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EVALUATION OF THE COMPRESSIVE STRENGTH OF HYBRID AND NANOCOMPOSITES-ORIGINAL RESEARCH

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Conflicts of Interest: Nil

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ABSTRACT

Esthetic correction represents one of the clinical conditions that require the use of composite veneers in the anterior region. Aim of the study is to evaluate the fracture strength of direct veneers in maxillary central incisors fabricated from composites (Direct Technique).Thirty sound human maxillary central incisors were used in this in vitro study. Teeth were randomly divided into three experimental groups of ten teeth each. Group A-Restored with Nano Hybrid (Ceram Spheretec), Group B-Restored with Microhybrid (Tetric n ceram) & Group C-Restored with Direct Composite Veneer(Spectrum).Standard preparations were done using ceramic veneer set and all specimens were stored in distilled water at 37 degree C for 2 weeks. After that the specimens were mounted in a acrylic block. The load was applied on the incisal part of the veneer to the long axis of the tooth using Universal Testing Machine .Results were analyzed with One Way Anova & LSD Tests. Group a showed higher mean of fracture strength with stastically significant difference in comparison to group B and group C. All Veneers used in this study can be considered as acceptable for treatment in the anterior region. Direct Composite veneer is the most favourable technique in terms of fracture strength.

Keywords; Composite veneers, Direct Veneers, Fracture strength, Microhybrid composite, Nanocomposite.

Introduction

The growing importance placed on aesthetics may result in an increased demand for cosmetic dental treatment. As smile design not only means designing teeth, but also creating a smile that truly complements the patient's face and personality. Following this philosophy, recreating a smile need not be limited to the anterior teeth, but may extend to include the posterior teeth. Crown preparation involves significant removal of tooth structure and may cause pulpal irritation and irreversible pulpitis. After preparation, the restoration is viewed from both the facial and incisal angles to ensure that the proper prep is achieved and all margins are completely hidden without breaking the contact. Application of etchant and bonding agent is then followed by the addition of a microhybrid or nanofill composite to start sub-opaquing the underlying tooth color. The restoration is sculpted, contoured and shaped and then polymerized for 60 seconds. The most frequent failure modes associated with laminate veneers are fracture and debonding. [1,2]

Materials & Methods

Thirty sound human maxillary central incisors with comparable dimensions were selected for this in vitro study. The faciolingual and mesiodistal dimensions were measured. To determine that the enamel was free from cracks, all teeth were visually examined under blue light transillumination. Teeth were then cleaned by scaling and stored in distilled water at room temperature.(Fig.1)

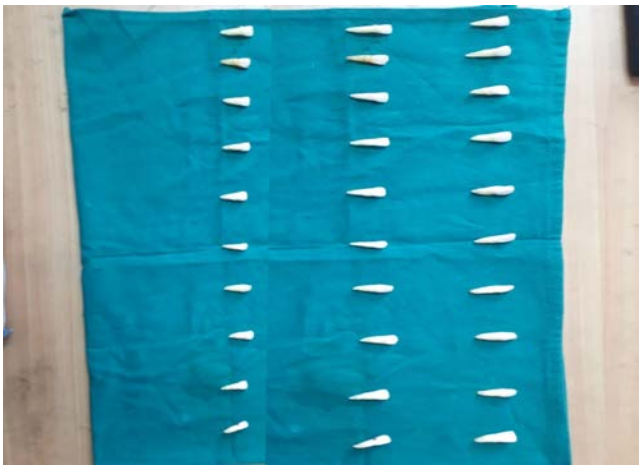


Figure 1: 30 SAMPLES

Teeth were then randomly divided into three groups of 10 specimens each:

- Group A-Restored with Nano Hybrid(Ceram Spheretec),
- Group B-Restored with Microhybrid (Tetric n ceram) &
- Group C-Restored with Direct Composite Veneer(Spectrum) (fig.2,3,4)

Figure 2: CERAM X SPHERTECH

Figure 3: TETRIC N CERAM

Figure 4: SPECTRUM

Standard preparations were done using ceramic veneer set.. The teeth were mounted individually in specially designed, locally-manufactured rubber mold (30 mm height × 30 mm diameter) with cold cure acrylic with the long axis of the tooth parallel to center of the mold. Each tooth was suspended in the middle of the mold using a Ney Surveyor (Bego, Germany) to ensure vertical positioning of the tooth inside the mold. All specimens were embedded up to 2 mm apical to the CEJ to simulate the natural biologic width. (fig.5,6,7,8,9,10)

