

# Comparison of Fiber-reinforced composite crowns and Metal ceramic crowns according to status of fracture

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## Abstract:

**Back ground:** Fiber reinforcement was introduced to clinical dentistry for the first time in the 1960s when investigators attempted to reinforce polymethyl- methacrylate dentures with glass or carbon fibers. It has recently been shown that crowns, bridges and posts made of FRC can be used successfully in dental practice and they possess adequate flexural modulus, flexural strength and fracture strength. **Aims:** A prospective comparative cross-sectional study was performed involving 60 patients who attended in the out patients department of Prosthodontics, Faculty of Dentistry, BSMMU during the period of January 2007 to December 2008. **Objective:** Compare status of fracture of fiber-reinforced composite crowns and metal ceramic crowns. **Methods:** Clinical data were recorded from the randomly selected 60 patients divided in to tow groups “experimental” and “control”. Esthetic status was indexed after California Dental Associations quality evaluation system. **Results:** The age of patients ranged between 18 and 42 years in group A and 17 and 38 years in group B. The highest number of patients was in the age group 21-30 years in both groups. The mean age was 24.9±5.8 years and 25.0±4.8 years in group A and group B respectively. There were 26 male and 34 female patients in the study groups and male female ratio was 1:1.3. In group A patients, 12(40.0%) were male and 18(60.0%) female. In group B patients 14(46.7%) were male and 16(53.3%) were female. After 4 months all the patients were in grade I in both groups. After 8 months 29(96.7%) patients were in grade I in group A and 30(100%) patients were in grade I in group B. The difference was not statistically significant ( $p>0.05$ ) in chi square test. After 12 months 30(100%) patients were in grade I in group A and 29(96.7%) patients were in grade I in group B. The difference was not statistically significant ( $p>0.05$ ) in chi square test. **Conclusion :**The Fiber Reinforced Composite crown represents a valuable development in field of Prosthetic Dentistry.

**Key words:** Status of fracture, Fiber reinforced composite crown, Metal ceramic crown.

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## Introduction:

Metal–ceramic crowns are clinically successful<sup>1</sup>. But the visibility of metal and the change in natural tooth translucency is aesthetically unfavorable. The desire for natural looking restorations has encouraged research in the last decades on metal-free, tooth colored materials for dental restorations<sup>2</sup>.

As early all-ceramic restorations exhibited high failure rates,<sup>3</sup> an alternative has been seen in the use of reinforced composite materials. In recent years, there have been several in vitro<sup>4-6</sup> and in vivo studies<sup>7,8</sup> of the properties of these composites and promising results have been reported for crowns,<sup>9</sup> and for fixed partial dentures.<sup>10</sup>

However, although these materials seem to provide excellent aesthetics,<sup>11</sup> some authors do not recommend composite materials for permanent restorations,<sup>12,13</sup> because of their unstable aesthetics, their increased wear<sup>14</sup> and their liability to plaque accumulation.<sup>15</sup>

With the introduction of fiber reinforced composites, it seemed to be possible to eliminate these disadvantages of composites and to exploit their advantages, including the simple laboratory procedure, the lower costs and the possibility of repair.

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Additionally, this new generation of composites has given promising in vitro results with respect to color change,<sup>16</sup> wear<sup>17</sup> and fracture resistance.<sup>18</sup>

The objective of this present prospective clinical study was then the assessment of the clinical performance of esthetic status of a new experimental fiber reinforced composite anterior crowns, compared with a metal–ceramic control group.

The objective of this present prospective clinical study was then the assessment of the clinical performance of a new experimental fiber reinforced composite anterior crowns, compared with a metal–ceramic control group according to fracture status.

#### **Methods:**

Participants for this study were recruited from patients visiting the Department of Prosthodontics Faculty of Dentistry, BSMMU during the period of January 2007 to December 2008. The university's review board approved the study and all patients signed an informed consent form. Criteria for including was-Fracture teeth with healthy periodontal tissue, Discolored anterior teeth, Endodontically treated tooth (Root canal treated tooth), Abrasion, erosion of anterior teeth and excluding- Excluding premolar and molar teeth, Periodontally compromised teeth, Para functional habit (bruxer), Vertical fracture, Grossly damage teeth, Developmentally defective teeth; all evaluated by the examiner.

