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A COMPARATIVE EVALUATION OF MARGINAL ADAPTATION BETWEEN SELF ADHERING FLOWABLE COMPOSITE AND BULK FILL FLOWABLE COMPOSITE: AN IN VITRO STUDY

Dental Sciences

Dr. Satyam Kashyap	Post Graduate, Babu Banarasi Das College of Dental Sciences, Department of Conservative Dentistry & Endodontics, Lucknow, India.
Dr. Praveen Singh Samant	Head of Department & Professor, Babu Banarasi Das College of Dental Sciences, Department of Conservative Dentistry & Endodontics, Lucknow, India.
Dr. Tanu Tewari	Associate Professor, Babu Banarasi Das College of Dental Sciences, Department of Conservative Dentistry & Endodontics, Lucknow, India.
Dr. Rita Gupta	Senior Lecturer, Babu Banarasi Das College of Dental Sciences, Department of Conservative Dentistry & Endodontics, Lucknow, India.

ABSTRACT

Despite several improvements in restorative materials and techniques in the recent decade, postoperative sensitivity, marginal discoloration and secondary caries with composite restorations still remains a challenge, the reason being poor marginal adaptation. To overcome this problem, this study was undertaken in order to assess the best available composite material that would closely adapt to the cavity walls and provide the best possible marginal adaptation between the newer all-in-one bonding system, and the Bulk fill composite. A total of 30 mandibular premolars were selected for this study, Class II cavities were prepared on the distal surfaces of all teeth. The samples were then divided into 3 equal groups according to the restorative material to be used, Vertise flow, DMG Constric and SDR Flow respectively. After the completion of restoration, the specimens were further sent for SEM investigation. Thereafter the result concluded that marginal adaptation SDR Flow(control group)was better than the other two groups.

KEYWORDS

marginal adaptation, self adhering flowable composite, Vertise flow, DMG Constric, SDR Flow

INTRODUCTION

Dental restorative materials are required to fulfil basic prerequisites including similarity to tooth structures in their mechanical, physical, and esthetic properties. Although dental restorative materials differ significantly in their characteristics, they are all, fabricated to be as durable and inert as possible, yet, restorations may deteriorate, degrade or fail.[1]

Inadequate marginal adaptation can result in secondary caries, postoperative sensitivity, and marginal discoloration, all of which shorten the lifespan of a composite restoration. The marginal failure in a composite resin restoration is mostly associated with strength of the bond between resin and the dental substrate, as well as the stress that polymerization shrinkage causes inside the restoration[2] The polymer matrix of dental composites is the primary cause of shrinkage.[3] The postoperative sensitivity with composite restorations continues to be a difficulty for restorative dentists, even with advancements in restorative materials and techniques over the past few decades[2]

These days, minimally invasive dentistry and conservative techniques necessitate the use of adhesive resin restorations, which work effectively in moderate- to small-sized preparations. Despite the potential greatness of flowable resin restorations, the decision was not as credible in the past due to the material's mechanical flaws.[4]

The use of nanotechnology to flowable resin composites has been a breakthrough that has the potential to improve these materials' clinical performance. Because of their easy placement and adaption to the inner cavity walls, their mechanical qualities improved to the point where they could compete with some standard viscosity resin.[5]

Flowable composites were earlier used only as liners due to their low elastic modulus. The second-generation flowables developed since 2000 promised increased mechanical properties and are proposed for use in bulk restorations as well. The development of self-adhering flowable composite, which combines the benefits of restorative and adhesive material technologies in a single application process, represents an ambitious advancement (eighth generation).[6]

When dealing with patients who are difficult to work with or who have several carious defects, the Self adhering flowable composite promises fewer steps, a lower probability of application errors, and the shortest chair time feasible.[7]

One of the main goals of the dentistry industry's current research and development activities is the simplification of clinical adhesive procedures.[8]

To create a long-lasting bond, however, the hydrophobic–hydrophilic mismatch between dental composite and tooth substrate must be addressed. The development of composite cements that stick together has led to the development of a new class of self-adhesive (restorative) composites (SACs) that are bonded to tooth enamel and dentin without a separate adhesive.

An indicator characterizing the properties of restorative materials, with particular importance for preventing secondary caries, is the integrity and durability of marginal sealing. Thermocycling and ageing with SEM marginal analysis and marginal adaptation are still closer to the clinical situation, allowing us to compare these important for the clinic characteristics of different restorative materials.

The present study aimed to evaluate and correlate marginal adaptation in Class-II cavities restored with self-adhering flowable composite and bulk-fill flowable composite, analyzed under SEM.

MATERIALS AND METHODS

30 non carious mandibular premolars, were selected for this study. Class II cavities were prepared on the distal surface of all teeth with the dimensions of the cavity being 4 mm buccolingual width, 2 mm mesiodistal depth and the gingival margin of the cavity was placed at the cementoenamel junction (CEJ). No bevels are placed at any of the cavosurface margins; however, all margins were smoothened using an enamel hatchet.

Thereafter all teeth were then randomly divided into 3 groups of 10 samples each. All samples were restored according to the manufacturer's guidelines.

Group I (n=10)-Vertise flow without etchant and bond The cavities in this group were neither etched nor any bonding agent was applied. Vertise flow was placed directly onto the cavity as a liner in a uniform thickness of 1mm and was light cured for 20sec.