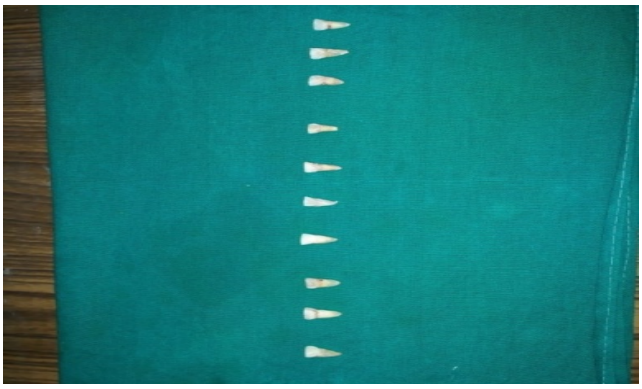


Figure 5: Veneer preparation

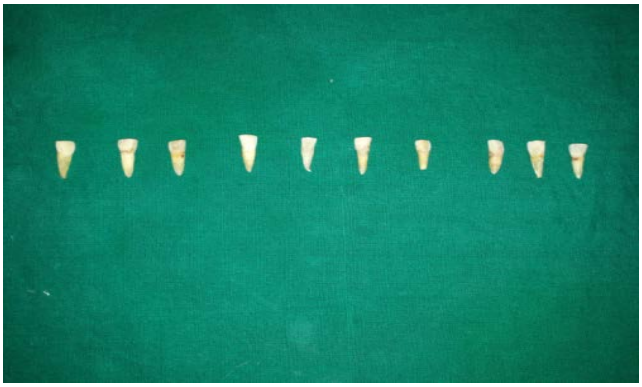


Figure 6: Veneer preparation

Figure 7: Veneer preparation

Figure 8: Veneer preparation

Figure 9: Veneer preparation

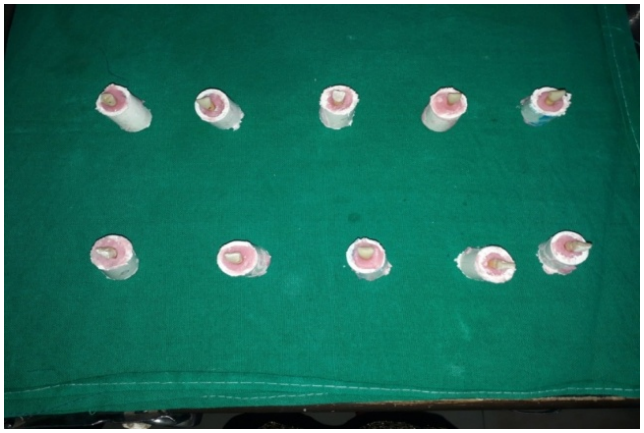


Figure 10: specimens embedded in cold cure acrylic mould

The specimens were then restored with direct composite veneers using Ceram x spheretech, Tetric n ceram and spectrum. The prepared tooth was cleaned with fluoride-free pumice using polishing cup and then etched with 35% phosphoric acid (Scotchbond™ Etchant, 3M ESPE, USA) for 15 seconds, rinse for 10seconds and air dried gently for 5 seconds according to manufacturer's instructions (fig.11,12,13)

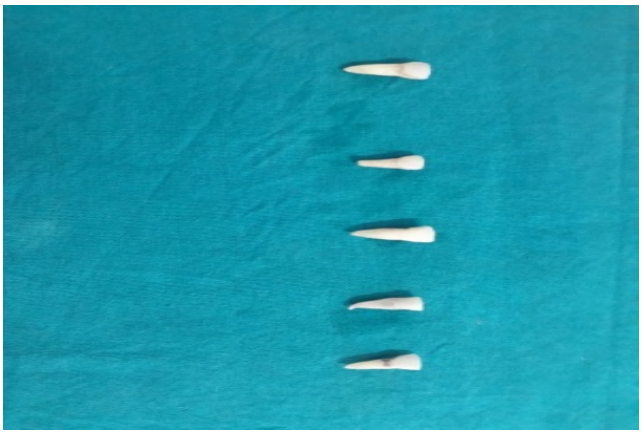


Figure 11: Specimens displaying direct veneering with composite restoration

Figure 12: Specimens displaying direct veneering with composite restoration

Figure 13: Specimens displaying direct veneering with composite restoration

- *The veneers were then stored in distilled water at 37 degree C for 2 weeks before testing.*
- *The fracture strength test performed using a Universal Testing Machine (LARYEE universal testing machine, China).*
- *Load was applied at a crosshead speed 0.5 mm/min with a customized plunger (steel rod with a flat end 3.6 mm diameter) attached to the upper movable compartment of the machine placed at the facial part of the veneer.*
- *The load was applied at 45˚ to the long axis of the tooth. This orientation was standardized with a specially designed, locally manufactured, mounting jig .*
- *The maximum load to produce fracture for each sample was automatically recorded in Newton (N) using computer software.*
- *The results of this study were analyzed with one-way ANOVA and LSD test.*