**Clinical treatment** – at chair side and laboratory procedures followed a standardized scheme. After the removal of old restorative materials and caries excavation, the teeth were built up according to the manufacturer's instructions.

**Adaptation of Fiber** – Pre impregnated resin, flat & Unidirectional Dentapreg fiber strip manufactured by Prestige Dental UK was used for fabrication of framework of crown. Bucco-linguallay length of the restoration was measured by scale & Dentapreg fiber strip was cut down according to measurement.

Covering paper of Dentapreg strip was removed and adapted one side of the fiber –reinforced composite (FRC) on the buccal side teeth and visible light (Litex) was applied for 20 seconds. Then the fiber –reinforced composite was shaped and adapted slowly lingual side teeth and light

curing was applied for 20 seconds. Then the transparent plastic protective film on the strip was removed.

**Composite build up** By the incremental way the hybrid veneering composite (ceramic nano-Densply) was applied over the abutments/die and light curing was applied for 40 seconds. The medial and distal proximal contact was made up with the help of cellophane strip. Gingival embrasure was prepared by the application of standard dental wedges. Final light curing, shaping, polishing and finishing were done by standard ways. The fiber Reinforced Composite full veneer crown was polished by standard composite plastic polisher and light cure bonding agent.

**Cementation** The inside of the crown of Fiber Reinforced Composite (FRC) was sand blasted with aluminum oxide. The internal surface was then treated with a bonding agent and delivered with a low viscosity, hybrid, and composite luting agents. These luting agents were bonded to the inside of the crown to the etched dentine and enamel of the abutments.

**Procedure of Metal Ceramic crown:** The tooth reduction was done in all aspect with ideal procedure. Impression was taken with alginate. Cast was poured with die stone. Die was prepared with ideal method and trimming was done for wax pattern. Waxing was done with inlay casting wax. Investing and casting were done with standard procedure. Metal framework was tried in for proper fit. Porcelain was bonded over metal framework. Porcelain bonded prostheses was trailed. Final polishing and glazing was done.

Cementation was done with Glass-inomer luting cement. Instruction was given to the patients and advised them to report after 4 months, 8 months and 12months interval. Esthetic status was indexed after California Dental Associations quality evaluation system<sup>19</sup>.

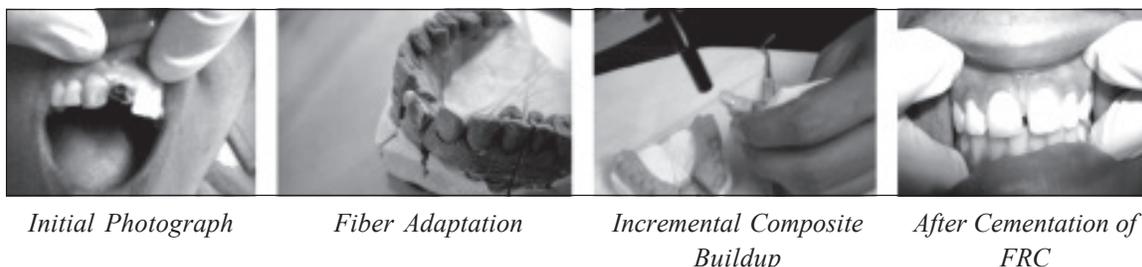
#### **Fracture status (longevity):**

**Grade I:** No Fracture

**Grade II:** a) Chipping out composite or porcelain  
b) Hair line fracture

**Grade III:** Crown fracture

**Study Procedure:** Each patient of group-A was treated with Fiber Reinforced Composite Crown and group-B was treated with Metal Ceramic full veneer crown. After completion of the treatments, patients were advised to report after 4 months, 8 months, and 12 months for follow up.



**Data Collection:** Necessary data were collected from the patients who attended to report their prostheses condition after 4 months, 8 months and 12 months.

**Data analysis:** All the relevant collected data was compiled on a master chart first. After coding and editing, the collected data was analyzed by using statistical package for social science (SPSS). The result was presented in tables. Chi-square test was done by using Epi Info (version 12). Results of significance were expressed as P-value. P-value <0.05 was considered as significance.

**Results:**

The observational study was done after 4 months, 8 months and 12 months interval of the cementation of crowns and data were collected according to selected parameters of fracture status. Collected data of different parameters was presented in tabulated form and statistical analysis was done to observe the statistical significance.

