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Comparative evaluation of microleakage and shear bond strength of cention-n, lightcure gic and nanohybrid composite

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Abstract

Background: In contemporary dentistry, microleakage and shear bond strength of a restorative material are considered to be the most important requisites for a successful restoration.

Aim: To evaluate and compare the Microleakage and Shear bond strength of Cention N, Light cure GIC, Nanohybrid composite in primary molar teeth.

Materials and Methods: 120 primary molars were randomly divided into four groups (n=15) based on the materials used. Each group was subdivided into 2 for checking microleakage (A) and shear bond strength (B). Class V cavities were prepared on the buccal surface and restored. Sixty samples were stained with 2% Methylene blue for 24 hours to evaluate dye penetration for microleakage under stereomicroscope and sixty samples were prepared to determine shear bond strength using Z wick universal testing machine. Results were analysed statistically

Results: Group IA (Cention N with bonding agent) showed least microleakage and the difference between the values were statistically significant ($p < 0.001$). Of all groups tested: Group IA (Cention N with bonding agent) showed highest shear bond strength (p=0.0001).

Conclusion: Cention N with bonding agent exhibited least microleakage and highest shear bond strength when compared to other restorative materials used.

Keywords: Cention N, Shear strength, Nanohybrid composite, Primary Molar, Glass ionomer cements.

Introduction

With the advent of tooth-colored filling materials, the anterior tooth restoration has become easier and more acceptable by the patients owing to their good lustre and esthetic properties. But performance of these materials still remains a concern which depends on their durability and integrity of marginal sealing.

Microleakage is defined as the clinically undetectable passage of bacteria, fluids, molecules or ions between the cavity wall and restorative material applied to it. Possible reasons for microleakage at the dentin restoration margin are cavity configuration (c-factor) dentinal tubule orientation to the cervical wall (CEJ) and organic content of dentine substrate. Polymerization shrinkage of restorative materials results in marginal discrepancies causing microleakage which leads to secondary caries. [1]

Another important consideration for the restorative material is the bond strength. Masticatory forces on the restoration transfer stress in the form of compression, tension or shear along the tooth restoration interface. Thus, the true nature of adhesive strength of the materials at the interface is depicted by the shear bond strength. The quality and efficacy of these adhesive materials is reflected in their mode of failure. Conventional restorative materials have a disadvantage of moisture sensitivity and low strength.

Glass ionomers were introduced to the profession twenty-five years ago and have been shown to be a very useful adjunct to restorative dentistry. Glass ionomers cements are composed of a calcium – alumino – silicate glass powder and an aqueous solution of an acrylic acid homo – or copolymer. These cements possess certain unique properties that make them useful as restorative and adhesive materials, including adhesion to tooth structure and base metals, anticariogenic properties due to release of fluoride, thermal compatibility with tooth enamel, and biocompatibility. In recent years there have been considerable changes in the formulations, properties and handling properties of the glass ionomer cements for different clinical applications. It is certain that no material is perfect, but with the current level of intensive research on glass ionomers, the deficiencies that exist seem to be eliminated or at least reduced, resulting in an ever – improving range of materials of this type [2]. Newer resin modified glass cements (LC- GIC) has an advantage of adhesion by development of an ion – exchange layer adjacent to dentin. They have a higher shear bond strength than conventional [3].

Apart from the traditional hybrid-type and microfilled resins, a new group of resin composites containing nano-sized filler particles has been introduced. These materials are claimed to offer reduced polymerization contraction, enhanced mechanical characteristics, and improved esthetics. Nanofill composites are formulated with both nanomer and nanocluster filler particles, whereas nanohybrid composites are hybrid resin composites containing finely ground glass filler and nanofiller in a prepolymerized filler form. Resin composite are widely used in restorative dentistry due to their mechanical properties. Recently hybrid composite materials are developed containing blends of micron and submicron fillers which offer sufficient strength and wear resistance due to the presence of nano particles [4].

