Original article:

Clinical Evaluation Of Direct Composite Resin And Indirect Micro Ceramic Composite Resin Restorations In Class-I Cavity Of Permanent Posterior Teeth

A H M Zakir Hossain Shikder[1], KamrunNaher Shomi[2], Nushrat Saki[3],Ferdousi Begum[4], Kazi Hossain Mahmud[5], MdShamsul Alam[6]

Abstract

Background:Previous studies have indicated that the clinical performance of direct composite restoration mainly depends on the polymerization shrinkage. The use of micro ceramic inlay technique has proved to be elegant approach to overcome the polymerization shrinkage and improve the marginal adaptation, reduce wear and leakage of posterior restorations. ***Objectives:***To compare the clinical performance between direct composite restorations and indirect micro ceramic composite restorations in occlusal surface of permanent posterior teethof class-I cavity. ***Results:*** The result of this study showed that there was no statisticallysignificant difference between two groups in the treatment of occlusal surface ofclass-I cavity of permanent posterior teeth ($p > 0.05$). It was concluded that indirect micro ceramic composite resin shows no better clinical efficacy than that of direct composite resin in occlusal surface of class-I cavity of permanent posterior teeth.

International Journal of Human and Health Sciences Vol. 03 No. 02 April'19 Page : 109-115
DOI: http://dx.doi.org/10.31344/ijhhs.v3i2.85

Introduction:

Amalgam is one of the most commonly used direct restorative materials in occlusal surface of class-I cavity of permanent posterior teeth. Amalgam doesn't bond to tooth structure, contains mercury and it is not aesthetic, but its low cost, easy manipulation, rapid application and good track record of clinical performance, it become a most convenient restorative material in occlusal surface of class-I cavity of permanent posterior teeth. In recent years, the popularity of amalgam has been declined due to public health concerns over its mercury content.[1]

Now-a-days patients are reluctant to accept any display of metal in their oral cavity due to its unacceptable aesthetics and health hazards. The validity of most of these negative claims is yet to be determined by environmental based study reports. Nevertheless, these ideas have reduced the metallic restoration in dentistry and influenced the greater use of nonmetallic restorations.[2]

Dental resin composites were introduced initially for use as anterior restorative materials. Later, with technological improvements, the prospect of restoring posterior teeth with composite was introduced. Though there are numerous causes for failure of clinical restorations made of direct composites, the major cause with the earlier posterior composites was poor wear resistance.[3]While the newest direct composite resin offers excellent optical and mechanical properties, its use in larger posterior restorations

1. Assistant Professor, Department of Pedodontics, BSMMU, Dhaka.
2. Assistant Professor, Department of Conservative Dentistry & Endodontics, Dhaka Dental College & Hospital, Dhaka.
3. Assistant Professor, Dept. of Oral Anatomy & Physiology, Bangladesh Dental College.
4. Junior Consultant, Department of Conservative Dentistry & Endodontics, Rangpur Medical College & Hospital.
5. Assistant Professor, Department of Conservative Dentistry & Endodontics, Update Dental College & Hospital, Dhaka.
6. Professor and Chairman, Department of Conservative Dentistry & Endodontics, BSMMU, Dhaka.

Correspondence to: Dr. A H M Zakir Hossain Shikder, Assistant Professor Department of Pedodontics, BSMMU, Cell 02-01552354186 **E-mail:**zakirendo@gmail.com

is still a challenge since polymerization shrinkage remains a concern in cavities. Though there have been numerous advances in adhesive systems, it is observed that the adhesive interface is unable to resist the polymerization stresses in enamel-free cavity margins.[4,5] This leads to improper sealing, which results in microleakage, postoperative sensitivity, and recurrent caries. The achievement of a proper interproximal contact and the complete cure of composite resins in the deepest regions of a cavity are other challenge related to direct composite restorations. Various approaches have been developed to improve some of the deficiencies of direct placement composites.[6, 7] However, no method has eliminated the problem of marginal microleakage associated with direct composite.[4]