**Table-I**  
*Distribution of patients by age (n=60).*

Age (year)	Group A (n=30)		Group B (n=30)	
	n	%	n	%
<20	6	20.0	6	20.0
21 – 30	18	60.0	19	63.3
31 – 40	5	16.7	5	16.7
>40	1	3.3	0	0.0
Mean ±SD	24.9	±5.8	25.0	±4.8

**Group A-** Fiber Reinforced Composite crown  
**Group B-** Metal ceramic composite crown  
 Figure in the parenthesis indicate corresponding percentage  
 n = number of subjects

The table and figure shows the age distribution of both groups patients of the study. The age of patients ranged between 18 and 42 years in group A and 17 and 38 years in group B. The highest number of patients was in the age group 21-30 years in both groups. The mean age was 24.9±5.8 years and 25.0±4.8 years in group A and group B respectively.

**Table-II**  
*Distribution of patients by sex (n=60).*

Sex	Group A(n=30)		Group B(n=30)		pvalue
	n	%	n	%	
Male	12	40.0	14	46.7	0.602 NS
Female	18	60.0	16	53.3	

Statistical analysis was done by chi square test  
**Group A-** Fiber Reinforced Composite crown  
**Group B-** Metal ceramic composite crown  
 Figure in the parenthesis indicate corresponding percentage  
 n = number of subjects  
 NS = not significant

In this study, both male and female patients were treated in both groups. There were 26 male and 34 female patients in the study groups and male female ratio was 1:1.3. In group A patients, 12(40.0%) were male and 18(60.0%) female. In group B patients 14(46.7%) were male and 16(53.3%) were female. The difference was not statistically significant (p>0.05) in chi square test.

**Table-III**  
*Distribution of patients according to status of fracture of full veneer crown after 4 months (n=60).*

Fracture status	Group A(n=30)		Group B(n=30)		p value
	n	%	n	%	
Grade – I	30	100	30	100	
Grade – II	0	0.0	0	0.0	-
Grade – III	0	0.0	0	0.0	

Statistical analysis was done by chi square test  
**Group A=** Fiber Reinforced Composite crown  
**Group B=** Metal ceramic crown  
 n= number of subjects  
 Figure in the parenthesis indicate corresponding percentage  
 NS= not significant  
**Grade I:** No Fracture  
**Grade II:** a) Chipping out composite or porcelain  
 b) Hair line fracture  
**Grade III:** Crown fracture

Table-III shows distribution of patients according to the status of fracture of full veneer crown. After 4 months all the patients were in grade I in both groups.

**Table-IV**

*Distribution of patients according to status of fracture of full veneer crown after 8 months (n=60).*

Fracture status	Group A(n=30)		Group B(n=30)		p value
	n	%	n	%	
Grade – I	29	96.7	30	100	0.500 <sup>NS</sup>
Grade – II	1	3.3	0	0.0	
Grade – III	0	0.0	0	0.0	

Statistical analysis was done by chi square test

**Group A**= Fiber Reinforced Composite crown

**Group B**= Metal ceramic crown

n= number of subjects

Figure in the parenthesis indicate corresponding percentage

NS= not significant

**Grade I:** No Fracture

**Grade II:** a) Chipping out composite or porcelain  
b) Hair line fracture

**Grade III:** Crown fracture

Table-IV shows distribution of patients according to the status of fracture of full veneer crown. After 8 months 29(96.7%) patients were in grade I in group A and 30(100%) patients were in grade I in group B. The difference was not statistically significant ( $p>0.05$ ) in chi square test.

**Table-V**

*Distribution of patients according to status of fracture of full veneer crown after 12 (n=60).*

Fracture status	Group A(n=30)		Group B(n=30)		p value
	n	%	n	%	
Grade – I	30	100	29	96.7	0.500 <sup>NS</sup>
Grade – II	0	0.0	1	3.3	
Grade – III	0	0.0	0	0.0	

Statistical analysis was done by chi square test

**Group A**= Fiber Reinforced Composite crown

**Group B**= Metal ceramic crown

n= number of subjects

Figure in the parenthesis indicate corresponding percentage

NS= not significant

**Grade I:** No Fracture

**Grade II:** a) Chipping out composite or porcelain  
b) Hair line fracture

**Grade III:** Crown fracture

Table-V shows distribution of patients according to the status of fracture of full veneer crown. After 12 months 30(100%) patients were in grade I in group A and 29(96.7%) patients were in grade I in group B. The difference was not statistically significant ( $p>0.05$ ) in chi square test.

