

Clinical evaluation between Micro Ceramic Composite Crown and Metal Ceramic Crown in single damaged tooth

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Abstract:

Esthetic is one of the most important concern for patients appearance during the restoration of tooth by artificial crown. This study was done to evaluate and compare the clinical performance of micro ceramic composite crown and metal ceramic crown. This randomized clinical trial was done in the Department of Prosthodontics, BSMMU, Dhaka, during the period of May 2013 to April 2014. Total 56 patients were included in equal two groups. After cementation of restoration, data were collected and recorded on a pre-design data collection sheet on the basis of color match by using the modified USPHS (United States Public Health Service) criteria. During data collection, evaluation was done by two clinicians and recorded in the sheet. The marginal accuracy and wear resistance of micro ceramic composite crown was better than that of conventional metal ceramic crown. Within the limitations of the study, it can be concluded that the micro ceramic composite crown is better than the metal-ceramic crown.

Key words: Artificial crown, Micro ceramic composite crown, Restoration, Wear, Metal ceramic crown.

(Bangladesh Dental Journal 2015; 31: 31-37)

Introduction:

The available choice currently for esthetic materials for restoring teeth is limited to resin composite, porcelain/ceramic or porcelain fused-to-metal. Resin composite seems to be utilized more than other restorations for a number of reasons. During last decade esthetic dental materials, technology, science and practice have upgraded dramatically, greatly expanding and improving the choice of materials.¹

The wear resistance and marginal fit are important criteria for long-term success of a prosthesis. Fracture resistance of composite resin crowns was significantly improved by

increasing the occlusal thickness of the crowns, by using resin cement, and by reducing the total convergence angle.²

Metal-ceramic materials still dentistry's state of the art. These materials can be used in any situation, in a single-unit restoration or in the most complex complete fixed or implant prosthesis, provided that there is enough space to ensure that the prosthesis will have the strength necessary to withstand dental forces. Metal-ceramic technique is continuing to advance but a problem in the traditional metal-ceramic design was the poor esthetic effects of metal visibly underlying ceramics at the margin. Practitioners continued to use this technique because of the belief that metal provided the best marginal seal.³

Marginal accuracy is considered a crucial factor in the success and longevity of an indirect restoration because an inadequate adaptation of the restoration may be detrimental to both the tooth and supporting periodontium. There have been many studies regarding the marginal fit of crowns. McLean and von Fraunhofer proposed a restoration would be successful in marginal gaps and cement thickness of less than 120 μm could be achieved. Testing Celay In-CeramTM, beschnidt et al reported mean marginal gaps of 78 μm in maxillary incisor crowns.⁴

Though porcelain is considered superior to all types of restorative materials used in Prosthodontics its main

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disadvantages are brittleness, tendency to fracture and break away from metal, lesser edge strength, high hardness resulting in more impact to the opposing teeth during mastication and also abrasion of enamel of the natural opposing and adjacent teeth.

Prosthodontists developed a technique that provided better esthetic results without compromising marginal accuracy. This was done by cutting back the metal from the margin area and up the axial wall to permit an increased zone of a 360-degree buccal ceramic shoulder. This technique has proved beneficial in areas in which esthetics are a major concern, but using it requires increased skill and still have a chance of fracture of the ceramic.⁵

Over the last decade, the use of composite material as indirect restoration has increased remarkably. This scenario may be due to progressive increase in both mechanical and handling properties of the composite materials as well as esthetic demand by the patient. One of such material applicable for indirect tooth-colored restoration is "The Estenia material". (Kuraray Medical Inc., Tokyo, Japan). Laboratory evaluation expressed that this indirect type of material is superior in color stability, wear resistance⁷, and strengths. Therefore indirect composite is currently used for single esthetic restorations, fixed partial dentures (FPDs), as well as super structure of implant-supported prostheses.⁷

Now a days, indirect composite restorations are extensively used in esthetic dentistry as a less expensive and less technique sensitive alternative to ceramic crown. Moreover, the indirect technique improves the control of marginal adaptation, proximal contacts, anatomic form and polymerization shrinkage, compared to the other techniques. Even fracture resistance of composite resin crowns was significantly improved by increasing the occlusal thickness of the crowns, by using resin cement, and by reducing the total convergence angle.²

There are indirect new-resin based composite brands available for indirect composite restorative technique. In this case the indirect restorative materials that is most modern and are commercially called "Ceramage" (SHOFU INC, Japan). Ceramage has been setting new standards in indirect composite resin technology by combining unsurpassed esthetics, superior strength, less wear on opposing dentition and color stability which are specially indicated for veneer, inlay, onlay, crown, and bridge.