Indirect resin composites were introduced to reduce polymerization shrinkage and improve the properties of restorative material. Direct resin composites were composed mostly composed of organic resin matrix, inorganic filler, and coupling agent. The first-generation indirect restorative composites had a composition identical to that of the direct resin. For inlay composites, an additional or secondary cure is given extra orally, which improves the degree of conversion and also reduces the side effects of polymerization shrinkage. It was observed that the first-generation indirect restorative composites showed improved properties only in vitro studies but had failure in clinical studies.[8]First generation composites showed poor clinical performance. Deficient bonding between organic matrix and inorganic fillers was the main problem leading to unsatisfactory wear resistance, high incidence of bulk fracture, marginal gap, microleakage, and adhesive failure in the first attempts to restore posterior teeth. Measures to solve these problems included increasing of inorganic filler content, reduction of filler size, and modification of the polymerization system. The second-generation composites have micro hybrid filler. By increasing the filler load, mechanical properties and wear resistance is improved, and by reducing the organic resin matrix, the polymerization shrinkage is reduced.[9] The new composite resins contain high amounts of filler contents, which make them adequate for restoring posterior teeth.

Ceramage is a micro ceramic polymer system with 73% of zirconium silicate filler (PFS-Progressive Fine Structured filler) supported by an organic polymer matrix which ensures a durable surface quality with excellent polishability and high resistance to plaque. This extra ordinary structure of ceramage shows properties similar to porcelain making it an ideal choice for posterior restorations. The aim of this study is to compare the clinical performance of direct composite resin restoration and indirect micro ceramic composite resin restorations at 3, 6, 9, and 12 months, using the modified USPHS criteria as the main evaluation.

Materials and Methods:

This was an experimental clinical trialof one year. Study was performed at the Department of Conservative Dentistry and Endodontics, Faculty of dentistry, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Patient attending the outdoor patient Department of Conservative Dentistry and Endodontics, BSMMU was included in the study. Simple random sampling (Lottery method) was used to allocate the samples. Thirty-six teeth that fulfilled the inclusion criteria were selected for the study from outpatient Department of Conservative Dentistry and Endodontics. These samples were randomly assigned to two groups; Group 1 (Direct composite restorations) and Group 2 (Indirect micro ceramic composite restorations). Restoration was assessed bymodified Ryge's criteria by means of color matching, marginal adaptation, and secondary caries. Patients were recalled after 3, 6, 9, and 12 months for follow up visit to evaluate the colour match, marginal adaptation and secondary caries. Chi-square test was used for testing differences between the two groups.

Results:

The study was conducted with 18 patients with 36 restorations could be evaluated. The restorations were evaluated for color matching (stability of color), marginal adaptation and secondary caries. Using Chi-square test, no statistically significance differences among the restorative materials were shown all the evaluation criteria. The result of the clinical evaluation of the 36 restorations using modified USPHS criteria are summarized in tables I, II &III

TableI shows comparison of color matching (stability of color) between direct and indirect micro ceramic composite restoration during follow up period. It was observed that at the evaluation period the difference was not statistically significant ($p > 0.05$) between two groups.

Table I: Comparison of color matching between two groups (n=18 teeth)

Color matching (Ratings)	Group1 (n=18 teeth) No.	%	Group2 (n=18 teeth) No.	%	P value
Base line					
AAlpha (100% color match)	18	100%	18	100%	a
BBravo (Slight mismatched)	0	0%	0	0%	a
CCharlie (Total mismatched)	0	0%	0	0%	a
After 3 months					
AAlpha (100% color match)	18	100%	18	100%	a
BBravo (Slight mismatched)	0	0%	0	0%	a
CCharlie (Total mismatched)	0	0%	0	0%	a
After 6 months					
AAlpha (100% color match)	18	100%	18	100%	a
BBravo (Slight mismatched)	0	0%	0	0%	a
CCharlie (Total mismatched)	0	0%	0	0%	a
After 9 months					
AAlpha (100% color match)	15	83.3%	16	88.9%	0.62^{ns}
BBravo (Slight mismatched)	3	16.7%	2	11.1%	0.62^{ns}
CCharlie (Total mismatched)	0	0%	0	0%	a
After 12 months					
AAlpha (100% color match)	14	77.8%	16	88.9%	0.37^{ns}
BBravo (Slight mismatched)	4	22.2%	2	11.1%	0.37^{ns}
CCharlie (Total mismatched)	0	0%	0	0%	a