### Discussion:

The prospective comparative study was conducted among the patients who fulfilled the inclusion criteria's. The patients were attended in the outpatient department of Prosthodontics faculty of Dentistry at Bangabandhu

Sheikh Mujib Medical University, from January 2007 to December 2008. Total 60 patients were included in this study among them, 30 patients were in group-A, who treated with Fiber Reinforced Composite Crown and another 30 patients were in group-B who treated with Metal ceramic full veneer crown. The main objective of this study was to compare the effect of Fiber Reinforced Composite Crown and Metal ceramic full veneer crown

After cementation of Prosthesis the patients were requested to come and maintain follow up visit after 4 months, 8 months and 12 months interval and Data were collected according fracture status of the Prosthesis.

The age ranged of both groups was from 17 to 41 years. The highest number of patients was in the age of 21-30 years in both groups.

In this study out of 60 patients, 26 were male and 34 were female and male female ratio was 1:1.3.

Regarding to the status of fracture of crowns, after 4 months, all the patients were in grade-I i.e. no fracture, in both groups. After 8 months, only 1(3.3%) patient of group-A were in grade-II and rest of the patients of both groups were in grade-I. After 12 months, only 1(3.3%) patient of group-B was in grade – II and rest of the patients of both groups were in grade-I. The difference was not statistically significant ( $p>0.05$ ) in chi square test. Regarding fracture status of group-A, after 8 months one patient was in grade-II that is chip out composite (palatal surface in right canine) because the proper thickness of composite was not maintained during fabrication and the patient had multiple missing teeth in posterior region both arches. Due to missing posterior teeth the mastigatory force was exerted onto the FRC crown during functional movements. In that case to overcome the problem the posterior missing teeth was replaced and the chip out portion was repaired intraorally by maintaining proper thickness and the next follow up visit of the patient showed that there was no fracture in the FRC crown.

M. Behr et al<sup>20</sup> observed that three types of fiber-reinforced composite (FRC) molar crowns were tested on their fracture resistance. The fracture resistance of molar crowns made of glass-fiber reinforced composite was higher than those of polyethylene fiber-reinforced composite crowns. However, there was no statistically significant difference.

Chul-Whoi et al studied on compare of the fracture strengths of metal-ceramic crowns and 3 types of ceromer crowns. Ten crowns for each of 3 ceromer systems were fabricated from the same metal die. Their fracture resistance

was tested in a universal testing machine. The load was directed at the incisolingual line angle, at 130 degrees to the long axis of each specimen, until catastrophic failure occurred. A 7-mm diameter was used to load the artificial crowns. Metal-ceramic crowns fractured at significantly higher values than ceromer crowns ( $P_{.05}$ ). No significant difference was found among the fracture values of fiber reinforced crowns.

Previous study on effect of Fiber reinforced composite in fixed partial denture (FPD) was conducted in the Department of Prosthodontics at BSMMU, among forty patients divided into two groups. In that study it was showed that there were no change in esthetic status and no attrition of opposing teeth. Only 2(10.0%) patients were found to chip out composites. Fiber reinforced composite fixed partial denture is an innovative alternative to conventional metal ceramic fixed partial denture<sup>21</sup>.

### Conclusion:

The Fiber Reinforced Composite crown represents a valuable development in field of Prosthetic Dentistry. This study indicates Fiber reinforced composite crown provide better fracture resistance. As well as it provides life like esthetical appearance, good marginal adaptation and no attrition of opposite teeth. It is a time saving restoration, easy to repair and cost effective.

### Recommendations:

Within the limitations of this study it is strongly recommended that Dentists can use Fiber Reinforced Composite crown to ensure esthetically pleasant and durable restorations.

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

- a) The study should be conducted on a long term basis. A larger period of observations is required to test the hypothesis.
- b) As it is a technique sensitive restoration so proper curing and high strength composites should be used to increase the longevity of the prostheses.
- c) 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.

