

An-Invitro Comparative Evaluation of Marginal Microleakage of Cention-N with Bulk-FIL SDR and ZIRCONOMER: A Confocal Microscopic Study

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Abstract: ***Aim:** To compare and evaluate marginal microleakage of CENTION-N with bulk FILL SDR and ZIRCONOMER using confocal microscopy. **Methodology:** Thirty freshly extracted human maxillary premolars were selected for the study. Standardized mesio-occlusal [MO] cavities were prepared. The specimens were randomly divided into three groups. Group I: restored with Cention-N. Group II: restored with bulk-fill SDR. Group III: restored with Zirconomer. The specimens were thermocycled, and a layer of nail varnish was applied on all surfaces except for 1mm around the restoration margins. The samples were then immersed in 0.6% rhodamine dye solution for 24 hours. Samples were sectioned and observed under confocal microscope (x10). **Statistical Analysis:** The statistical analysis of this study was done using kruskal wallis and mann whitney U tests. **Results:** A statistically significant difference was observed among all the groups tested. The minimum leakage was seen in group-I (Cention-N) and the maximum in group-III (Zirconomer). **Conclusion:** Based on the results of this study, it can be concluded that bulkfill SDR showed least microleakage scores followed by cention-N and zirconomer*

Keywords: Bulk fill SDR, Cention-N, Marginal Microleakage, Zirconomer

1. Introduction

Esthetic dentistry has shown much advancements in material science and technology over the past few years. In the current age of adhesive or microdentistry, there is a gradual shift from amalgam to newer esthetic restorative materials. The reasons that led to the phase down of amalgam are concerns for mercury toxicity, unpleasant colour, low edge strength, lack of adhesion to tooth structure etc^[1].

Composite restorations have become more popular these days owing to its superior esthetics and optimal physical properties. There has been a substantial improvement in composite technology over the past two decades. However, polymerization shrinkage is one of the major drawback of this versatile material.^[1,2,3] Polymerization shrinkage results in potential gap formation between the composite resin and the cavity walls. Marginal gap formation contributes to microleakage permitting the passage of oral fluids, ions and bacteria leading to post-operative sensitivity, pulpal inflammation and recurrent caries.^[4]

Very recently, bulk-fill composites (like SDR) were introduced into market with handling characteristics typical of flowable composite. Bulk-fills can be placed in 4 mm increments and cured with minimal polymerization stress. Advantages include better flow, ease of placement, excellent adaptation to the cavity walls, low modulus of elasticity, thereby reducing the stress generated on the cavity walls.^[5,6] Zirconomer or white amalgam, is modified glass ionomer cement with the strength and durability of amalgam. The

inclusion of Zirconia fillers reinforces the structural integrity of the restoration and imparts superior mechanical properties in posterior load-bearing areas.^[7]

Cention N is a novel bulk fill direct posterior restorative material based on "alkasite" technology (a subgroup of the composite resin).^[8] Advantages of cention-n include bulk placement, optimal physical/mechanical properties, superior esthetics and optional light-curing.

Therefore, the aim of the present in-vitro study was to compare and evaluate the marginal microleakage of the most innovative restorative material CENTION N with bulk fill SDR composite and zirconomer.

2. Materials and Methods

Sample Selection

Thirty intact human maxillary premolar teeth extracted for orthodontic reasons were selected and stored in 0.1 vol % thymol solution for 48 hrs and then in distilled water until use. Teeth of comparable size and shape were selected after measuring the bucco-lingual and mesio-distal dimensions of the crown.

Cavity Preparation

Standardized Class II mesio-occlusal cavities were prepared using No.245 tungsten carbide bur in high-speed arotor handpiece (NSK, Japan) with water spray. The overall dimension and depth of cavity preparation were standardized (occlusal floor- width 4 mm, length 5 mm; axial wall- width

4 mm, height 3 mm; gingival floor- width 4 mm, depth 2.5 mm. The gingival seat was placed well above (2mm) from the cemento-enamel junction(CEJ). A William's graduated periodontal probe (Hu-friedy, Chicago, IL, USA) was used to measure the dimensions of the prepared cavity. The teeth were then placed in distilled water at room temperature until use. All prepared samples were then randomly divided into 3 groups (n=10).