Ceramage is a Micro Ceramic Polymer System with 73% of Zirconium Silicate filler (PFS filling materials, Progressed Fine Structured Filler) supported by an inorganic polymer matrix which ensures a durable surface quality with excellent polish ability and high resistance to plaque. This structure shows properties similar to porcelain making it an ideal choice for both metal supported and metal-free anterior or posterior crowns. It has the physical properties of light transmission very close to that of natural dentin and enamel. Therefore Ceramage combines a natural colour reproduction with extraordinary strength, elasticity and has high color stability which is also biologically not harmful.⁸

This study has been designed to observe clinically to evaluate, the properties of micro ceramic composite materials and to focus on this newer generation of indirect restorative material for crown to achieve better service for the patient with improved technology. By this study, a new dental material and technique will be introduced in our country to fabricate most esthetic restorations with improved properties such as - High fractural strength, good adhesive bonding capacity, better marginal fitness, easy fabrication technique and cost effective. which can serve a better esthetic as well as functional restoration and can be used as a durable restoration instead of metal ceramic restoration.

Materials and methods:

The randomized clinical trial was done above 56 patients having single damaged tooth in equal two groups over a period of 12 months in the Department of Prosthodontics, Faculty of Dentistry, BSMMU, Dhaka, to compare the Marginal integrity and Wear of restoration between micro ceramic composite crown and metal ceramic crown. The study population was the peoples required full veneer crown in a single damaged tooth. Following proper administrative procedures with all the ethical issues were considered to collect the samples and carried out the research work. Sampling was done by simple random sampling procedure. Patients were selected from OPD of Dept. of Prosthodontics by lottery method, among the patient who were came for wear a single artificial crown. All the restoration was evaluated using modified United States Public Health Services (USPHS) or Ryge's direct criteria at baseline and thereafter at an interval of 03, 06 and 12 months. Each restoration was evaluated by two clinicians trained in the technique.

Table-I
Evaluation Criteria: (Modified USPHS Criteria for direct clinical evaluations).

<i>Criteria</i>	<i>Test Procedure</i>	<i>Rating</i>	<i>Charecterstics</i>
Marginal integrity	Visual inspection with explorer and mirror	A	No visual evidence of a crevice along the margin & explorer does not catch when drawn across the surface of the restoration toward the tooth.
		B	The explorer catches & there is visible evidence of a crevice, into which the explorer penetrates (indicates that the restoration does not adapt closely to the tooth structure).
		C	The explorer penetrates a crevice defect.
Wear of restoration	Visual inspection with explorer and mirror	A	The restoration is a continuation of existing anatomic form.
		B	A surface concavity is evident (slightly flattened).
		C	There is loss of restorative substance such that a surface concavity is evident (Replacement is required).

Here, A=Alpha, B=Bravo, C=Charlie.

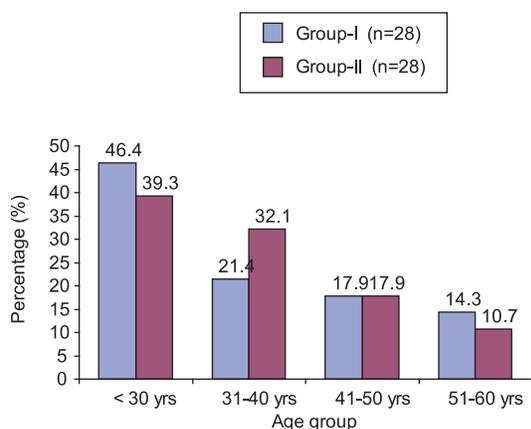
Table-II
Research materials: Trade name, Composition and Manufacturer of Research materials

