COMPARATIVE EVALUATION OF THE EFFECT OF ULTRASONIC SCALING ON THESURFACE ROUGHNESS OF TWO DIFFERENT TOOTH COLOURED CLASS VRESTORATIONS. AN IN VITRO STUDY

Original Article

Harsh Verma*, Roshanikumari Chaudhari**, Devvrat Gohil***, Shraddha Chokshi****, Zarana Sanghvi*****, Pruthvi Patel******

ABSTRACT

Aim: The aim of study is to evaluate the effect of ultrasonic scaling on surface roughness of two different toothcolored Class V restoration. **Materials and method:** 30 freshly extracted human teeth were taken and divided into 3 groups of 10 each. Control group were marked with area of 2 x 2 mm outline of class Vcavity. In Group 2 and 3 Class V cavities were prepared with an outline of dimensions (2mm depth 2mm length and 2mm width) on facial surface with carbide bur no. 245 and restored with two different tooth colored restorative materials. **Group 1:** Control group **Group 2:** Restored with Fuji II GL(GC) **Group 3:** Restored with Filtek Z250 X T COMPOSITE (3M ESPE) All specimens were stored in artificial saliva at 37°C for one week. Initial surface roughness value (Ra in μm) of restorations was evaluated with Surface Roughness Tester. Ultrasonic instrumentation was then carried out on the restoration surface and a final surface roughness value was evaluated. Data was then statisticallyanalyzed with ANOVA and Post hoc test. **Result:** GIC Fuji IIGL had highest, whereas Nanohybrid composites Filtek Z250 XT had lowest pre- and post-instrumentation roughness values. **Conclusion:** Nanohybrid composites are found to withstand instrumentation better than GIC.

Received: 26-07-2018; **Review Completed:** 29-11-2018; **Accepted:** 23-01-2019

INTRODUCTION:

Class V carious lesions are the defects that occurs on the gingival third of facial and lingual surface of all teeth.1Non carious class V lesions are commonly referred to as abrasion and erosion.

Due to esthetic concerns, these types of defects are preferably restored with tooth-colored restorations such as Glass ionomers and Composites.

The main limitation of the glass ionomer cements is their relative lack of strength and low resistance to abrasion and wear. Conventional glass ionomer cements have low flexural strength but high modulus of elasticity, and are therefore very brittle and prone to bulk fracture.

With the introduction of composites in dentistry over four decades ago, the issue of aesthetics has been overcome to a certain extent. Composites have an edge over other restorative materials as they offer advantages of easy handling, better aesthetics and relatively low cost.[2,3] Although considerable improvements have been made in the properties of dental resin composite since their introduction, however, major developments come from improvements in filler systems. Resin composites have undergone through generations of traditional macrofilled composites, microfilled, hybrid, microhybrid, nanocomposites and nanohybrids.[4,5]

The trend in the newer microhybrid materials is to maximize filler loading and minimize filler size. The latest version of microfilled hybrids has used nanofiller technology to create nanohybrid composite resins. These nanohybrids can be used in any situation similar to the microhybrids, with possibly a slight improvement in polishability because of the smaller particle size.[6,7]

It is common clinical finding that plaque and calculus deposits occur heavily in the gingival third of teeth causing irritation to the gingiva. Ultrasonic scaling isa routine periodontal procedure recommended by periodontistevery 6 months to 1 year to maintain good oral hygiene.[8] Hence to remove these deposits from the gingival third dental practioner has to run the ultrasonic insert over the surface of the restorations. However the mechanical stimulation may alter the surface integrity of the restoration and tooth thereby increasing the surface roughness which may influence staining, aesthetic appearance, bacterial colonization and accelerate the rate of plaque formation.[9,10]

MATRIALS & METHOD

Thirty human teeth freshly extracted for orthodontic orperiodontal treatment purpose excluding mandibular incisors were used in this study. Tooth samples were randomly selected and divided into 3 groups of 10 each. Out of these, 10 teeth were randomly selected and included in a control.