n = Number of samples

a = No statistics are computed because of identical numbers in both groups

ns = Not Statistically Significant

Group1: Direct composite restoration

Group2: Indirect micro ceramic composite restoration (ceramage)

TableII: Comparison of marginal adaptation between two groups (n=18 teeth)

Marginal adaptation (Ratings)	Group1 (n=18 teeth) No.	%	Group2 (n=18 teeth) No.	%	P value
Base line					
AAlpha (No crevice along margin)	18	100%	18	100%	a
BBravo (Crevice along the margin)	0	0%	0	0%	a
CCharlie (Fractured, missing)	0	0%	0	0%	a
After 3 months					
AAlpha (No crevice along margin)	18	100%	18	100%	a
BBravo (Crevice along the margin)	0	0%	0	0%	a
CCharlie (Fractured, missing)	0	0%	0	0%	a
After 6 months					
AAlpha (No crevice along margin)	18	100%	18	100%	a
BBravo (Crevice along the margin)	0	0%	0	0%	a
CCharlie (Fractured, missing)	0	0%	0	0%	a
After 9 months					
AAlpha (No crevice along margin)	16	88.9%	17	94.4%	0.54^{ns}
BBravo (Crevice along the margin)	0	0%	0	0%	a
CCharlie (Fractured, missing)	2	11.1%	1	5.6%	0.54^{ns}
After 12 months					
AAlpha (No crevice along margin)	16	88.9%	17	94.4%	0.54^{ns}
BBravo (Crevice along the margin)	0	0%	0	0%	a
CCharlie (Fractured, missing)	2	11.1%	1	5.6%	0.54^{ns}

n = Number of samples

a = No statistics are computed because of identical numbers in both groups

ns = Not Statistically Significant

Group1: Direct composite restoration

Group2: Indirect micro ceramic composite restoration (ceramage)

TableII shows comparison of marginal adaptation between direct and indirect micro ceramic composite restoration during follow up period. It was observed that at the evaluation period the difference was not statistically significant ($p > 0.05$) between two groups.

After the time of 3 and 6 months, no changes occur in marginal adaptation. USPHS ratings of the marginal adaptation of direct and indirect composite restorations were not statistically significant difference ($p > 0.05$) (TableII).

Table III: Comparison of secondary caries between two groups (n=18 teeth)

Secondary caries (Ratings)	Group1 (n=18 teeth)		Group2 (n=18 teeth)		P value
	No.	%	No.	%	
Base line					
Alpha (No evidence of caries)	18	100%	18	100%	A
Bravo (Evidence of caries)	0	0%	0	0%	A
After 3 months					
Alpha (No evidence of caries)	18	100%	18	100%	A
Bravo (Evidence of caries)	0	0%	0	0%	A
After 6 months					
Alpha (No evidence of caries)	18	100%	18	100%	A
Bravo (Evidence of caries)	0	0%	0	0%	A
After 9 months					
Alpha (No evidence of caries)	18	100%	18	100%	A
Bravo (Evidence of caries)	0	0%	0	0%	A
After 12 months					
Alpha (No evidence of caries)	18	100%	18	100%	A
Bravo (Evidence of caries)	0	0%	0	0%	A