An ideal material used for restoration should be adhesive, tooth colored, resistant to wear, nontoxic, biocompatible to the tissue. Recently Cention N has been introduced in dentistry which the manufacturers claim to possess best of the properties of Amalgam and GIC. Cention N is an "alkasite" which is a new category of filling material for direct restorations. It is self-curing with optional additional light curing. The liquid comprises of dimethacrylates and initiators and the powder contain various glass fillers, initiators and pigments. It is radio opaque and the alkaline glass fillers are capable of releasing fluoride, calcium and hydroxide ions. Cention N is stated to exhibit a high polymer network density and degree of polymerization in the entire depth of the restoration [5].

Thus, the present study was conducted to evaluate and compare the microleakage and shear bond strength of Cention N, LC-GIC and Nanohybrid composite in primary teeth**.**

Materials and methods

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

Distribution of samples

120 primary molars, having no caries, or white spot lesion and intact crown structure, indicated for extraction or exfoliated, were collected and randomly divided into four groups depending on the basis of materials used for restoring the samples. Further, each group samples were divided into two subgroups A and B as shown in fig 1.

Grouping of Samples

In subgroup A samples microleakage assessment were done .(figure.1)

In subgroup B samples SBS were assessed.

For evaluation of Microleakage

Preparation of samples : After procuring sixty extracted human primary molar teeth, standard class V cavities measuring 5 millimetres in length (mesiodistally), 2 millimetres in width (occluso gingivally) and 1.5 millimetres in depth were prepared on the buccal surfaces of each tooth. Cavities in each group were restored with different restorative materials according to manufacturer instructions.

- For Group IA, the cavity is cleaned and single bond is applied onto the tooth surface and it was light cured for 20 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. Finally, the cement was cured for forty seconds.
- For Group IIA, the cavity is cleaned and 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. The excess cement was removed and a layer of petroleum jelly was applied over the set restoration.
- For Group IIIA, the powder and liquid of light cure GIC were mixed in a ratio of 3:1 and single bond agent is applied on to the tooth surface for 15 seconds. The mixed material is loaded onto the plastic filling instrument and cured for 60 seconds.
- For Group IVA, the cavity is cleaned and single bond is applied onto the tooth surface and cured for 30 seconds. The cavity was restored with Filtek Z250XT composite and light cured for forty seconds.

The samples of 60 teeth werelabeled 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 one millilmetre window around the cavity margins. Root apices were sealed with sticky wax and samples were kept in a solution of 2% methylene blue for 24 hrs 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 in a labiolingual direction through the centre of the restoration 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)

0 = No dye penetration

1 = Dye penetrating is to the lesser than and upto one half of the depth 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: Remaining sixty freshly extracted human primary molars for each group will be taken for shear bond strength evaluation. The samples will be scraped of any residual tags and cleaned thoroughly. After decoronation the samples will be mounted horizontally on acrylic block exposing the facial surface outward. Different restorative materials will be applied on the exposed tooth surface. Each group (Group IB-Cention N with bonding agent), (Group IIB Cention N without bonding agent), (Group IIIB Light cure glass ionomer cement), (Group IV B Nanohybrid composite). A split Teflon mold will be used to build the restorative material cylinder on the dentinal surface of all the samples. Shear bond strength will be determined by using a universal testing machine (UTM).

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

Results

Microleakage Analysis: Out of 60 primary molar teeth, it was observed that Cention N with bonding agent (Group IA) showed the least and light cure GIC (Group IIIA) showed highest microleakage. The difference in mean values between the groups was statistically significant. ($p < 0.001$). It was observed that Cention N with bonding agent (Group IA) exhibited no microleakage. (Table 1)

No significant difference was observed between Group I A and Group II A. Group I A and Group IV A exhibited no significant differences. Group II A and Group III A showed highly significant difference, whereas Group II A and Group IV A observed no significant difference. Group III A and Group IV A did not show significant difference. (Table 2)

Shear Bond Strength (SBS) Analysis: The results of shear bond strength showed that Group I B has the highest SBS (1232.09 N) when compared to other restorative materials. It was observed that the teeth restored with Light cure GIC exhibited inferior SBS (555.58 N) in relation to the teeth restored with Cention N without bonding agent (1194.96 N) and nanohybrid composite (996.32 N). (Table 3)