group (Group I). Teeth of control group were

*PG Student, ****PG Student, *****Professor & Head, ******Professor

DEPARTMENT OF CONSERVATIVE DENTISTRY AND ENDODONTICS, AHMEDABAD DENTAL COLLEGE AND HOSPITAL

ADDRESS FOR AUTHOR CORROSPONDENCE : DR. HARSH VERMA, TEL: +91 95580 21953

marked with areaof 2x2 mm to simulate outline of class V cavity; no cavity preparation was done on them. On twenty teeth, the standardized class V cavities of 2 mm width, 2 mm length, and 2 mm depth were prepared on facial surface with carbide bur no 245. According to type they were restored as follows:

Group 1: (n=10) Control group teeth with no preparation done

Group 2: (n=10) Teeth restored with GIC Fuji II GL

Group 3: (n=10) Teeth restored with Nano hybrid composite Filtek Z250 XT

In group 2 the cavities were conditioned first with GIC liquid with help of applicator tip for 10 sec. Powder and liquid were mixed on mixing pad with agate spatula in accordance with manufacturer's instructionsand placed into the prepared cavities. Mylar strip was placed over it and pressure was applied to extruded excess material with the help of scalpel

In group 3 the cavities were conditioned with 37% phosphoric acid (Scotchbond Universal Etchant gel) for 15 sec. Then they were rinsed with water for 10 sec and blot dried. A bonding agent (Adper Single Bond 2) was applied over the conditioned and moist surfaces in accordance with the manufacturer's instructions. The material was polymerized for 20 sec by using light curing unit on each surface. Then Nano hybrid composite material (Filtek Z250 XT) was appliedusing Teflon coated composite instrument (API). Then the material was polymerized for 60 sec by using light curing unit against a Mylar strip. After polymerization, excess material was removed by scalpel. Polishing was done with the help of Soflexpolisihing discs.

After initial set of each material, excess was carefully removed. Restorations in group 2 was covered with petroleum jelly and allowed to set in100% humidity. All specimens were then stored in artificial saliva prepared at 37˚C for 1 month. Specimens in each group were rinsed in running tap water for 30 seconds. They were air dried, and initial surface roughness was evaluated in terms of Ra value (μm) using Surface Roughness Tester (Mitutoyo, Japan, SJ 210) withstylus moving at the speed 0.5 mm/s.

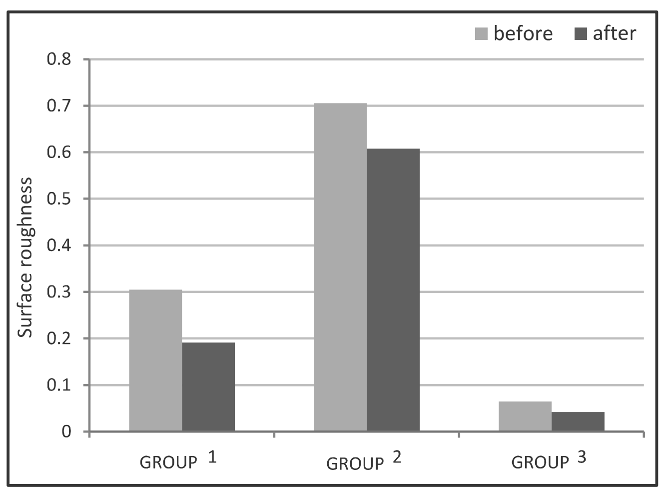
Later, ultrasonic scaling was performed on all specimens with (P5 Booster, ActeonSatelec, North America) ultrasonic scaler having N1 insert/tip under copious water flow for 60 seconds at level 2 power setting. The scaling tip was angled approximately to 15˚ to the restoration surface. The direction of scaling was approximately perpendicular to the long axis of the tooth in the horizontal plane, moving the scaler insert slowly from gingival to coronal third of the restoration. All instrumentations were performed by one experienced periodontist who was not aware of the type ofrestorative material and their groups.

The specimens were rinsed in running tap water for 30 seconds and cleaned in an ultrasonic bath for 6 minutes. All specimens were air dried, and post-ultrasonic instrumentation roughness was then evaluated as mentioned previously. Data was statisticallyanalyzed with ANOVA and Post hoc test.