= Number of samples

a = No statistics are computed because of identical numbers in both groups

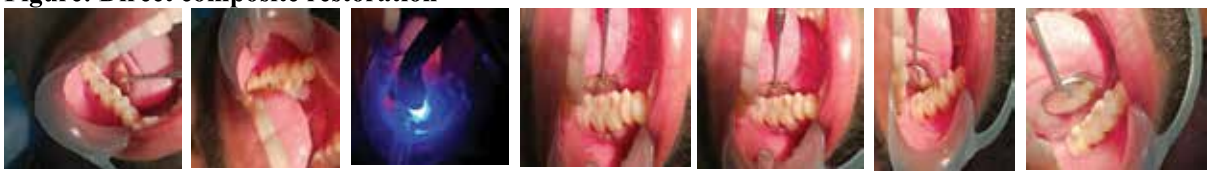
ns = Not Statistically Significant

Group1: Direct composite restoration

Group2: Indirect micro ceramic composite restoration (ceramage)

Tableshows comparison of secondary caries between direct and indirect micro ceramic composite restoration during follow up period. It was observed that at the evaluation period the difference was not statistically significant ($p > 0.05$) between two groups. At the time of evaluation period, there was no secondary caries in either direct or indirect composite resin restoration was found (Table III).

Figure: Direct composite restoration



Initial | Cavity preparation | Photo curing | After 3 months | After 6 months | After 9 months | After 12 months

Fig: Indirect restoration

Initial | Cavity preparation | Photo curing | After 3 months | After 6 months | After 9 months | After 12 months

Discussion

In this present study when direct restorations were examined at 3 and 6 months, it was found that all direct and indirect restorations showed acceptable color matching and marginal adaptation. Furthermore, neither secondary caries nor any post-operative sensitivity or discoloration of restoration was observed. The differences between two groups were not statistically significant.

However, at nine months, two direct and one indirect composite (ceramage) restorations showed loss of marginal adaptation due to chipping at margin of the restoration and they were not replaced. A careful examination of these restorations revealed that all chipping occurred due to direct contact with opposing cusp. The problems highlighted here could have been avoided by the operator. Direct and indirect composite restorations (ceramage) should not be placed in direct contact with opposing cusp. This is also supported by some of the previous studies.[10]

When the color of the restorations was verified, it was found that 3 (16.7%) direct and 2 indirect (11.1%) restorations were slightly mismatched with the adjacent teeth. Careful examinations of the restorations showed that mismatch of the colors of the restorations were due to body discoloration of the materials. Previous studies have reported that mismatch of the composite restoration could be happen due to gradual discoloration of the monomer component of the material. The results found in that present study were correspondent to previous study of Ali Riza Cetin and Nimet UNLU.[11] This study compared direct and indirect composite restoration in posterior teeth and found that all the restoration demonstrated clinically satisfactory performance with no significance differences among them.

At 12 months observation period, the results of marginal adaptation did not changed. Again, 2 direct and 1 indirect restorations showed loss of marginal adaptation. At this stage, these restorations were not replaced but they were repaired by composite resin. Furthermore, 4 (22.2%) direct and 2 (11.1%) indirect restorations showed slight mismatch with the adjacent teeth. Again, the reason was due to body discoloration. Furthermore, no restorations showed secondary caries at this observation period. The results between two groups were not statistically significant.

Aesthetic dentistry continues to evolve through innovations in restorative material and conservative preparation technique. The use of direct composite restoration in posterior teeth is limited to relatively small cavities due to polymerization stresses. Indirect composites offer an esthetic alternative to micro ceramic composite for posterior teeth. Many evaluation criteria are available for evaluation of clinical study. United States Public Health (USPHS) criteria were used for the clinical evaluation of tooth-colored restorations in posterior teeth, which is originally based on Ryge criteria.[12]In this study, direct composite restorations and indirect micro ceramic composite (ceramage) restorations were assessed to ensure comparability of the results using USPHS criteria.