Group II (n=10)-DMG Constric without etchant and bond. The cavities in this group were neither etched nor any bonding agent was applied. DMG constric are placed in a uniform thickness of 1mm was placed as a liner and was light cured for 20sec.

Group III (n=10)-SDR Flow (positive control group) The cavities were total etched with 37% phosphoric acid gel for 15 sec thereafter rinsed with water and then air dried. Two coats of Pro Bond were applied onto the cavity surface, gently air dried and light cured for 10sec using a LED curing light at an intensity of 1000 mW/cm2.. The cavities were then lined with SDR flow in a uniform thickness of 1mm and light cured for 20sec.

For seven days, all samples were kept in distilled water at 37°C. 500 thermal cycles were then run, with a dwell duration of 30 s in each bath and a transfer time of 15 s, between 5°C and 55°C.

All specimens were then sent for Scanning Electron Microscope analysis. To assess the restoration's marginal adaptation, a 1 cm by 1 cm sagittal section of the restoration were made and examined under a scanning electron microscope.

The SEM images of the tooth-restoration interface were captured at 200 × 15 magnification and renamed/coded by another colleague not involved in the study; to keep the principal investigator blinded, for the micromorphological evaluation of the tooth restoration interface according to the criteria by Blunck and Zaslansky, mentioned as below[9].

- MQ1-Margin not or hardly visible; No or slight marginal irregularities; No gap
- MQ2-No gap but severe marginal irregularities
- MQ3-Gap visible (hairline crack up to 2 µm); No marginal irregularities
- MQ4-Severe gap (>2 µm); slight and severe marginal irregularities.

The term “marginal irregularities” refers to porosities within the adhesive layer, marginal restoration fracture, and/or a bulge within the adhesive layer

RESULTS

The above tables shows the distribution of marginal adaptation among the various groups of the study. The results shows that there was statistically significant difference among the groups ($p<0.05$) with the sequence of best marginal adaptation as follows Group III > Group II > Group I.

Table 1: Results

		MQ1	MQ2	MQ3	MQ4	TOTAL	P-VALUE
Group I	Count	3	4	1	2	10	**0.035**
	% within group	15.8%	22.2%	14.3%	33.3%	20.0%	
	% total	6.0%	8.0%	2.0%	4.0%	20.0%	
Group II	Count	1	4	2	3	10	
	% within group	5.3%	22.2%	28.6%	50.0%	20.0%	
	% total	2.0%	8.0%	4.0%	6.0%	20.0%	
Group III	Count	3	5	2	0	10	
	% within group	15.8%	27.8%	28.6%	0.0%	20.0%	
	% total	6.0%	10.0%	4.0%	0.0%	20.0%	

DISCUSSION

Marginal failure in composite resin restorations occurs mainly due to bond quality with the dental substrate and stress from polymerization shrinkage.[2]

Flowable composite resins show improved marginal adaptation due to their rheological properties flexibility and low modulus of elasticity, relieving stresses during polymerization shrinkage and enhancing restoration adaptation.[10] Flowable composites demonstrate high wettability, ensuring better penetration into tooth surface irregularities forming thin layers without air entrapment. hence, they are recommended as initial increments and as cavity liners.[11]

Buonocore's etch and rinse adhesive approach remains the gold standard but self-etch adhesive offer faster and less technique sensitive alternative.

The self adhering composite revolutionized adhesive dentistry by combining an all in one bond system, eliminating the need for separate etching and adhesive application.[3]

The study showed reduced marginal leakage at the coronal margin in specimens restored with total etch adhesive system SDR flow when compared to those using vertise flow without etchant and bond and DMG constric without etchant and bond . The reason behind this could be due to vertise flow and DMG constric having higher viscosity than the bonding agent in etch and rinse system thus, limiting its penetration into collagen fibres and dentinal tubules causing incomplete resin infiltration and a defective interfacial seal.

This was supported by an article by Man et al who compared the marginal adaption of Self etched composite system with conventional etch and bond systems.

This study found Vertise Flow's marginal adaptation comparable to SDR Flow and DMG Constric, supported by Aleksander Maj et al.'s findings. Maj's studied on 37 patients with 64 fillings compared Vertise Flow without etching or bonding to Premise Flowable with various bonding systems.[12]

Over 24 months, clinical evaluations showed Vertise Flow without etching or bonding had the weakest marginal adaptation. The areas of dentin that had been deeply demineralized yet incompletely infiltrated by the resin were revealed by silver nitrate deposits and have been considered responsible for a defective interfacial seal.

This study contradicts the study done by C.Rengo et al, who found no significant difference in microleakage between phosphoric acid etched flowable composite and self etched self adhering flowable composite at the enamel surface.[13]

Another study conducted by Osama et al. reported similar findings on comparing self-adhering and conventional flowable composites in occlusal cavities. Eighteen patients received both Vertise Flow and Filtek Z350XT flowable restorations. Results were evaluated at baseline and after 24 months, it was found that marginal adaptation showed no significant difference between the materials, with both scoring well.

Despite good in vitro results and less polymerization shrinkage, the study found no materials provided 100% marginal integrity, likely due to the challenges of bonding to dentin's high organic content and tubular structure.

These results cannot be correlated with clinical performance due to the study's limitations, such as not simulating temperature changes, masticatory forces, and pH fluctuations. Future research, including in vitro, ex vivo studies, and randomized clinical trials, is recommended to address these limitations.

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