Material	Trade Name	Composition	Manufactures
Micro ceramic composite	Ceramage	1)73% Zirconium Silicate filler –PFS filler (Progressed Fine Structured Filler). 2) Inorganic polymer matrix	SHOFU Inc, Japan.
Resin Cement	Resicem	Paste A: Fluoroaluminosilicate glass, initiator. Paste B: Fluoroaluminosilicate glass, Carboxilic acid monomer. Primer A: Water,Acetone, Initiator. Primer B: Carboxilic acid monomer, Acetone.	SHOFU Inc, Japan.
Porcelain	Vintage	1) Silica (Sio ₂) – 60% 2) Alumina (Al ₂ O ₃) 3) Soda 4) Potash 5) Boric oxide 6) Zinc oxide 7) Zirconium oxide	SHOFU Inc, Japan.
Ni-Cr Alloy	Vera Bond	1) Ni - 77.95% 2) Be – 1.95% 3) Cr – 12.60%	Aalba Dent, USA.

Result:

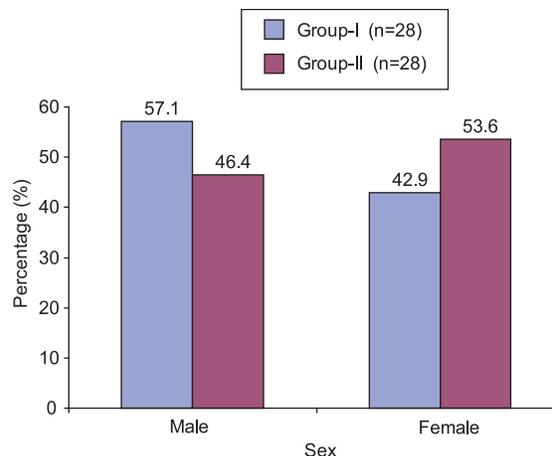
This randomized clinical trial was conducted among the patients who were treated at Bangabandhu Sheikh Mujib Medical University, in the Department of Prosthodontics, Faculty of Dentistry, during the period of May 2013 to April 2014. Total fifty six patients with 56 restorations were included in this study, among them 28 patients were treated

with Micro ceramic composite crown (Ceramage) and another 28 patients were treated with Metal ceramic crown. All the patients willingly agreed to participate in the study. This study reflected the result of the given restoration after 03, 06 and 12 months. This study was mainly conducted to evaluate the restorations for Marginal integrity and wear of re of the restoration with the natural tooth.



Group I: Micro ceramic composite crown.
Group II: Metal ceramic crown.

Fig.-1: Age distribution of the study patients



Group I: Micro ceramic composite crown.
Group II: Metal ceramic crown.

Fig.-2: Sex distribution of the study patients

Table-III

Distribution of the patient according to marginal integrity of the restorations in Group I and Group II (n=56)

Marginal integrity	Group-I (n=28) No. (%)	Group-II (n=28) No. (%)	p value
Baseline			
A	28(100.0%)	28(100.0%)	-
B	0(0.0%)	0(0.0%)	
C	0(0.0%)	0(0.0%)	
After 3 months			
A	28(100.0%)	25(89.3%)	0.07 ^{ns}
B	0(0.0%)	3(10.7%)	
C	0(0.0%)	0(0.0%)	
After 6 months			
A	28(100.0%)	23(82.1%)	0.02 ^s
B	0(0.0%)	5(17.9%)	
C	0(0.0%)	0(0.0%)	
After 12 months			
A	27(96.4%)	22(78.6%)	0.04 ^s
B	1(3.6%)	6(21.4%)	
C	0(0.0%)	0(0.0%)	

A=Alpha, B=Bravo, C=Charlie

Group I: Micro ceramic composite crown.

Group II: Metal ceramic crown.

Data were expressed in number and percentage.

Statistical analysis was done by Chi-square test

The test of significance was calculated and p values < 0.05 was accepted as level of significance.

s = Significant ns = Not significant n = Number of samples.

A No visual evidence of a crevice along the margin & explorer does not catch when drawn across the surface of the restoration toward the tooth.

B The explorer catches & there is visible evidence of a crevice, into which the explorer penetrates (indicates that the restoration does not adapt closely to the tooth structure).

