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INFLUENCE OF HAND AND ULTRASONIC INSTRUMENTATION ON THE SURFACE TEXTURE OF COMPOSITE VENEERING RESTORATIVE MATERIALS

Dental Science

Dr. Rajeswari C. L* M.D.S, Professor, Department of Prosthodontics, KLE Society's Institute of Dental Sciences, Bengaluru *Corresponding Author

Dr. Vipin Jain K. M.D.S, Reader, Department of Public health dentistry, KLE Society's Institute of Dental Sciences, Bengaluru

ABSTRACT

Purpose; To evaluate and compare the effect of hand and ultrasonic scaling on the surface texture of Composite veneering restorative material.
Materials and Methods; Disc shaped 15 wax patterns measuring 10mm in diameter and 0.5mm in thickness was casted in Nickel Chromium. They were layered with composite veneering restorative material. Hand and ultrasonic scaling was performed for 15 seconds on each division of each specimen. Profilometer and Scanning Electron Microscopic(SEM) were used to analyze the surface roughness.
Results; The average surface roughness(µm) of the polished test specimens was maximum for ultrasonic than hand scaling. It was found to be statistically significant for both hand(t= -0.297, p=0.001) and ultrasonic scaling(t= -0.348, p=0.001) as per paired sample 't' test.
Conclusion; The Surface roughness on the tested specimens was more produced by ultrasonic scaling than hand scaling.

KEYWORDS

Composite veneering restorative material, Surface roughness, Ultrasonic scaling, Hand scaling

INTRODUCTION:

Esthetic dentistry has taken a leading role in current dentistry. The materials used are the composites, tooth colored acrylic resins, dental ceramics etc., but commonly used esthetic restorative material used for fillings, veneering the teeth and metal F.P.D etc., are composites. The reasons for failure of such restorations are many; one such is esthetics, caries and gingivitis and periodontitis prime reason being the dental plaque[1].

The dental plaque is cleaned and maintained by the patient by brushing, where as inaccessible areas, oral prophylactic instrumentation are the most effective techniques. But sometimes wrong applications can cause hazardous defects both on the tooth surfaces, restorations[2] and the tooth restoration interface leading to microleakage ultimately the failures of the restorations[3,4].

There is abounded data regarding the effect of prophylactic instrumentation on hard and soft tissues. However, there is inadequate literature reporting on the effect of prophylactic instrumentation on composite veneering restorative materials. Hence, the goal of this study was to examine the influence of hand and ultrasonic prophylaxis on composite veneering restorative material.

MATERIALS AND METHODOLOGY:

Disc shaped, 15 wax patterns measuring 10mm in diameter and 0.5mm in thickness were made by flowing inlay wax into the rubber mould. They were casted with nickel-chromium (VeraBond II) as per the manufacturer's instructions.

The castings were separated from the casting rings and were sandblasted with alumina particles(50µm) and cleaned by ultrasonic cleaning unit for 3 min. A metal primer(Kerr corp., U.S.A) was applied on the surface of each specimen. A layer of 1 mm of composite veneering restorative resin(Charishma, Kulzer) was applied on the surface and was divided into 2 equal divisions by a plastic instrument. They were cured for 90 seconds using a light cure unit. All the specimens were finished using the composite finishing kit(Shofu Inc.,Japan) in one direction from centre to periphery.

All the specimens were numbered and were embedded in dental stone block. Hand scaling(HS) and Ultrasonic scaling(US) (Cavitron) was carried out using surface and interdental scaler/tips for 15 seconds in the direction of the finishing and polishing of each specimen of the representative division. The tip of ultrasonic scaler was held perpendicular to the surface with back and forth motion with continuous water spray.

Profilometer (Taylor Hobson,England) stylus was made to run on the surface of each division on each specimen, before and after scaling in opposite direction. The average surface roughness(Ra) values were obtained and was subjected to statistical analysis. One sample was selected at randomly for qualitative evaluation of the surface topography by scanning electron microscope evaluation(JSM 840A SEM, JEOL) of the representative area of each division.

RESULTS:

The Table No. 1 represents the Mean, standard deviation, and pairwise difference using paired sample after hand scaling and ultrasonic scaling of polished test specimens of composite veneering material. The values found to be statistically significant with for both hand(t= -0.297, p=0.001) and ultrasonic scaling(t= -0.348, p=0.001) as per pairwise difference using paired sample 't' test.

DISCUSSION:

One of the reasons for the failure of the fixed partial denture is caries or due to periodontal reasons. This is due to inadequate plaque removal in the inaccessible areas like on margins of the restorations due to defective casting or dissolution of the cement. In such situations the dental prophylaxis plays an important role in removing the plaque, but literature has proved along with removal of plaque it produces surface alterations on teeth, restorative materials[4] etc,.

Studies have revealed that irrespective of good finishing and polishing the surface of restorative materials has some amount of roughness. The critical surface roughness threshold established for bacterial adhesion is 0.2 µm. which is one of the various factor for plaque accumulation[5]. Once the plaque develops it gets influenced by the surface free energy of the bacteria and by the free energy and roughness of the plaque accumulatory substratum[6]. The other factors for the plaque accumulation are the margins; contour of the restoration, patient's oral hygiene and the type of restorative materials.

