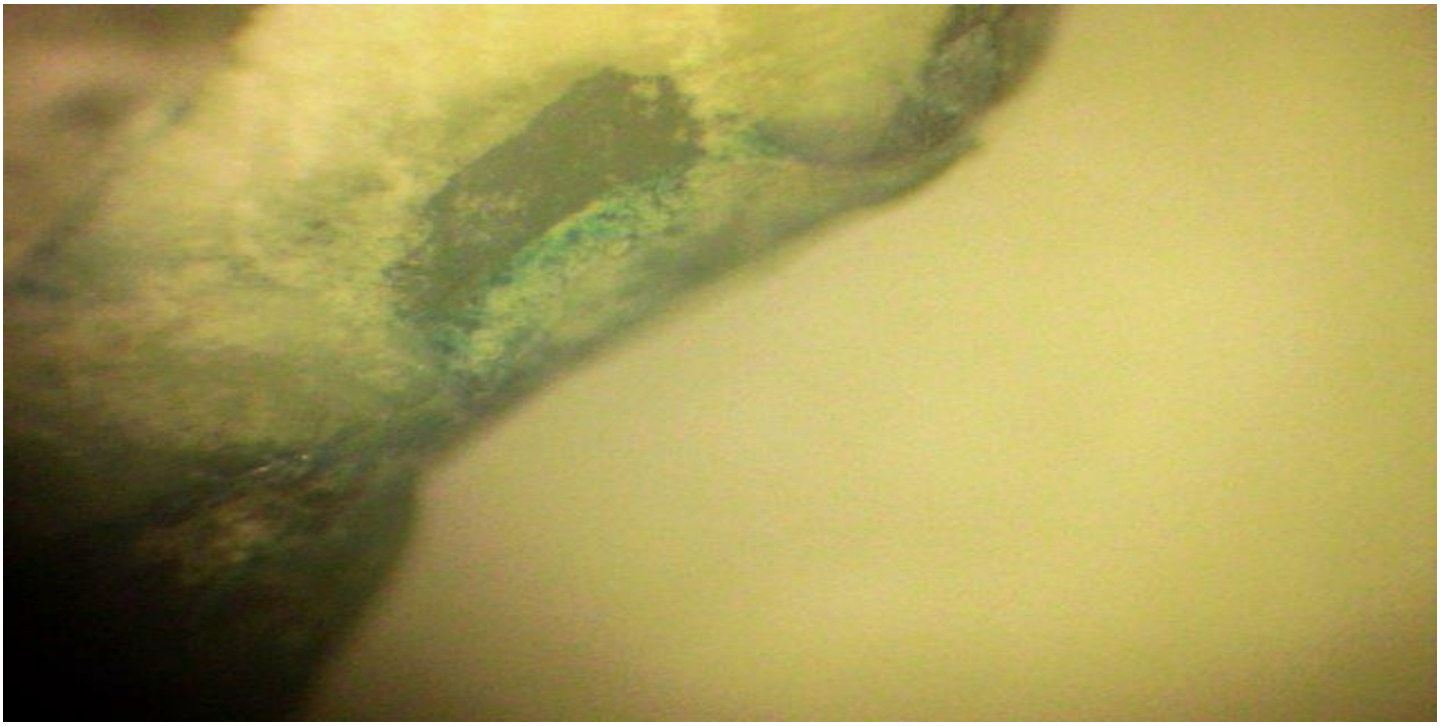

Figure 2: showing dye penetration score 4

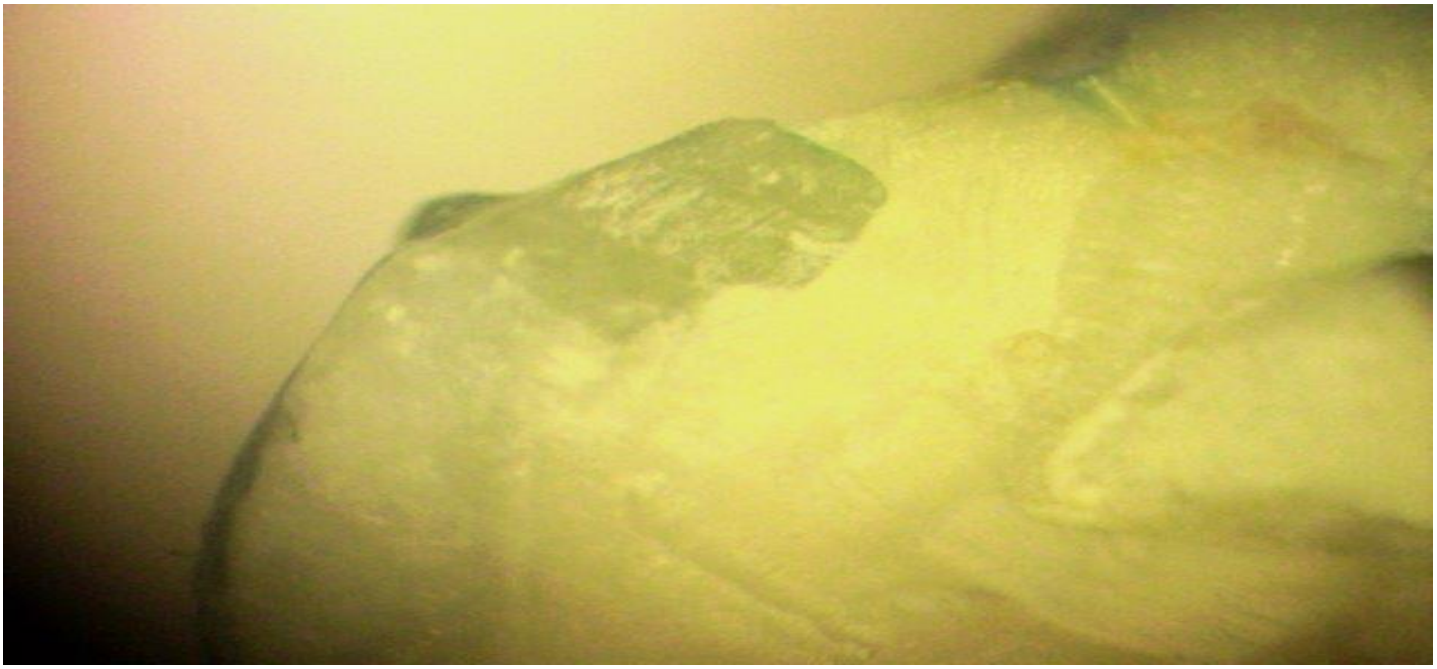

Figure 3: showing dye penetration score 1