RESULTS

	Control Group	GIC	Composite
Before	**0.305**	**0.706**	**0.065**
After	**0.191**	**0.608**	**0.042**

Table 1: Mean initial and final surface roughness values before and after ultrasonic scaling



Graph 1: Mean initial and final surface roughness values after and before ultrasonic scaling

Data was statisticallyanalyzed with ANOVA and Post hoc test. Mean initial and final surface roughness values (µm) are as given in table 1 and graph 1. Initial surface roughness values (Ra) from highest to lowest were in the order of Fuji II GL, Control group, and Filtek Z250 XT, post-instrumentation surface roughness were in the order of Fuji II GL, Control group, and Filtek Z250 XT.

There was statistically significant difference between roughness values before and after ultrasonic instrumentation.

There was no significant difference between control group and Fuji II GL (pvalue 0.103), whereas there was significant difference amongst control group, Fuji II GL and Filtek Z250 XT (p value <0.001).

DISCUSSION

Class V caries usually develops due to many reasons like unclean tooth surface, caries inducing diet, gingival recession, a reduced salivary flow caused by certain medical conditions (e.g. Sjogren's syndrome), medication or head and neck radiation therapy. The other cervical lesions that need to be restored are abrasion, abfraction, and erosion.[1]

Ultrasonic scaling is essential part of periodontal therapy. It is advocated by periodontist within every 6 months to 1 year. Thus, class V restorations are also exposed to the periodontal prophylaxis. The tips of the ultrasonic inserts are found to vibrate between 18,000 and 45,000 cycles per second.[11, 12] These are excellent for removing plaque, calculus, and bacterial debris.[12]

There is increased surface roughness of tooth and class V restorations that are in close proximity to gingiva may lead to more plaque accumulation, staining, gingival irritation, increased patient discomfort, and recurrent caries.[11,13]

To restore such defects, materials used should have qualities and properties such as good flexural strength, longevity, ease of use, past success, esthetics, bonding ability, good finishing and polishing ability.[1]

Glass ionomer cements are typically used to restore cervical lesions because of its chemical adhesion, anticariogenic property and high flexural strength.[14] The conventional glass ionomer (Fuji II GL) was significantly roughened by both scaling treatments. This might be attributable to its heterogeneous and biphasic nature. The weak poly salt matrix phases are preferentially removed, leaving the harder, unreacted glass particles protruding from the surface.[15,16] This accounts for the significant increase in Ra values observed after ultrasonic and sonic scaling.

Composite blend in with surrounding tooth structure to give natural appearance. Its advantages include control over working time, immediate finishing of restoration and control over depth of cure since no mixing is required. It means easier handling and minimal porosity. However, recently it has been found that Nanohybrid composites also posses better flexural properties and low surface roughness.[17]

Composite is a single component material, whereas in case of Glass ionomers, powder has to be mixed with liquid, therefore risking the more air bubble incorporation and increased porosity.[18,19] These porosities may get enhanced after ultrasonic instrumentation leading to greater surface roughness.

Nanohybrid composite have smaller particle size, reaching in order to 0.02 to 2 µm. This is explains the superiority in physical properties in comparison with GIC Fuji II GL, as well as their smooth surface.

Eid *et al.* have mentioned that bacterial adhesion is directly proportional to surface roughness of the restorations.[20] **Ikeda *et al*.** also stated that surface roughness has a positive influence on S. mutansbiofilm adherence.[21]

In this study, Filtek Z250 XT nanohybrid composite showed less surface roughness than other group. It is sequence as follows:

Control group < Fuji II GL < Filtek Z250 XT

Which is in accordance with study done by **Shenoiet al**.[22]

In a similar in vitro study, **Lai *et al***. reported that after ultrasonic scaling, Glass ionomer cement (Fuji II) showed significantly higher surface roughness than Composites Z100 and Tetric Flow.[11]

Erdilek*et al*. mentioned in his studies that Glass ionomer has roughest surface value while flowable has smoothest surface.[23] These findings were consistent with those of **Hossamet *al***.[20] and Mourouziset al.[24]