C The explorer penetrates a crevice defect.

Table-IV
Distribution of the patient according to wear of restorations in Group I and Group II (n=56)

Wear of restoration	Group-I (n=28) No. (%)	Group-II (n=28) No. (%)	p value
Baseline			
A	28(100.0%)	28(100.0%)	-
B	0(0.0%)	0(0.0%)	
C	0(0.0%)	0(0.0%)	
After 3 months			
A	28(100.0%)	27(96.4%)	0.31 ^{ns}
B	0(0.0%)	1(3.6%)	
C	0(0.0%)	0(0.0%)	
After 6 months			
A	27(96.4%)	25(89.3%)	0.29 ^{ns}
B	1(3.6%)	3(10.7%)	
C	0(0.0%)	0(0.0%)	
After 12 months			
A	27(96.4%)	24(85.7%)	0.15 ^{ns}
B	1(3.6%)	4(14.3%)	
C	0(0.0%)	0(0.0%)	

A=Alpha, B=Bravo, C=Charlie

Group I: Micro ceramic composite crown.

Group II: Metal ceramic crown.

Data were expressed in number and percentage.

Statistical analysis was done by Chi-square test

The test of significance was calculated and p values < 0.05 was accepted as level of significance.

s = Significant ns = Not significant n = Number of samples.

A The restoration is a continuation of existing anatomic form.

B A surface concavity is evident (slightly flattened).

C There is loss of restorative substance such that a surface concavity is evident (Replacement is required).

Table-III shows comparison of marginal integrity between Micro ceramic.

Composite and Metal ceramic restorations during follow up period. At the baseline all patients(100%) of both groups were categorized alpha. After 03 months there observed no change. After 06 months 28(100%) restorations rated Alpha in group I, where 3(10.7%)categorized Bravo and 25(89.3%) rated Alpha in group II. After 12 months in group I, 27(96.4%) rated Alpha and 1(3.6%) rated Bravo, in group II 22(78.6%) rated Alpha and 6(21.4%) rated Bravo. No Charlie rating were rated in any Group I among whole evaluation period. Between USPHS ratings of two groups, the p-value was absent after 03 months but after 06 and 12 months the differences in marginal adaptation was significant ($p>0.05$) in Chi square test.

Table-IV shows comparison about wear of restoration between micro ceramic Composite and metal ceramic restorations during follow up period. At the baseline all patients (100%) of both groups were rated alpha. After 03 months 28(100%) restorations of group I was categorized as Alpha and in group II, 27(96.4%) restorations rated Alpha

other 1(3.6%) restorations rated as Bravo. After 06 months restorations 27(96.4%) rated Alpha and 1(3.6%) rated Bravo in group I, where 3(10.7%) categorized Bravo and 25(89.3%) rated Alpha in group II. After 12 months in group I, there was no change from the rating of 06 months but in group II 24(85.7%) rated Alpha and 4(14.3%) rated Bravo. No Charlie rating were rated in any Group, among whole evaluation period. Between USPHS ratings of two groups, there was no significant differences obtained ($p<0.05$).



Fig.-3 : Initial Photograph of damaged tooth.



Fig.-4 : *Cemented micro ceramic composite crown in upper central incisors with good marginal integrity.*



Fig.-5 : *Impression taken with Silicone impression material.*



Fig.-6 : *Material kit of Micro ceramic composite (Ceramage).*

Discussion:

Now a days, peoples are interested to maintain their esthetics by wearing the best color matching restoration

to increase quality of life in the society. It influences the development of oral health as well as functional efficacy. So, when damage of any tooth occurs, a restoration is essential. Most of the discolored and heavily damaged teeth are restored with full veneer crown, but color match and longevity is the most prime things that we have to consider during fabrication of the crown.

In this study the primary objective was to evaluate the esthetic outcome of micro ceramic composite crown and compare the results with that of conventional metal ceramic crown which was conducted between two groups, where each group contained 28 patients.