Restorative Procedures

All samples in groups (1&2) were etched using 37% phosphoric acid gel (Dentsply) for 10 seconds, washed with water jet for over 30s and dried with gentle stream of air leaving a moistened surface. Two consecutive layers of Adper single bond plus (3M, ESPE) was then applied using a disposable microbrush, and light cured (IvoclarVivadent) for 20s.

Group1specimens were restored using Cention-N (Ivoclar,Vivadent). Dosing, mixing and restoration of the cavity were strictly according to manufacturer instructions. Additional light curing for 20 sec was done.⁸

Group2 specimens were bulk-filled using SDR (Dentsply) and light cured for 20 sec.

Group 3 specimens were directly restored using Zirconomer (SHOFU INC.)

After finishing and polishing all the specimens were subjected to a thermocycling regimen of 2500 thermal cycles by alternating immersion in water at $+5 \pm 8^\circ\text{C}$ and $+55 \pm 8^\circ\text{C}$ with a dwell time of 2 minutes and transfer time of 5 seconds in each bath. Two coats of nail varnish, were applied all around leaving a 1 mm window around the cavity margins. Root apices were sealed with sticky wax. The teeth were then immersed in rhodamine-B dye for 24 h.

Teeth were sectioned in mesio-distal direction, coincident with the center of the restoration, using a hard tissue microtome under water spray. The dye penetration at the occlusal and gingival margins of each section was evaluated independently using a confocal microscope (Olympus) at a magnification of X 10 and scored as follows^[10,11](Table-1)

Sl No	Tooth Restoration Interference	Score criteria
1	No dye penetration	0.00
2	Dye penetration upto the first third of the prepared cavity wall	0.25
3	Dye penetration upto the Second third of the prepared cavity wall	0.50
4	Dye penetration onto the entire prepared cavity wall	0.75
5	Dye penetration onto the entire prepared cavity wall and the Pulpal wall	1.0

3. Results

In the present study, percentage microleakage was compared between Cention-n, bulkfill SDRand Zirconomerusing Kruskal wallis test. In occlusal area, mean percentage microleakage of cention-n was found to be 75.065+13.396, while that of SDR and zirconomer was 42.078+ 14.392 and 180.928+21.119 respectively. There was a statistically significant difference in mean percentage microleakage between all 3 groups.

Table 2: Kruskal Wallis Test

Kruskal Wallis Test							
Marginal microleakage		N	Mean	SD	Chi-Square	df	p
Occlusal	Cention n	10	75.065	13.396	25.3	2	<0.001
	SDR	10	42.078	14.392			
	Zirconomer	10	180.92	21.119			
Gingival	Cention N	10	92.324	10.6065	24.81	2	<0.001
	SDR	10	69.217	9.62178			
	Zirconomer	10	669.43	131.904			
Score	Cention N	10	0.25	0	24.7	2	<0.001
Occlusal	S D R	10	0.1	0.1291			
	Zirconomer	10	0.575	0.12076			
Score	cention n	10	0.25	0	28.01	2	<0.001
Gingival	SDR	10	0.25	0			
	Zirconomer	10	0.825	0.12076			

Table 3 Mann-Whitney U

Mann-Whitney U			
Dependent Variable	Reference group	Comparison group	p
MM occlusal	Cention N	S D R	<0.001
		Zirconomer	<0.001
	S D R	Zirconomer	<0.001
MM Gingival	Cention N	S D R	0.001
		Zirconomer	<0.001
	S D R	Zirconomer	<0.001
Score Occlusal	Cention N	S D R	0.004
		Zirconomer	<0.001
	S D R	Zirconomer	<0.001
Score Gingival	Cention N	S D R	1
		Zirconomer	<0.001
	S D R	Zirconomer	<0.001

Pair wise comparison was done using Mann-Whitney U test. In the occlusal area, there was a statistically significant difference in microleakage scores between cention-n and SDR (p<0.001), cention-n and zirconomer(p<0.001)& SDR and zirconomer (p<0.001). However, no statistically significant difference exist between cention-n and SDR in the gingival area .