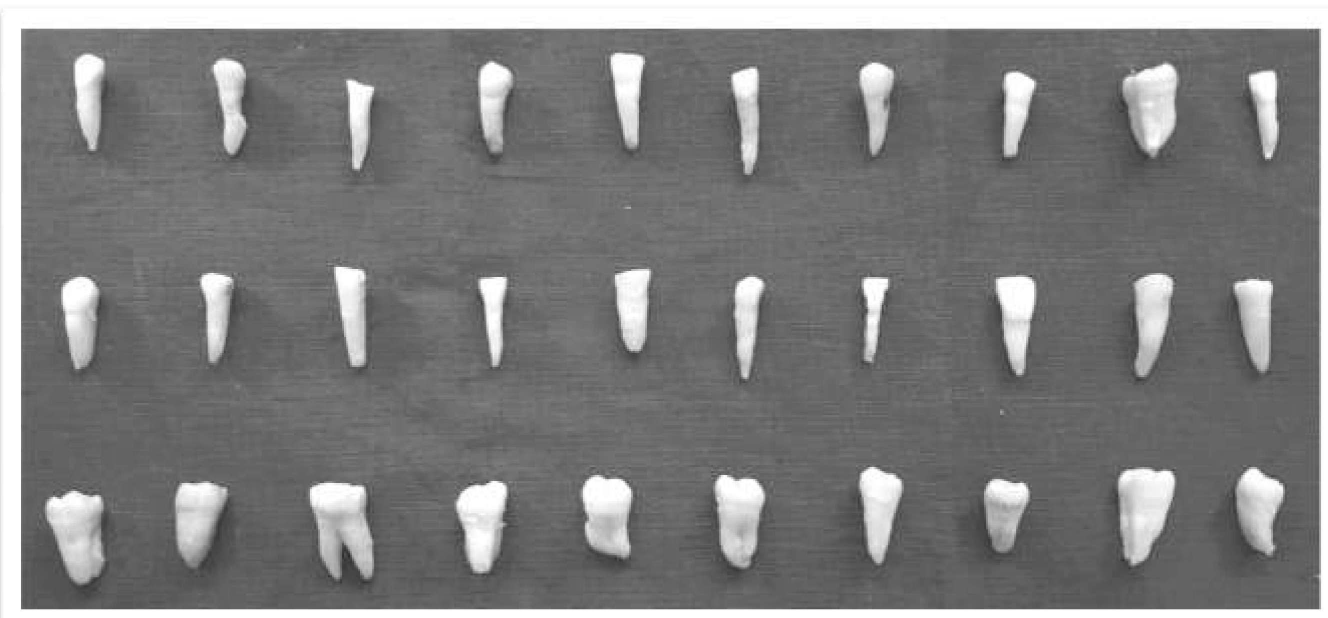
Filtek Z250 XT showed least pre and post-ultrasonic instrumentation roughness, which is attributable to its smaller and wide distribution of particle sizes, higher filler loading (82% by weight) with resultant high strength and wear resistance when compared to other test groups.[24,25]

The results of this in-vitrostudy may vary in in-vivoconditions as they are frequently subjected to various deleterious actions inside oral cavity like abrasion (brushing), attrition and erosion (citrus drinks, fruit, soft drinks, alcoholic and non-alcoholic beverages), exogenous substances including acids, bases, salts, alcohol, oxygen, etc. contacting the restoration surfaces during oral food and fluid intake and oral hygiene[15, 26] and also to the cyclic flexural forces in the cervical region during occlusal loading.[19]

