International Journal Dental and Medical Sciences Research
Volume 6, Issue 4, July. – Aug. 2024 pp 57-60www.ijdmsrjournal.com ISSN: 2582-6018

Cuspal Deflection of SelfAdhesive Bulk-fill Resin Composite vs Conventional Resin Composite and Resin Modified Glass-ionomer: A Comparative Study

Basant S.Ibrahim[1],Naglaa R.Elkholany[2],Tawakol A.Enab[3] ,Nadia M.Zaghloul[4]
1 Postgraduatestudent at Conservative DentistryDepartment, Faculty of Dentistry, Mansoura University, Egypt.
2 assistant Professor of Conservative Dentistry Department, Faculty of Dentistry, Mansoura University, Egypt.
3 professor,Production and Mechanical Design Engineering DepartmentFaculty of EngineeringMansoura University,Egypt
4 Professor, Conservative DentistryDepartment, Faculty of Dentistry, Mansoura University, Egypt.

Date of Submission: 01-07-2024 Date of Acceptance: 07-07-2024

ABSTRACT: The aim of this study is to compare the cuspal deflection of teeth restored with three types of materials (self-adhesive bulkfill resin Composite, conventional resin-composite, and resin-modified glass ionomer restorations). A total number of 36 premolars (n=36), n=12 for each group, Mesio-occluso-distal cavity was prepared in all teeth, the specimens were fixed under ZEISS, Stereozoom Microscope Stemi 508 (50×) attached to the camera and Three measurements were taken for each specimen, pre-restoration measurement / post-restoration measurement within 5 and 15 minutes. Which revealed that none of the study variables had a significant effect on the cuspal deflection results In conclusion, Self-adhesive bulk fill resin composite showed the highest cuspal deflection and polymerization shrinkage, but conventional resin-based composite showed the lowest with no significant difference.

KEYWORDS: Cusp deflection; Resin composite, Selfadhesive bulk fill.

I. INTRODUCTION

[1] Resin composites became the material of choice for most patients and dental practitioners when esthetic restorations are intended. Incremental techniques have been suggested to compensate the polymerization shrinkage of resin composites by reducing the stresses developed within the tooth-restoration system. In Bulk application technique is simpler, and it makes the work quicker by reducing the number of clinical steps. [2] Adhesive bonding to tooth structure has been an integral part of modern restorativedental practice that obviously improves the biomechanical and esthetic quality outcomes of restorations. [3] Self-adhesive resin composites (SACs) are claimed to bond to tooth substrate without a separate adhesive. [4] Glass-ionomer cement (GIC) is the true example of self-adhesive bulk-fill material that Widely used in certain cases. The modification of glass ionomer cement by the addition of resins was created with the intention of decreasing the setting time, enhancing mechanical properties, and lessen the material's sensitivity to early fluid contamination when compared to GICs. The hybrid substance was given the term resin-modified glass ionomer cement (RM-GIC).

II. MATERIALS AND METHODS

Three different restorative materials;Self-adhesive bulk-fill hybrid resin composite (surefil one, dentsplaysirona, Konstanz, Germany), Resin modified glass ionomer (fuji, GC, corp, Tokyo, Japan) and Conventional Resin-based composite (Filtek Z250, 3M ESPE) with All Bond Universal adhesive (bisco) were used in this study. Manufacturing, composition, descriptions of these materials are presented in **Table 1.**

Table 1. Materials used in the study

Material	Type	Manufacturer	Composition	Batch number
Surefil one	Self adhesive bulk fill resin composite (hybrid)	Dentsplaysirona, Konstanz, Germany	MOPOS, BADEP, acrylic acid, water, reactive glass filler,non-reactive glass filler, initiator, stabilizer	2205000565