The methodology that was followed in this study allowed collection of data as per parameter of this study, Marginal integrity and Wear of the restoration from the individual samples. This, in turn, permitted accurate analysis of the results, which was indicated for the comparative evaluation of the variables between the samples of group I and group II. All the restorations were evaluated using modified United States Public Health Services (USPHS) or Ryge's direct criteria. Each restoration was evaluated by two clinicians trained in the technique. The age range of both groups was from 18 to 60 years. The highest number of patients was in the age of <30 years in both groups. In this study out of 56 patients, 29 were male and 27 were female and male female ratio was 1.07:1.

Tanoue N.et al.⁷ showed that One of such material applicable for indirect tooth-colored restoration is "The Estenia material". (Kuraray Medical Inc., Tokyo, Japan). Laboratory evaluation expressed that this indirect type of material is superior in color stability, wear resistance and strengths. Therefore indirect composite is currently used for single esthetic restorations, fixed partial dentures (FPDs), as well as super structure of implant-supported prostheses.

Changes in marginal integrity:

In this study the marginal integrity of Micro ceramic composite crown was better than Metal ceramic crown. After 03 months the difference was not statistically significant ($p=0.07$), however after 06 and 12 months the difference was significant ($p<0.05$) in chi square test. According to marginal adaptation after 03 and 06 months, it showed that all the patients of group –I were in Alpha i.e. no visual evidence of a crevice along the margin & explorer was not caught when drawn across the surface of the restoration toward the tooth. After 12 months 27(96.4%) were in Alpha and only 1(3.6%) restoration was categorized Bravo, i.e. the explorer was caught & there

was visible evidence of a crevice, into which the explorer penetrated. Where in group II, after 03, 06 and 12 months consequently 25(89.3%), 23(82.1%), 22(78.6%) were in Alpha and 3(10.7%), 5(17.9%), 6(21.4%) restorations were observed in the category Bravo.

Shino et al.⁷, showed good marginal integrity with the Micro ceramic composite (Ceramage) crown, which coincide with this study, here the result was found with sub-gingival deep chamfer finish line. The study by Ayad MF⁴, showed that the shoulder finish line had higher marginal opening value than the chamfer finish line incase of fibre reinforced composite crown. However, other contradicting studies, of L. Cho et al.⁹, evaluated better marginal adaptation of composite crowns with a shoulder finish line and D Irio D. et al.¹⁰, showed improved biomechanical performance with a shoulder margin in posterior single crown.

Changes in wear of restoration:

In case of wear of the restoration, after 03 months all the patients of group-I were in Alpha i.e. the restoration is a continuation of existing anatomic form. After 06 months 27(96.4%) restoration was rated as Alpha and the left 1(3.6%) was categorized as Bravo, i.e. a surface concavity was evident (slightly flattened), and after 12 months the result was same. On the other hand, in group-II after 03 months 27(96.4%) restorations were in Alpha and 1(3.6%) in Bravo, after 06 months 25(89.3%) and 3(10.7%) in Bravo. After 12 months 24(85.7%) restorations rated Alpha and 4(14.3%) were Bravo. The percentage of wear of restoration of metal ceramic crown was higher than Micro Ceramic Composite crown. The differences were not statistically significant ($p= 0.15$, after 12 months) in chi square test. Here in composition of Ceramage the amount of zirconium silicate is 73% which might enriched the material to become more wear resistant.

A similar findings has been reported in study conducted by Tanoue N. et al.⁶, where Abu Tayeb Md. Ahsanullah found no attrition of opposing tooth after wearing the restorations.

Conclusion:

The Micro ceramic composite (Ceramage) crown presented a valuable development in the field of Prosthodontics. This study represents, those crown provides better Marginal integrity and Wear of the restoration . As well as it is a less time consuming procedure, easy to repair and

cost effective. So Micro ceramic composite crown can be a better alternative than the Metal-ceramic crown.

Recommendations

Within the limitations of this study, it is strongly recommended that the clinician can use micro ceramic crown (Ceramage) to ensure better marginal fit which is healthy and esthetically pleasant restoration, as an alternative to metal-ceramic crown.

The following recommendations are put forward for the establishment of the procedure:

1. Further research and long-term follow-up investigations are necessary to elicit the best clinical outcome of micro ceramic crown.
2. The study conducted only at BSMMU among the small group of patients, the additional study with large sample size should be done for further conclusion of this result.

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