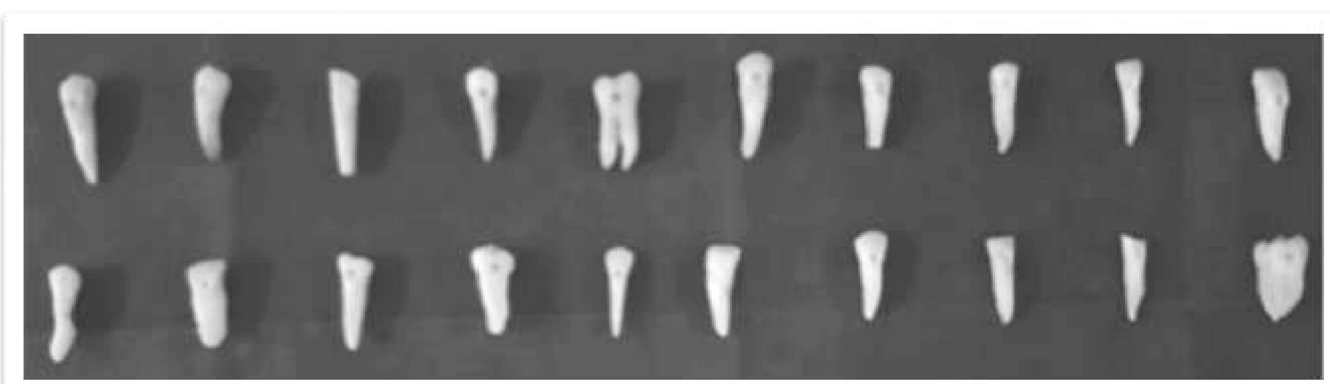
CONCLUSION

Within the limitations of this study, ultrasonic instrumentation has caused significant changes in the surface roughness of both control and test specimen. GC II had highest, whereas Nanohybrid composites Filtek Z250 XT had lowest pre- and post-instrumentation roughness values.

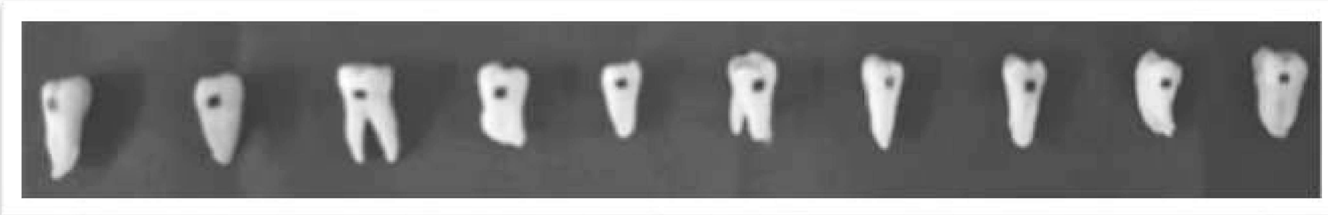
Nanohybrid composites are found to withstand instrumentation better than other tested materials but still we would like to pass a message that carry out the routine ultrasonic scaling with caution and subsequently polish the roughened restorations after scaling.



30 freshly extracted natural tooth

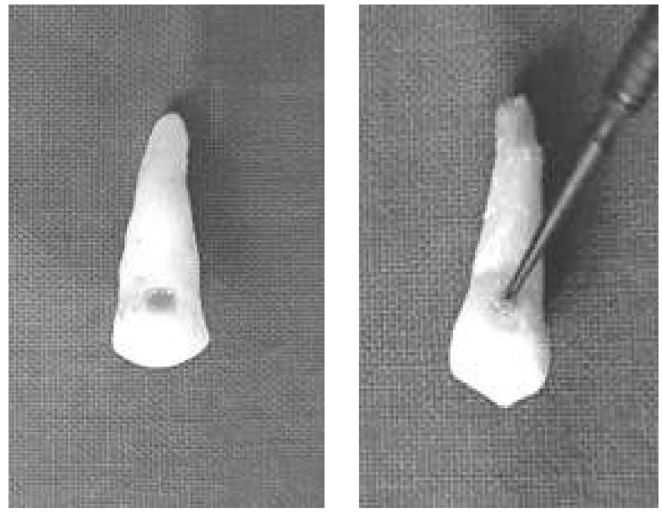


On Twenty Teeth, The Standardized Class V Cavities of 2 Mm Width, 2 Mm Length, And 2 Mm Depth Were Prepared On