Fuji II LC capsule	self-adhesive resin modified glass ionomer (RMGI)	GC Corp., Tokyo, Japan.	Powder: 100% strontium fluoroalumino silicate glass, Liquid: 35% HEMA, 25% distilled water,24% polyacrylic acid, 6% tartaric acid and 0.10% Camphorquinone.	2202181
Filtek Z250	Adhesive restorative material(Conventional nanohybrid resin composite restoration)	3M ESPE	BIS-GMA, UDMA, and Bis-EMA (Bisphenol A polyethylene glycol diether dimethacrylate). This light-cured resin is filled with 60% (volume) silica/zirconia.	9582030
All Bond Universal adhesive	Light cured dental adhesive	Bisco , Bisco, Inc. 1100 W Irving Park Road, Schaumburg, IL 60193 USA	BisGMA, Ethanol, 2-Hydroxyethyl Methacrylate, 10-MDP	2200003898
Abbreviations: MOPOS: Modified polyacids, BADEP: Bifunctional acrylate,BIS-GMA: GMA (Bisphenol A diglycidyl ether dimethacrylate), UDMA (urethane dimethacrylate),10-MDP:10-Methacryloyloxydecyl Dihydrogen Phosphate.				

Freshly extracted sound human maxillary non carious premolars were collected Teeth cleaned from adherent debris using hand scaler, rubber cup, pumice, and low speed hand piece. Teeth were disinfected for one day in 5% chloramines solution. Later, the teeth were examined for the presence of any micro cracks or defects using a stereomicroscope. The selected teeth were randomly divided into 3 main groups according to the type of restorative material used,12 teeth for each material All selected teeth were measured using a digital caliper. They had approximately the same crown size.

[5] All selected teeth had the same occlusal anatomy.The roots of all teeth were fixed vertically in acrylic resin cylinders up to 2 mm below CEJ to facilitate the preparation and restoration steps. Mesio-occluso-distal cavity was prepared in all teeth using straight fissure carbide bur (6836KR 314 018; Komet, Brasseler, Lemgo, Germany) in high-speed handpiece (T3, Sirona Benshein, Germany) under copious water coolant.

Every five preparations, the carbide bur was changed to ensure high cutting efficiency. A pencil was used to mark the outline before preparation. The dimensions of the prepared cavities were 3 mm bucco-palatally that predetermined by measuring with a periodontal probe and 4 mm depth from the occlusal cavo surface margin to the pulpal floor, depending on the radiograph and using a mark on the used carbide instrument at 4 mm from the tip to keep the depth of cavity does not exceed 4 mm then confirmed by a periodontal probe161 The teeth for the cuspal deflection test were subjected to pre-restoration measurement (first measurement) after cavity preparation through the application of two occlusal marks drawn on buccal and lingual cusps tips by permanent super fine 0.5 mm marker with high color stability. After finishing the restoration, the restoredteeth immediately were measured for cuspal deflection under the microscope, then within 5 minutes and15 minutes the restored teeth were refixed under the microscope then re-measured using microscope system.

III. RESULTS

Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Quantitative data were described using mean± Standard deviation for normally distributed data. A

one-way ANOVA test was used to determine the effect of study Variables (materials) and their interaction on the cuspal deflection values (at $p < 0.05$), which revealed that none of the study variables had a significant effect on the cuspal deflection results ($p > 0.05$). All samples showed inward cuspal deflection but the mean cuspal deflection for the (Surefil one) was the highest (4768.04±443.84) but but for (Filtek Z250) The mean CD after the placement of restoration decreased was (4577.87±336.12).

IV.DISCUSSION

[6] The result of this study showed that after completing the restorative procedure an inward cuspal deflection for all groups occurred, and inward cuspal
deflection, might be attributed to the amount of the remaining free radicals, double bonds in the resin base composite restoration which persisted to react after the polymerization reaction process consequence,the polymerization stress developed and causes inward of both cusps. This deflection was continued for several minutes (at time intervals of 5 min to 15 min).

[7] Based on the findings of this study, the null hypothesis regarding cuspal deflection was accepted, as none of the investigated materials had a significant effect on the cuspal deflection results ($p > 0.05$). The present study compared the influence of application technique (incremental and bulk-fill) on the cusp deflection for conventional and bulk-fill resin composites. This finding supports other studies that also found similarities in the cuspal deflection between high-viscosity bulk-fill and conventional resin composites the results of this studyshowedthat teeth restored with self-adhesive resin composite (surefil one) showed the highest cuspal deflection value, then resin modified glass ionomer (fuji) and conventional resin composite (filtek Z250) showed the lowest mean cuspal deflection. The incremental technique shows less cuspal deflection compared to bulk-fill technique, and this could be attributed to the recommended maximum depth of cure for each incremental layer of resin composite material is about 2mm. However, in the bulk-fill technique, the depth of polymerization might not be totally completed causes internal stress to be developed within the structure of the material as well as more cuspal recoil.