The mean SBS values of all groups revealed that there was a very highly significant difference between different restorative materials ($p < 0.0001$). No significant difference existed in mean SBS values between Group I B and Group II B. There was very highly significant difference between Group I B and Group III B. Group I B and Group IV B exhibited no significant differences. Group II B and Group III B exhibited very highly significant differences, whereas Group II B and Group IV

B exhibited no significant differences. Group III B and Group IV B showed very highly significant differences. (Table 4)

Discussion

An ideal restorative material should have the properties of good marginal seal, chemical adhesion with dental tissues, and similar thermal expansion coefficient with the tooth, good color stability, and biocompatibility. The adhesion of restorative materials to dentin is a desirable property because it can prevent the formation of secondary caries, microleakage, marginal discoloration, and subsequent pulpal damage[6]. Therefore, in the current study, SBS and microleakage of different restorative materials were evaluated.

Out of 60 primary molar teeth, it was observed that the Group IA showed the least and Group IIIA showed highest microleakage. The difference in mean values between the groups was statistically very highly significant. ($p < 0.001$). It was observed that Cention N with bonding agent exhibited no microleakage. Group IA (Cention N with bonding agent) and Group IVA (Nano hybrid composite) exhibited no significant differences. Group IIA (Cention N withoit bonding agent and Group IIIA (Light cure GIC) showed highly significant difference, whereas Group IIA (Cention N withoit bonding agent) and Group IVA (Nano hybrid composite) observed no significant difference. Group IIIA (Light cure GIC) and Group IVA (Nano hybrid composite) exhibited no significant difference.

Although Cention N could be used without bonding agent as per the recommendations but dentin agent was used in this study to exploring additional benefit of its usage at tooth adhesion interface. Dentin bonding systems consist of bifunctional molecules: 1) A methacrylate group that bonds to the restorative resin by chemical interaction and 2) a functional group that is able to penetrate wet dentin surface[7]. Thus, bonding systems help in preventing microleakage between the tooth and restorative surface interface.

The results of the present study were in accordance to the study conducted by Samanta et al[5] who compared microleakage in class V cavities filled with Flowable Composite resin, Glass ionomer cement and Cention N. They concluded that Cention N exhibited better results in terms of microleakage when compared to other materials. In another study done by Agarwal N et al[8]who compared microleakage of Cention N, Nano- Filled Composite and Ketac Molar. They concluded that Cention N was better than Ketac Molar and Nano- filled composite in terms of microleakage. Aakriti et al[9]in their study concluded that all the three restorative materials compared in their study showed some microleakage. However, Cention N displayed the least microleakage and came to be better than the other restorative. Meshram et al[10]evaluated microleakage at enamel restoration and dentin restoration interface of Class V cavities restored with Cention N, with and without using bonding agent and flowable composite resin. They concluded that microleakage at enamel restoration interface was less than microleakage at dentin restoration interface of each group, but the differences were not statistically significant. Least microleakage was seen with Cention N with adhesive followed by flowable composite. Hence, it can be well attributed to the fact that Cention N with bonding agent did not exhibit any microleakage in respect to the other materials used in the present study.

In selected 60 primary molar teeth, shear bond strength was compared and evaluated. They were decoronated and mounted on an acrylic block exposing the facial surface outward and different restorative materials were placed. They were randomly divided into four groups namely, Group IB (Cention N with bonding agent), Group IIB

(Cention N without bonding agent), Group IIIB (Light Cure GIC), Group IVB (Nano Hybrid composite). Shear Bond Strength was tested using a Universal Testing Machine. The difference in mean values between the groups was statistically very highly significant. ($p < 0.001$). It was observed that Cention N with bonding agent exhibited greater shear bond strength.