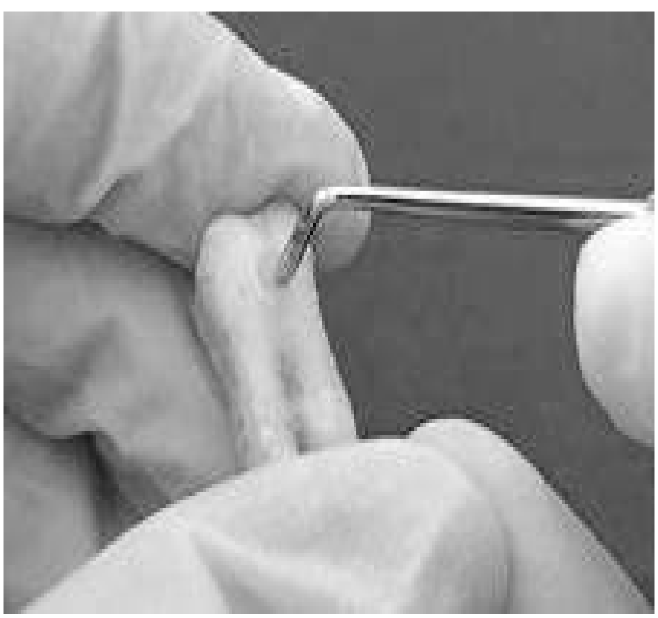


Teeth of Control Group Were Marked With Area of 2 x 2 Mm To Simulate Outline of Class V Cavity; No Cavity