Thus, Group-2(Bulk fill SDR) had minimal occlusal/gingival micro leakage compared to group-1(Cention-N) and group-3(zirconomer). Group -3 presented highest leakage scores. The leakage scores of Cention -N was in between that of groups 2 and 3.

4. Discussion

- 1) Major factor influencing the longevity of any dental restoration is microleakage. Microleakage is defined as the clinically undetectable passage of bacteria, fluids, molecules, or ions between a cavity wall and the restorative material applied to it. Microleakage causes staining at the margins of the restoration, hypersensitivity of the restored teeth, recurrent caries at the tooth/restoration interface, and the development of pulpal pathology.^[12,13]
- 2) Maxillary first premolars were selected for this study and standardized class 2 cavities were prepared to simulate clinical situation. Cavities were prepared and restored strictly according to manufacturer instructions. Thermocycling was done to mimic intra-oral temperature variations. Two layers of nail varnish were applied all

around leaving 1 mm from the restoration margins, and the apex was sealed with sticky wax, to avoid any dye penetration from invisible cracks, areas devoid of enamel or cementum etc. The teeth were then immersed in Rhodamine-B dye for 24 hours. Rhodamine-B was used because of its better penetration, water solubility, diffusibility and hard tissue non-reactivity. Confocal laser scanning microscopy is a technique for visualizing subsurface tissue characteristics. Statistically significant differences were observed among all the three groups. Marginal microleakage among the experimental samples were then observed under a confocal microscope at 10x magnification.

- 3) Bulkfill SDR (Fig 1) showed minimal leakage among all the three groups tested followed by cention-N and zirconomer. The microleakage scores of bulk fill SDR were in accordance with other similar studies.^[14,15,16]
- 4) The advantages of bulk-fill materials include low filler loading, low viscosity, and high flowability. SDR has self levelling property; it can be bulk placed up to 4 mm and light cured. According to Orłowski et al, SDR offers 60 percent less polymerization shrinkage. Bulkfill SDR incorporates a polymerization modulator with its resin backbone as stated by the manufacturer. This polymerization modulator synergistically interacts with camphorquinone resulting in slower modulus development (ie, linear chain propagation /branching occurs without much cross-linking). Thus, higher rates of monomer conversion can be achieved without much shrinkage stresses.^[17]
- 5) Cention N (Fig 1) includes a special patented filler (Isofiller). Isofiller acts as a shrinkage stress reliever-minimizing shrinkage forces during polymerization. According to the manufacturer, the shrinkage stress reliever within Cention N acts like a spring expanding slightly as the forces between the fillers grow during polymerization. Moreover, the organic/inorganic ratio and the monomer composition of the material, accounts for its low volumetric shrinkage-allowing bulk filling of cention -N.^[9] Only minimum literature is available regarding polymerization shrinkage and marginal leakage of Cention N.
- 6) Zirconomer (Fig 3) presented the highest microleakage when compared to both CENTION-N and SDR. Addition of zirconia fillers to the glass component of Zirconomer improved its mechanical properties but not its marginal integrity. The results obtained for zirconomer were in accordance with other similar studies.^[11]

5. Conclusion

Within the limitations of the present study, it can be concluded that-

Bulkfill SDR showed least marginal microleakage followed by cention-n and zirconomer.

Marginal leakage scores of novel restorative material, CENTION-N was minimal and within acceptable limits.

Cention-n offers a promise for future as direct posterior restorative material.

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Figure 1: BULK FILL SDR



Figure 2: CENTION-N



Figure 3: ZIRCONOMER