Figure 14: Universal testing machine

Figure 15: Load applied over the prepared tooth

RESULTS

The means and standard deviations of fracture strength were calculated for each group shown in TABLE

- **Material**; teeth
- **No. of samples**-10 each
- **Test parameters**
- **Compressive strength, Mpa**
- **Ceram spheretech-Cgroup**
- **Tetric N Ceram-T group**
- **Spectrum**-S group

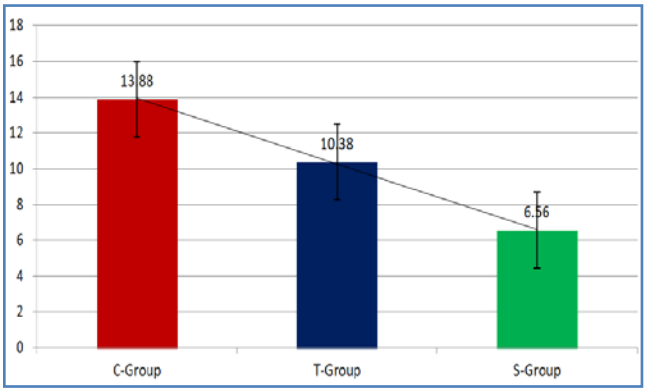
Table 1:

S.No	C- group	S- group	T -group
1	14.7	7.7	12.7
2	15.8	7.5	10.1
3	13.2	5.6	12.5
3	14.5	6.5	9.5
5	10.5	5.2	6.5
6	11.1	6.5	10.5
7	15.5	7.7	9.5
8	13.5	5.9	13.5
9	14.7	7.0	10.5
10	15.3	6.0	8.5
Avg	**13.8**	**6.5**	**10.3**

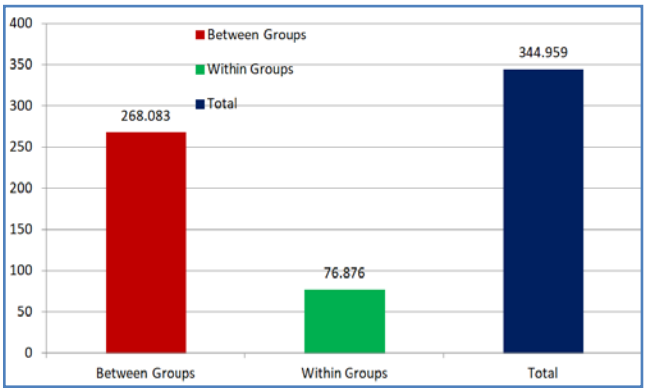
- *The results of this study showed that the highest mean of fracture strength was recorded for Group A, followed by Group B and Group C respectively.*
- *ANOVA test revealed statistically highly significant differences among the three groups*

Table 2: COMPARISON BETWEEN THREE GROUPS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
C-Group	10	13.88	1.82	0.57	12.57	15.18
T-Group	10	10.38	2.10	0.66	8.87	11.88
S-Group	10	6.56	0.89	0.28	5.92	7.20



Graph 1:



Graph 2:

POST HOC ANALYSIS

p≤0.05 -Significant

Table 3:

	C-Group	T-Group	S-Group
C-Group		Mean Diff=:3.50 P=0.001	Mean Diff:=7.32 P=0.001
T-Group	Mean Diff=:3.50 P=0.001	-	Mean Diff:=3.82 P=0.001
S-Group	Mean Diff:=7.32 P=0.001	Mean Diff:=3.82 P=0.001	

❑ The results of LSD test showed that there were statistically higher significant differences(p≤0.05) in the fracture strength of group A as compared with all the experimental groups(B,C)

- Additionally, there were statistically significant differences in fracture strength between group A and group Band between group B and group C.

Discussion

The directly restored veneer is higher due to the elimination of cement layer in the direct composite veneer as cement is considered the weak restorative link. Composite luting materials are vulnerable to water sorption, polymerization shrinkage, and microleakage. This finding comes in agreement with Duzyol et al.

Failure analysis of the fractured VENEERS in this study showed mainly fracture of the veneer restoration followed by veneers debonding which coincides with the finding of Gresnigt and Ozcan. Clinically, these types of failure could be considered more favorable, since it allows intraoral repair options

Fracture of veneers was observed in 100% in groups (A,B, C) as the dominant type of fracture. Fracture of the veneer was attributed first to the good adhesion of the veneer to either dental tissue or the cement layer. Another explanation for this could be the relatively lower flexure strength of the materials, based on the fact that if the flexural strength of the veneer cannot protect the tooth, the veneer will fracture before the loading force is transferred to the tooth [3,4,5]

Conclusion

Within the limitations of this study, it was concluded that Ceram x sphertech was more resistant to fracture as compared to tetric n ceram and spectrum

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