Mixing of Gic

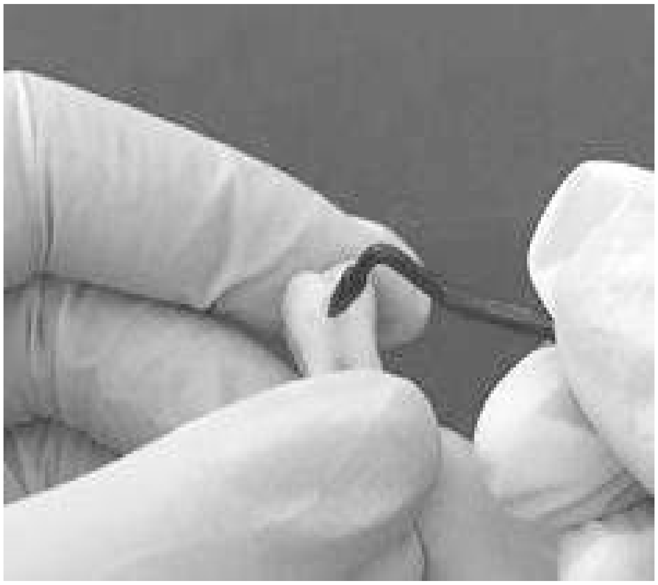


Application and Agitation of Bonding Agent



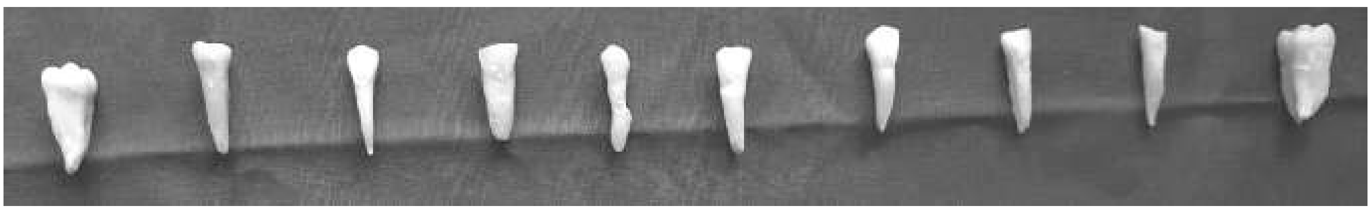
Placement of Gic

Curing of Bonding Agent

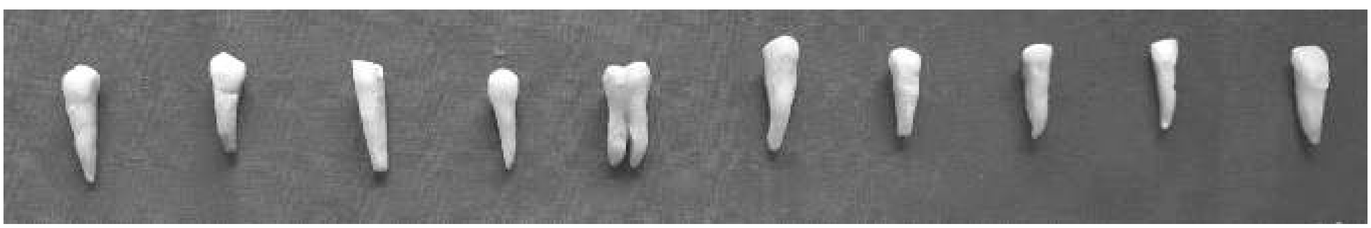


Restoring Cavity with Composite

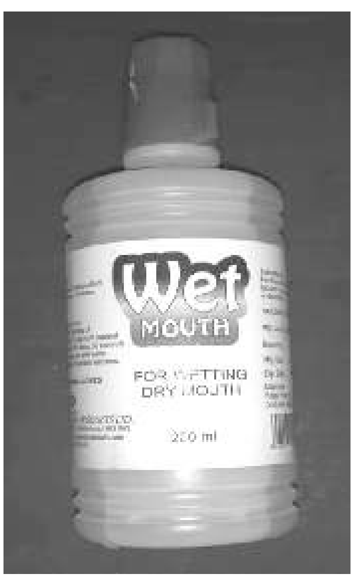
Curing of Composite Resin



Group 2: Restored with Gic



Group 3: Restored with Composite Resin

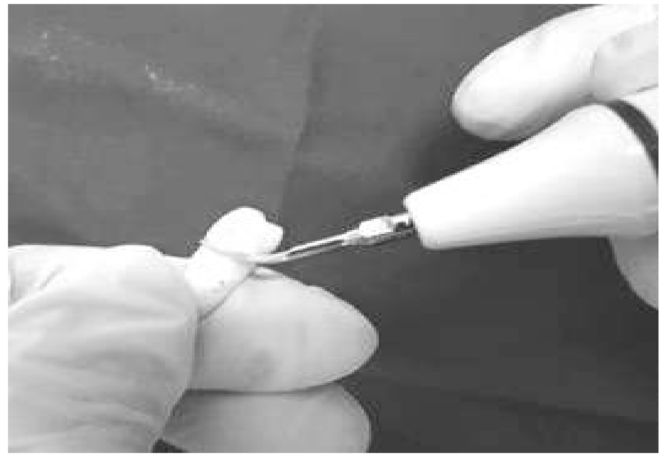


Artificial Saliva

Sample Stored in Saliva

Specimens Stored in Artificial Saliva at 37 Degree Celcius in Incubator in 100% Relative

Surface Roughness Tester



Ultrasonic Scaling Performed on all Specimen

REFERENCES:

1. Roberson TM. Fundamentals in tooth preparation. In: Roberson TM,Heymann HO, Swift EJ, editors. Sturdervant's Art and Science ofoperative Dentistry. 5th ed. Haryana (India): Elsevier; 2010. p. 281-324.
2. Ruddell DE, Maloney MM, Thompson JY. Effect of novelfiller particles on the mechanical and wear properties of dental composites. Dental Materials. 2002; 18: 72-80.
3. Nakfoor B, Yaman P, Dennison J, Herrero A. Effect of Lightemitting diode on composite polymerization shrinkage and hardness. Journal of Esthetic and Restorative Dentistry. 2005; 17: 110-116.
4. Lu H, Lee YK, Oguri M, Powers JM. Properties of a dentalresin composite with a spherical inorganic filler. Operative Dentistry. 2006; 31: 734-740.
5. Hegde MN, Hegde P, Bhandary S, Deepika K. An evaluationof compressive strength of newer nanocomposites: An in vitro study. Journal of Conservative Dentistry. 2011; 14: 36-39.
6. Colceriu A, Moldovan M, Prejmerean C, Buruiana T, Buruiana EC, Furtos G, et al. Prodan and C.Tamas. Nanocomposite used in dentistry. Eur Cells Mater 2005; 10:19
7. Puckett, A.D.; Ritchie, J.G., Kirk, P.C. &Gamblin, J. (2007). Direct composite restorative materials. The Dental Clinics of North America, Vol. 51, pp. 659-675.
8. Merin RL. Supportive periodontal treatment.

In: Newman MG, Takei HH, Klokkevold PR, Carranza FA, editors. Carranza's Clinical Periodontology. 10th ed. New Delhi (India): Elsevier; 2007. p. 1194-205.