### Referernces:

1. Donovan T, Simons RJ, Guertin G, Tucker RV. Retrospective clinical evaluation of 1314 cast gold restorations in service from 1 to 52 years. *Journal of Esthetic and Restorative Dentistry* 2004;16:194–204.
2. Ohlmann B, Dreyhaupt J, Schmitter M, Gabbert O, Hassel A, Rammelsberg P. Clinical performance of posterior metal-free polymer crowns with and without fiber reinforcement

One-year results of a randomised clinical trial, *journal of dentistry* 2006;6:6-11

3. El-Mowafy O, Brochu JF. Longevity and clinical performance of IPS-Empress ceramic restorations — a literature review. *Journal of Canadian Dental Association* 2002;68:233–7.
4. Behr M, Rosentritt M, Lang R, Handel G. Flexural properties of fiber reinforced composite using a vacuum/pressure or a manual adaptation manufacturing process. *Journal of Dentistry* 2000;28:509–14.
5. Tezvergil A, Lassila LV, Vallittu PK. The effect of fiber orientation on the polymerization shrinkage strain of fiberreinforced composites. *Dental Materials* 2005;17:17.
6. Bouillaguet S, Schutt A, Alander P, Schwaller P, Buerki G, Michler J, et al. Hydrothermal and mechanical stresses degrade fiber–matrix interfacial bond strength in dental fiber-reinforced composites. *Journal of Biomedical Materials Research Part B Applied Biomaterials* 2006;76:98–105.
7. Gohring TN, Schmidlin PR, Lutz F. Two-year clinical and SEM evaluation of glass-fiber-reinforced inlay fixed partial dentures. *American Journal of Dentistry* 2002;15:35–40.
8. Vallittu PK, Sevelius C. Resin-bonded, glass fiber-reinforced composite fixed partial dentures: a clinical study. *Journal of Prosthetic Dentistry* 2000;84:413–8.
9. Ellakwa A, Thomas GD, Shortall AC, Marquis PM, Burke FJ. Fracture resistance of fiber-reinforced composite crown restorations. *American Journal of Dentistry* 2003;16:375–80.
10. Freilich MA, Meiers JC, Duncan JP, Eckrote KA, Goldberg AJ. Clinical evaluation of fiber-reinforced fixed bridges. *Journal of American Dental Association* 2002;133:1524–34.
11. Cho L, Song H, Koak J, Heo S. Marginal accuracy and fracture strength of ceromer/fiber-reinforced composite crowns: effect of variations in preparation design. *Journal of Prosthetic Dentistry* 2002;88:388–95.
12. Behr M, Rosentritt M, Handel G. Fiber-reinforced composite crowns and FPDs: a clinical report. *International Journal of Prosthodontics* 2003;16:239–43.
13. Bohlsen F, Kern M. Clinical outcome of glass-fiberreinforced crowns and fixed partial dentures: a 3-year retrospective study. *Quintessence International* 2003;34:493–6.
14. Kern M, Strub JR, Lu XY. Wear of composite resin veneering materials in a dual-axis chewing simulator. *Journal of Oral Rehabilitation* 1999;26:372–8.
15. Behr M, Rosentritt M, Latzel D, Handel G. Fracture resistance of fiber-reinforced vs. non-fiber-reinforced composite molar crowns. *Clinical Oral Investigation* 2003;7:135–9.
16. Douglas RD. Color stability of new-generation indirect resins for prosthodontic application. *Journal of Prosthetic Dentistry* 2000;83:166–70.
17. Suzuki S, Nagai E, Taira Y, Minesaki Y. In vitro wear of indirect composite restoratives. *Journal of Prosthetic Dentistry* 2002;88:431–6.
18. Ku CW, Park SW, Yang HS. Comparison of the fracture strengths of metal–ceramic crowns and three ceromer crowns. *Journal of Prosthetic Dentistry* 2002;88:170–5.
19. Clinical Trial Results', *Journal of the California Dental Association*. 1—5
20. Behr M, Rosentritt M, Handel G, (2003), 'Fiber-reinforced composite crown and FPDs: a clinical report', *International Journal of Prosthodontist* 2003;16(3):239-43.
21. Ullah ATA,(2007), "Study on effect of fiber reinforced composite in fixed partial . "