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Fracture strength of composite veneers using different restorative materials: A comparative *in vitro* study

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Abstract
Aim: To evaluate the Fracture Strength of composite veneers using different restorative materials.
Methodology: Twenty sound human maxillary central incisors were used in this *in vitro* study. Teeth were randomly divided into two experimental groups of ten teeth each. Group A-Restored with Nano Hybrid (Ceram Spheretec), Group B-Restored with Microhybrid (Tetric n ceram) 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 an 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.
Results: Group A showed higher mean of fracture strength with stastically significant difference in comparison to group B.
Conclusion: 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

1. Introduction
Esthetic or cosmetic dentistry has become one of the main areas of dental practice emphasis and growth for several years. Recently, the main reason for applying restorative dental materials is not only to restore dental tissues lost because of caries or trauma, but also to correct the form and color of teeth for social acceptance. Crown preparation involves significant removal of tooth structure and may cause pulpal irritation and irreversible pulpitis The results of LSD test showed that there were statistically higher significant differences ($p \leq 0.05$) in the fracture strength of group A as compared with all the experimental groups (B,) Additionally, there were statistically significant differences in fracture strength between group Aand group B [1]. Due to the high esthetic properties of composite resin restorations, their application has greatly increased in the past few decades. Long term prognosis of these restorative materials is especially important because they are under constant masticatory forces inside the mouth and such forces can result in increased failure of these restorations. That is why properties of these materials have greatly improved. In order to improve the efficacy and properties of composite resins for posterior restorations, manufacturers are trying to increase the filler content and decrease the size of particles to elevate strength and wear resistance against masticatory forces. The new composite resins have high content of fillers, great technical application and optimal properties [2].
Nanotechnology has played as an important role in improving the clinical performance of dental resin composites in the last few years with chemical and physical methods to produce nanoscale operational materials which ranging in size from 0.1 to 100 nanometers [3].
Nanocomposites possess a combination of favorable properties of hybrid and microfilled composites. They also exhibit optimal esthetic properties and therefore are good candidates for anterior restorations. At the same time, they show suitable mechanical properties which make them good alternatives for posterior restorations as well. Hybrid and microhybrid composites are different from each other in terms of their filler particle size [2].

Nanomaterial includes nanoparticles, nanocluster, nanocrystals, nanotubes, nanofiber, nanowire, nanorod, etc. Numerous manufacturing approaches are available to synthesize nanomaterial. Nanomaterials may be used to manipulate the structure of materials to provide dramatic improvement in mechanical, physical, chemical, and optical properties. A large amount of examinations is being dedicated to the development of nanocomposites [3]. Ceram x spheretec is a nanoceramic, light cured, radiopaque, universal composite based on the novel Spheretec filler technology indicated for both direct and indirect restorations. It has a newer filler technology containing granulated spherical fillers in combination with an optimized resin matrix system which results in its preferred handling properties; (fig 1)

1. adapts easily to cavity surfaces
2. doesn't stick to hand instruments
3. easy to sculpt
4. slump resistant

Tetric n ceram is a light curing, radiopaque composite which can be used for direct veneering. It has key specifications such as versatile application, best esthetic results, bulk fill possible and special filler technology (fig 2).

Fig 1: Ceram sphertech

Fig2: Tetric n ceram

2. Materials & Methods

Twenty 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 cleaned by scaling and stored in distilled water at room temperature. Teeth were then randomly divided into two groups of 10 specimens each: (FIG3)

Group A: Restored with Nano Hybrid (Ceram Spheretec),
Group B: Restored with Microhybrid (Tetric n ceram)

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 (Vertex, Netherlands) 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 6).

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 10 seconds and air dried gently for 5 seconds according to manufacturer's instructions

- 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 (fig 7, 8).

The results of this study were analyzed with one-way ANOVA and LSD test.

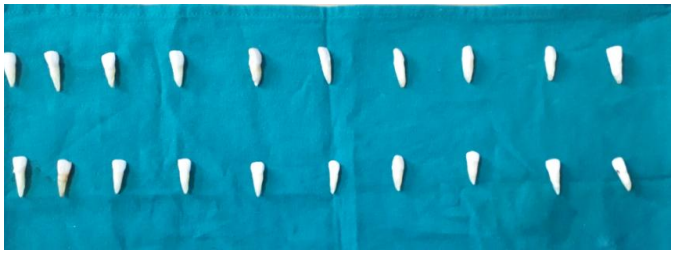


Fig 3: 20 samples

Fig 4: Veneer Preparation

Fig 5: Group 1 and 2 showing veneer preparation

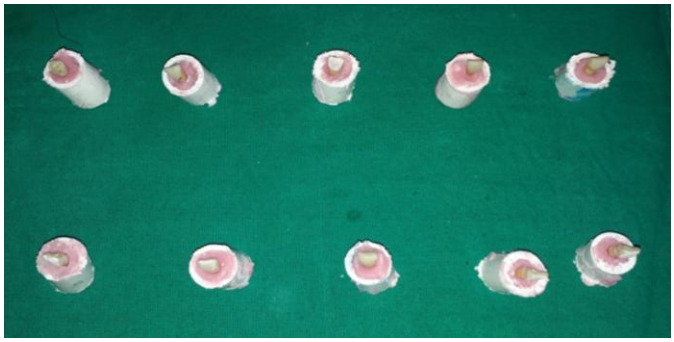


Fig 6: samples mounted on acrylic block

Fig 7: Universal testing machine

Fig 8: *Load applied over the prepared tooth*

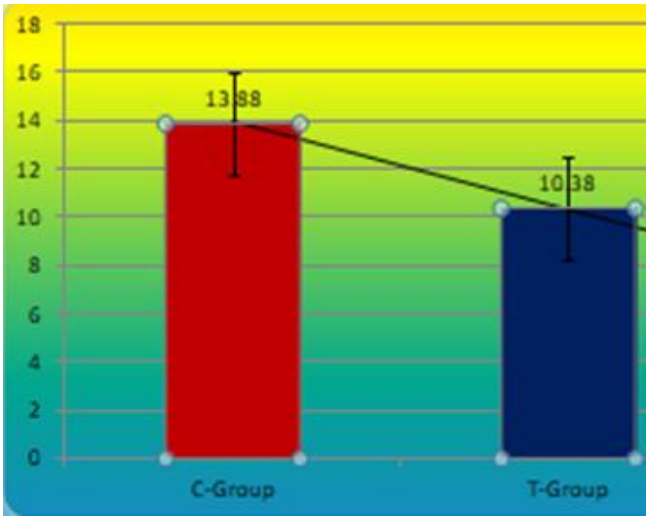
3. Results

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

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

Comparison between these two 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

	C-Group	T-Group
C-Group		Mean Diff=:3.50, P=0.001
T-Group	Mean Diff=:3.50, P=0.001	-

The results of LSD test showed that there were statistically higher significant differences ($p \leq 0.05$) in the fracture strength of group A as compared with all the experimental groups (B,) additionally, there were statistically significant differences in fracture strength between group A and group B.

4. Discussion

According to the results of this study, Group A presented the highest mean fracture load among the groups and the differences between groups were found to be statistically highly significant. The higher mean of fracture strength was recorded by group A, this may be due to the formation of a continuum between tooth surfaces, adhesive, and restorative material, which is accomplished by the demineralization and penetration of resin in enamel and the formation of a unique body between restoration and tooth structure [3].

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) 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 [1].

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.

6. References

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