Several studies have reported on the effect of oral prophylaxis on teeth, on various restorative materials. But not much of literature on composite veneering restorative materials. Hence this study examined to know the effect of hand and ultrasonic instrumentation on the composite veneering materials.

Composite veneering materials were layered on the nickel chromium metal specimen disc and cured. Hand and ultrasonic scaling was performed on the representative areas. During ultrasonic scaling the scaler tip was held perpendicular to the surface with a continuous water spray on the working area, as it would produce oscillations eight times more because of the cavitational activity and so the scaling effectively[7]. Single operator did the scaling with approximately same hand pressure and time[8].

The roughness was evaluated both quantitatively by using Profilometer and qualitatively with the SEM[2]

In this study the hand scaling had produced less alteration than ultrasonic scaling. The mean average surface value of pre hand scaling

was 0.34 µm and after hand scaling 0.64 µm where as for ultrasonic scaling before hand scaling 0.37µm and after 0.72µm. So the difference in average surface roughness is more for ultrasonic(US= -0.348µm) than for hand scaling(HS= -0.297 µm). These results were found to be statistically significant for both hand(t= -9.275, p=0.001) and ultrasonic scaling(t= -6.393, p=0.001) as per paired 't' test(Table - 1).

TABLE NO. 1: Mean, standard deviation, and pairwise difference in surface roughness(µm) using paired sample after hand and ultrasonic scaling of polished test specimens of composite veneering material\

Pairs		Mean (µm)	N	S.D.	Mean Difference	t Value	p value
1	Pre H/S	0.34	15	0.116	- 0.297	- 9.275	0.001
	Post H/S	0.64	15	0.148			
2	Pre U/S	0.37	15	0.142	- 0.348	-6.393	0.001
	Post U/S	0.72	15	0.307			

As per Kristine et al, the bacterial adhesion on the surface needs to have roughness above 0.2 µm results in a simultaneous increase of plaque accumulation and of the risk of caries and periodontal inflammation, questioning the longevity of the restoration[1]. Since all treated surfaces presented in our study showed surface roughness more than 0.2 µm, the effect of the finishing/polishing systems on the finished surface of microhybrid composite resins is clinically relevant[5].

SEM photographic comparison it was found that there were more surface alteration on the ultrasonic compared to hand scaling. On hand scaling the grooves was rougher and irregular(Fig- 1) and on ultrasonic scaling surface area the grooves appeared wider, irregular, scaly and occasionally deep gouges(Fig -2). All these features coincided with the Profilometer readings.

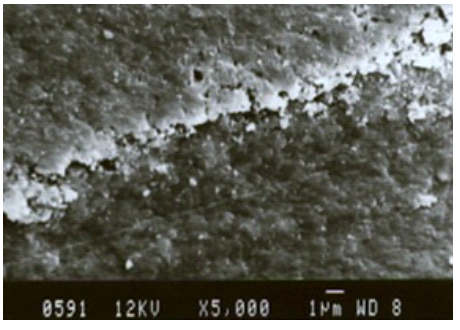

Fig 1: SEM photograph of surface of the specimen after hand scaling

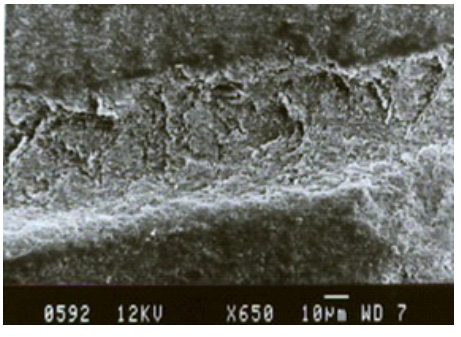

Fig 2: SEM photograph of surface of the specimen after Ultrasonic scaling

The present study results were in agreement with Bjornson et al, where they found that ultrasonic to produce more alterations on the teeth[9], but according to Renato et al., in their study proved that both hand and ultrasonic produced a similar defect depth irrespective of different power settings used for scaling[10]. On contradictory to the present study Rohani et al, concluded that hand instrumentation tends to result in smoother root surfaces than ultrasonic scaling[3].

The surface alterations produced on the composite materials may be due to the difference in the pressure applied, and the type of analyzer used. Moreover, studies revealed that the design, angulation, sharpness of the working edge and instrumentation time all impact the degree of surface roughness[11].

Depending on the partical size of the composite materials the surface alterations differ. This was proved in a study conducted by Mithra et al, where they stated that the smallest filler particle size was found to less alterations by ultrasonic scaling[12].

The surface hardness and the microstructural nature of the testing specimen would result in abrasion resistance the surface alterations were more in this study as the composite restorative materials has less hardness 50-60 KHN when compared to other restorative materials [13].

Profilometric readings and SEM photographic comparison, revealed the surface alterations were more on ultrasonic than the hand scaling. Hence dentist should be aware of the ontoward effects of using hand and ultrasonic instrumentation.

This in vitro study showed that the use of hand and ultrasonic scaling affect the surface roughness of the composite restorative veneering materials. However these restorative materials in the oral environment are subjected to various factors like ph levels, forces etc. Hence it is suggested that scaling in clinical conditions should be assessed for the performance of the materials.

CONCLUSIONS:

The hand and ultrasonic scaling on composite veneered materials were evaluated. Within the limitations of the study, the ultrasonic scaling showed more surface roughness and alteration than hand scaling.

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