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A Comparative Microleakage Analysis of a Newer Restorative Material – An Exvivo Study

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Aim: *To Compare and evaluate the microleakge of a newly introduced restorative material, Cention N, with the commonly used posterior restorative materials.MATERIALS AND METHODS:50 single rooted premolars free of caries or any other defects and extracted for orthodontic reasons were chosen for the study. Subsequently class 2 cavities were prepared and teeth were randomly assigned into five experimental groups (n = 10) and restored using amalgam, GIC, packable composite, cention with adhesive and without adhesive,respectively. All the specimens were subjected to thermocycling. Specimens were stained with 0.1% Methylene Blue Dye and evaluated for dye penetration under stereomicroscope. RESULTS:Cention N showed lesser microleakage compared to GIC and composite restorations. Groups restored using Cention N without adhesive showed lesser microleakage compared to that with adhesive.CONCLUSION:The study therefore showed Cention N to have lesser microleakage compared to GIC and composite restorations, thereby having better sealing ability*

Key Words: *CentionN, Glassionomer cement, Microleakage, Composite Resin.*

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I. Introduction

Over the past years esthetic dentistry has shown considerable progress leading to the development of a number of restorative materials with improved properties. One of the major requisites for the longevity of a restoration is its ability to adapt to the cavity walls, the failure of which would lead to microleakage[1].

Microleakage is the clinically undetectable passage of bacteria, fluids, molecules and ions between the cavity wall and the restorative materials applied to it[2,3]. Microleakage can lead to staining around the margins of restoration, post operative sensitivity, secondary caries, restoration failure, pulpal pathology or pulpal death, and partial or total loss of restoration[4].Controlling microleakage has always been an important goal of operative dentistry. Various restorative materials have been tried and tested for the same, with each having its own advantages and disadvantages.

Dental amalgam remains a predominant direct filling material for load-bearing areas. Although it is easy to apply, has good durability and strength and is economical, it also has disadvantages, which include its metallic grey color, increased sensitivity to the teeth, lack of adhesive properties, making undercuts for mechanical retention necessary, and most importantly, lack of marginal sealing[5,6].

GIC has been widely used as a restorative material ever since its introduction in 1972 by Kent and Wilson[7]. They showed advantages like bonding to the tooth structure, relative ease of use, and most importantly fluoride releasing property. However, even this material did show microleakage, along with lack of sufficient strength and toughness[1].

In recent years, the demand for composite resin restorations has dramatically increased due to advances in material aspect like, their ability to match tooth colour, absence of mercury, biocompatibility and adhesive resin technology[8].A major disadvantage associated with the use of this material is polymerization shrinkage which will eventually result in microleakage[9].

A new category of restorative material which is metal free and offers tooth coloured aesthetics as well as high flexural strength has been introduced. Cention N is an “alkasite” restorative material which is a subgroup of the composite class[1].

Thus, the present study was done to compare and evaluate the microleakge of a newly introduced restorative material, Cention N, with the commonly used posterior restorative materials.

II. Materials and methods

For the evaluation of microleakage:

50 single rooted premolars free of caries or any other defects and extracted for orthodontic reasons were chosen for the study (Fig 1). All specimens were cleaned and stored in distilled water till use.

Preparation of class II cavities:
Standardized Class II mesioocclusal cavities were prepared on the samples, the dimensions being 2 mm widthbuccolingually and 2 mm deep pulpally. Gingival seat of the proximal box was placed 1 mm above cementoenamel junction and was 1.5 mm wide (Fig 2).

Figure 1:single rooted premolar samples

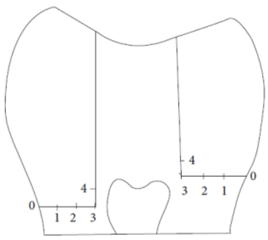
Figure 2: standardized class II cavity

Subsequently, teeth were randomly assigned into five experimental groups (n = 10) and restored according to the manufacturers' recommendations using:

Group 1– Amalgam
Group 2 - GIC
Group 3 –Packable Composite
Group 4 – Cention N Without Adhesive
Group 5 – Cention N With Adhesive

Preparation for assessment of microleakage:
After restoration, the sample were stored in distilled water at 37ºc for 24 hours, following which, they were subjected to a thermocycling regimen of 500 cycles between 5ºc and 60ºc, with a dwell time of 20 seconds in each bath. The samples were dried after thermocycling and then sealed with 2 coats of nail varnish 1 mm away from the gingival margin. The samples were then immersed in 0.1% methylene blue dye for 24 hours. The teeth were washed under running water for five minutes after dye exposure following which they were sectioned longitudinally in mesio-distal direction using a water-cooled low speed diamond disc. Stereomicroscopic evaluation of the sectioned samples in each group were done and the degree of dye penetration was assessed according to the following scoring criteria (Fig 3)[8]
Degree 0: no dye penetration
Degree 1: up to 1/2 the gingival seat
Degree 2: >1/2 the gingival seat
Degree 3: all along the gingival seat
Degree 4: degree 3 plus into the axial wall.

Fig 3: Scoring criteria for dye penetration



III. Statistical analysis
The data were collected, tabulated, and statistically analysed using ANOVA &Kruskal-Wallis test.