In the present one-year clinical studyboth the direct and indirect composite restorations were rated as clinically acceptable according to the evaluation criteria used and that there were no statistically significant differences in performance among the tested materials. On the lack of statistically significant differences, it could be due to the multiple similarities- in terms of chemical composition and high filler content underlying the composites used in this study. However, differences might emerge over longer periods of use. Nevertheless, better clinical performance might be obtained using ceramage, since they are indirect composite resins specifically designed for restoring posterior teeth. Furthermore, it is claimed that indirect composite, when tempered with heat and light, could have an enhanced degree of cure, thereby leading to improved physical properties.

According to a previous study, it was found that indirect ceramic inlays reveal better clinical results than direct composite restorations (IvoclarVivadent'sHeliomolar) in terms of marginal adaptation, color matching and secondary caries.

The results of this present study showed that there were no statistically significant differences between direct and indirect restorations in respect of marginal adaptation, color matching and secondary caries. So, this study will help the clinician that indirect micro ceramic composite resin shows no better clinical efficacy than that of direct composite resin in occlusal surface of class-I cavity of permanentposterior teeth.

All patients strictly followed the instructions during the course of treatment. This study had controlled the confounders which were induced by the participants. So, these study findings are unlikely to be influenced by other confounding variables.

Conclusion:

It can be concluded that indirect micro ceramic composite resin shows no better clinical efficacy than that of direct composite resin in occlusal surface of class-I cavity of permanent posterior teeth.

Research Materials& Instruments used for Ceramage preparation:


Solidilite light box

Ceramage polishing kit


Dura polish


Dura polish dia


Ceramage spacer


Ceramage separator


Ceramage body


ceramage Enamel


Ceramage modeling liquid


Ceramage Oxy barrier

Illustrations for ceramage inlay fabrication:


Spacer application


After drying of spacer


Separator application


Body application


Enamel application


Oxy barrier application


Curing in Solidilite light box


Super polishingby felt wheel


After super polishing

References:

1. Mario Bernardo, Henrique Luis, Michael D Martin, Brian GLeroux, Tessa Rue, Jorge Leitao, et al. Survival and reason for failure of amalgam versus composite posterior restorations placed in a randomized clinical trial. J Am Dent Assoc 2007; 138:775-83.
2. Gordon J Christensen. Indirect restoration use: A changing paradigm. JADA 2012; 143:398-400.
3. Dietschi D, Scampa U, Campanile G, Holz J. Marginal adaptation and seal of direct and indirect class II composite resin restorations: An in vitro evaluation. Quintessence Int 1995; 26:127-38.
4. Loguercio AD, Bauer JR, Reis A, Grande RH. Microleakage of packable composite in class II restorations. Quintessence Int 2004; 35:29-34.
5. Thonemann B, Federlin M, Schmalz G, Glunder W. Total bonding vs selective bonding: Marginal adaptation of class II composite restorations. Oper Dent 1999; 24:261-71.
6. Carvalho RM, Pereira JC, Yoshiyama M, Pashley DH. A review of polymerization contraction: The influence of stress development versus stress relief. Oper Dent 1996; 21:17-24.
7. Davidson CL, Feilzer AJ. Polymerization shrinkage and polymerization shrinkage stress in polymer-based restoratives. J Dent 1997; 25:435-40.
8. Garber DA, Goldstein RE. Porcelain and Composite inlays and onlays. Illinois: Quintessence Publishing Co Inc 2009; 194:117-33.
9. Miara P. Aesthetic guidelines for second-generationinlays and onlay composite restorations. PracPeriodontAesthetDent 1998; 10:423-31.
10. Hossain M, Kawakami S, Shimokobe H. Effect of gap dimension on wear of prototype glass ionomer luting cements in margin of ceramic restorations: in vivo. J Conserve. Dent 1995; 38:212-24.
11. Ali Riza CETIN and Nimet UNLU, 2009. One-year clinical evaluation of direct nanofilled and indirect composite restorations in posterior teeth. Dental Materials Journal 2009; 28:620-26.
12. Ryge G, Snyder M. Evaluating the clinical quality of restorations. J Am Dent Assoc 1973; 87:369-77.