9. Misra DN. Adsorption of low molecular weight sodium polyacrylate on hydroxyapatite. J Dent Res. 1993;71:1418–1422

10. Swartz ML, Phillips Rw, Clark HE. Long-term fluoride release from glass-ionomer cements. J Dent Res. 1984;63:158–160

11. Lai YL, Lin YC, Chang CS, Lee SY. Effects of sonic and ultrasonic scaling on the surface roughness of tooth-colored restorative materials for cervical lesions. Oper Dent 2007;32:273-8.

12. Jotikasthira NE, Lie T, Leknes KN. Comparative in vitro studies of sonic, ultrasonic and reciprocating scaling instruments. J ClinPeriodontol 1992;19:560-9.

13. Bjornson EJ, Collins DE, Engler WO. Surface alteration of compositeresins after curette, ultrasonic, and sonic instrumentation: An in vitrostudy. Quintessence Int 1990;21:381-9.

14. Prosser HJ, Powis DR, Wilson AD. Glass-ionomer cements of improved flexural strength. J Dent Res 1986;65:146-8.

15. Folwaczny M, Loher C, Mehl A, Kunzelmann KH &Hinkel R (2000) Tooth-colored filling materials for the restoration of cervical lesions: A 24-month follow-up study Operative Dentistry 25(4) 251-258.

16. Gladys S, Van Meerbeek B, Braem M, Lambrechts P &Vanherle G (1997) Comparative physico-mechanical characterization of new hybrid restorative materials with conventional glass-ionomer and resin composite restorative materials Journal of Dental Research 76(4) 883-894.

17. Keshwani, Jennifer & Patrick Dunn, W & P Link, Michael & Wang, Yong &Xu, Changqi& Walker, Mary. (2011). Comparison of flexural properties and surface roughness of nanohybrid and microhybrid dental composites. General dentistry. 59. 342-7; quiz 348.

18. Gladys S, Van Meerbeek B, Braem M, Lambrechts P, Vanherle G.Comparative physico-mechanical characterization of new hybridrestorative materials with conventional glass-ionomer and resincomposite restorative materials. J Dent Res 1997;76:883-94.

19. Jyothi K, Annapurna S, Kumar AS, Venugopal P, Jayashankara C.Clinical evaluation of giomer and resin modified glass ionomer cementin class V noncarious cervical lesions: An in vivo study. J Conserv Dent2011;14:409-13.

20. Hossam AE, Rafi AT, Ahmed AS, Sumanth PC. Surface topographyof composite restorative materials following ultrasonic scaling and itsImpact on bacterial plaque accumulation. An in vitro SEM study. J IntOral Health 2013;5:13-9.

21. Ikeda M, Matin K, Nikaido T, Foxton RM, Tagami J. Effect of surfacecharacteristics on adherence of S. mutans biofilms to indirect resincomposites. Dent Mater J 2007;26:915-23.

22. Shenoi PR, Badole GP, Khode RT,Morey ES, Singare PG. Evaluation of effect of ultrasonic scalingon surface roughness of four different tooth-colored class Vrestorations: An in-vitro study. J Conserv Dent 2014;17:471-5

23. Erdilek D, Sismanoglu S, Gumustas B, Efes BG. Effects of ultrasonic and sonic scaling on surfaces of tooth-colored restorative materials: An in vitro study. Niger J Clin Pract 2015;18:467-71.

24. Mourouzis P, Koulaouzidou EA, Vassiliadis L, Helvatjoglu-Antoniades M.Effects of sonic scaling on the surface roughness of restorative materials.J Oral Sci 2009;51:607-14.

25. Filtek™ Z250 XT Nano Hybrid Universal Restorative, Technical DataSheet. Available from:http://solutions.3mae.ae/3MContentRetrievalAPI/BlobServlet?lmd=13164424950&locale=en_EU&assetType=MMM_Image&assetId=1273695174257&blobAttribute=ImageFile.

26. Bansal K, Acharya SR, Saraswathi V. Effect of alcoholic and non-alcoholic beverages on color stability and surface roughness of resincomposites: An in vitro study. J Conserv Dent 2012;15:2