The results of the present study were in accordance to the study conducted by Mazumdar et al[11]who concluded that Cention N was also found to have a better bond strength when compared to Nano hybrid composite. In another study conducted by Naz F et al[12]who compared alkasite (Cention N) with glass ionomer cement (GIC) and nano-hybrid composite. They concluded that shear bond strength values with dentine were found to be highest for alkasite (Cention N) among the other tested groups. Chowdhury D et al[13] conducted a study where they compared the fracture resistance of two restorative materials namely, Z350 nanofill composite resin and Cention-N restorative material in a class II cavity with routinely used silver amalgam material. They concluded that under compression loading, the use of Cention-N and Z350 restorative materials significantly strengthened teeth after Class II cavity preparation and restoration.

On the contrary in a study by Feiz et al[14] the microtensile bond strength in primary teeth dentin, Giomer showed better results than Cention N, RMGI and Zirconomer, owing to the facet; presence of higher amount of PRG filler inGiomer.

Hence, in the present study the best result was shown by Cention N with bonding agent in terms of microleakage and shear bond strength when compared to the other materials used. The observations are totally in agreement with many previous studies conducted by multiple authors which concluded Cention N as the material of choice.

Conclusion

Within the limitations of the study design, it can be concluded that Cention N is better than light cure GIC and Nanohybrid composite in terms of both microleakage and shear bond strength.

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Legend Tables

Groups	N	Microleakage scores					Mean ± S.D.
		Score 0	Score 1	Score 2	Score 3	Score 4	
IA	15	15 (100%)	0	0	0	0	0.0
IIA	15	12 (80%)	3 (20%)	0	0	0	0.20±0.41
IIIA	15	6 (40%)	6 (40%)	3 (20%)	0	0	0.80±0.78
IVA	15	8 (57.1%)	6 (42.9%)	0	0	0	0.43±0.51
One way ANOVA, F=6.825, p=0.001*, significant							

Table 1: Table showing the extent of micro leakage in the samples

Groups	Mean	S.D.	F-value	p-value
Group IB	1232.09	178.22	17.925	0.0001
Group IIB	1194.96	122.01		
Group IIIB	555.58	102.74		
Group IVB	996.32	224.46		

Table 2: Intergroup comparison of micro leakage among the study groups

Test product (I)	Test product (J)	Mean difference (I-J)	p-value
IA	IIA	-0.20	1.00
	IIIA	-0.80	0.001*
	IVA	-0.429	0.164
IIA	IIIA	-0.60	0.013*
	IVA	-0.23	1.00
IIIA	IVA	0.37	0.327

Table 3: Mean Shear bond strength of four study groups

Group (IB)	Group (IIB)	Mean difference (I-J)	p-value
IB	IIB	37.12	1.00
	IIIB	676.50	0.001*
	IVB	235.76	0.223
IIB	IIIB	639.38	0.001*
	IVB	198.63	0.441
IIIB	IVB	-440.74	0.004*

Table 4: Inter group comparison using post hoc bonferroni

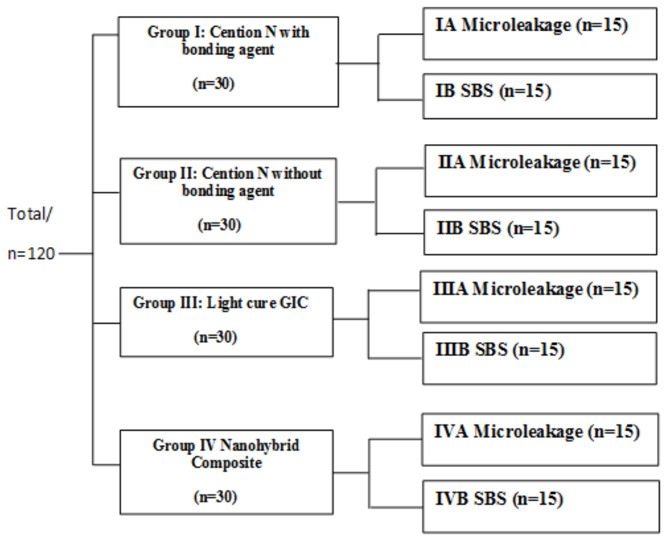

Figure 1: grouping of samples