[8] Despite the higher elastic modulus, it is possible that a higher percentage of UDMA in Filtek Z250, in comparison to the other materials, has favored a reduction in the amount of contraction and stress zonesthat occur during the degree of polymerization and has less cuspal deflection.

[9] This resin composites, which incorporate urethane di methacrylate and bisphenol A polyethylene glycol diether dimethacrylate, with lower triethylene glycol dimethacrylate content, produced less polymerization shrinkage and consequently, less cuspal deflection.

[10] The two-step etch-rinse adhesive, universal all bond used in combination with the proprietary resinbased composite, i.e., Filtek Z250 this approach is still considered as the “gold standard” when assessing the performance of a newer resin composite. The current adhesive contains 10-Methacryloyloxy-decyl dihydrogen phosphate (10-MDP) monomer that chemically bonds to hydroxyapatite crystals forming a nanolayer that further could lead to improved marginal sealing.

[11] RMGIC was used as it has a lower elastic modulus. RMGICs have also been shown to undergo volumetric contraction after polymerization and cuspal deflection, which is compensated by a delayed expansion in the presence of water.Comparisons of materials at five minutes after the restoration in the current study showed that the cuspal deflection of surefil one resin composite showed the highest mean cuspal deflection values but in filtek Z250 showed the lowest although these differences were not statistically significant ($P>0.05$).

V. CONCLUSION

Within the limitations of this laboratory study, it could be concluded that:Self-adhesive bulk fill resin composite (surefil one) showed the highest cuspal deflection and polymerization shrinkage, but conventional resin-based composite (filtek z250) showed the lowest with no significant difference.

REFRENCES

[1]. Pallesen U, van Dijken JW, Halken J, Hallonsten A-L, Höigaard R. (2013) Longevity of posterior resin composite restorations in permanent teeth in public dental health service: A prospective 8 years follow up. J Dent; 41:297-306.

[2]. Heintze SD, Rousson V. (2012) Clinical effectiveness of direct Class II restorations-a meta-analysis. J Adhes Dent.; 14:407-431.

[3]. Ilie N. (2022) Fracture and viscoelastic behavior of novel self-adhesive materials for simplified restoration concepts. Journal of the Mechanical Behavior of Biomedical Materials;125:104970.

[4]. Karaman E, Ozgunaltay G. (2013) Cuspal deflection in premolar teeth restored using current composite resins with and without resin-modified glass ionomer liner. Oper Dent;38:282–9.
[5]. Bucuta S, Ilie NJCoi. (2014) Light transmittance and micro-mechanical properties of bulk fill vs. Conventional resin based composites. Clin Oral Investig; 18:1991-2000.
[6]. Elsharkasi MM, Platt JA, Cook NB, Yassen GH, Matis BA(2018)Cuspal deflection in premolar teeth restored with bulk-fill resin-based composite materials. Oper Dent.; 43:1-9.
[7]. Yarmohammadi E, Kasraei S, Sadeghi Y. (2019) Comparative Assessment of Cuspal Deflection in Premolars Restored with Bulk-Fill and Conventional Composite Resins. Front Dent.;16(6):407-14.
[8]. Duarte R, Somacal D, Braga L, Borges G, Spohr A. (2023) Cuspal Deflection and Marginal Integrity of Class II Cavities Restored with Bulk-fill Resin Composites. The Open Dentistry Journal.;17:1-8
[9]. Fleming GJ, Cara RR, Palin WM, Burke FJ. (2007) Cuspal movement and microleakage in premolar teeth restored with resin-based filling materials cured using a 'soft-start' polymerisation protocol. Dent Mater.; 23:637-643.
[10]. Cetin A, Dinc H. (2020) Effects of artificial aging on the bond strengths of universal dental adhesives. Niger J Clin Pract.;23:1148-54.
[11]. Attin T, Buchalla W, Kielbassa AM, Hellwig E. (1995) Curing shrinkage and volumetric changes of resin-modified glass ionomer restorative materials. Dental Materials.;11(5):359-62.