IV. Results

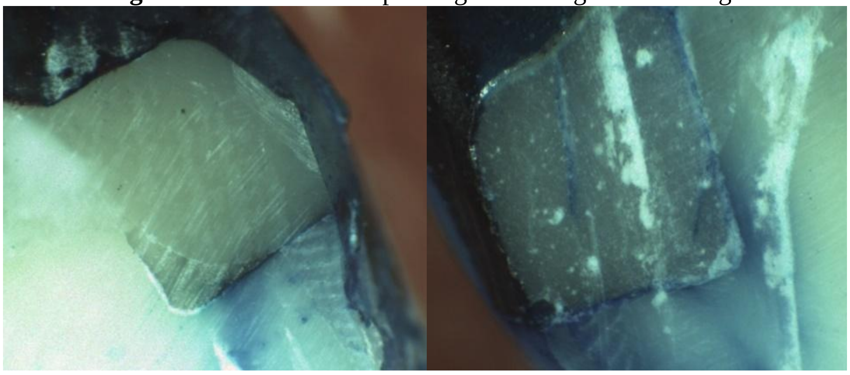
Table 1: Distribution of gingival microleakage seen over various groups

		Group					Total
		Group 1	Group 2	Group 3	Group 4	Group 5	
Leakage	Grade 0	10	0	7	9	7	33
		100.0%	.0%	70.0%	90.0%	70.0%	66.0%
	Grade 1	0	0	2	1	3	6
		.0%	.0%	20.0%	10.0%	30.0%	12.0%
	Grade 2	0	4	1	0	0	5
		.0%	40.0%	10.0%	.0%	.0%	10.0%
	Grade 3	0	2	0	0	0	2
		.0%	20.0%	.0%	.0%	.0%	4.0%
	Grade 4	0	4	0	0	0	4
		.0%	40.0%	.0%	.0%	.0%	8.0%
Total		10	10	10	10	10	50
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2: Mean difference between the microleakage for different restorative materials

Group	N	Mean	Std. Deviation	Kruskal wallis test value	p
Group 1	10	.00	.00	16.608	.000
Group 2	10	3.00	.94		HS
Group 3	10	.40	.70		
Group 4	10	.10	.32		
Group 5	10	.30	.48		

Figure 4: Stereomicroscope images showing micro leakage



On evaluation, the mean microleakage among the various groups was seen to be highest with GIC restorations. Cention N showed lesser microleakage compared to GIC and composite restorations. Groups restored usingCention N without adhesive showed lesser microleakage compared to that with adhesive.

V. Discussion

Micro leakage is still a concern in restorative dentistry, as it has been related to pulp alterations, sensitivity and secondary caries, which are the most common causes of restoration failure (Manhart& others, 2004)[10].

It is apparent that micro-leakage around restorations is a series of phenomenon and not a single entity(3)which is largely dependent on properties like coefficient of thermal expansion, polymerization shrinkage and property of adhesion.

Composite resin commonly used for aesthetic restorations demonstrated polymerization shrinkage. One of the weakest aspects of Class II composite resin restorations is microleakage at the gingival margin of proximal boxes. This is related to the absence of enamel at gingival margins, resulting in a less stable cementum-dentine substrate for bonding[11]. Modern composite resins undergo volumetric contractions ranging between 2.6% to 4.8 %.Also the coefficient of thermal expansion of composite resin is several times higher than that of enamel and dentin[1]. This physical property is also reported to be responsible for microleakage in resin based restorations. Alptekin T et al, conducted in vivo and in vitro studies and concluded that resin composite restorations revealed higher microleakage scores than amalgam restorations[9].

Glass Ionomer cements bond chemically to tooth structure, achieved via an exchange of ions arising from both the tooth and restoration leading to formation of calcium-polyacrylate bond[12]. Owing to the high p/l ratio and reduced glass particle size, GC Fuji IX GP is highly viscous material. The microleakage behaviour would probably have been due to its high viscosity, not allowing the wetting of the tooth surface properly, preventing the formation of good seal between tooth restoration interfaces[13]. These cements are highly technique sensitive and the most critical aspect is isolation from moisture for the first 30 minutes after placement. On exposure to water the matrix forming ions are easily leached out during the initial set which could interfere at tooth restoration interface. Also excessive dehydration can result in a chalky, crazed or a cracked surface leading to considerable marginal leakage[1].

Cention N is a tooth-colored, basic filling material for direct restorations. The liquid comprises of dimethacrylates and initiators, whilst the powder contains of various glass fillers, initiators and pigments[14].

Due to the sole use of cross-linking methacrylate monomers in combination with a stable, efficient self-cure initiator, Cention N exhibits a high polymer network density and degree of polymerization over the complete depth of the restoration.

It also includes a special patented filler (Isofiller) which acts as a shrinkage stress reliever minimising the shrinkage force which is responsible for the low volumetric shrinkage leading to least microleakage. Due to its low elastic modulus (10 GPa) the shrinkage stress reliever within Cention N reduces polymerization shrinkage and microleakage. Resin-based composites placed in conjunction with certain dental adhesives are believed to lose their sealing ability over time, thus permitting microleakage[14].Cention N restoration could be done with /without adhesive. In the present study without adhesive showed less micro leakage.

However, materials such as amalgam can seal the restoration margins through the formation of corrosion products over time[15]. Furthermore, new marginal gaps may develop during the lifetime of restoration due to thermally or mechanically induced stresses[16]. When an Amalgam is initially placed, a micro space exists between the amalgam restoration and tooth structure. The mechanism for the resolution of this problem is considered to be the sealing of the margins by corrosion products and possibly organic aggregates[9].

VI. Conclusion

The study therefore showed Cention N to have lesser microleakage compared to GIC and composite restorations, thereby having better sealing ability.

Conflict of interest: None

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