The effect of three finishing systems on three esthetic restorative materials

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أجريت هذه الدراسة لمعرفة خشونة السطح لمواد الحشوات التالية، الكمبوزيت، الزجاج المعدل، الكمبوزيت المعدّل وذلك بأستخدام ثلاثة طرق مختلفة في الإنهاء والصقل حضرت عشرة عينات من كل مادة، انهيت وصقلت بأحد الطرق الثلاثة المقترحه وهي أقراص (سوفتليكس، رؤوس الألماس والسيليكون، سنابل الإنهاء.)
قيست خشونه السطح للعينات بإستخدام جهاز بيرثوميتر. اظهرت النتائج بأن أقراص سوفتليكس ورؤوس الألماس والسيلكون أعطت سطوحاً أكثر انهاءاً وصقلا لمادة الكمبوزيت من المادتين الأخريين وظهرت اكثر السطوح خشونه باستعمال سنابل الإنهاء على مادة الزجاج المعدل.
على الرغم من أن استعمال الرؤوس الماسيه والسيليكون يمكن ان تعطي سريريا سطوح انهاء وصقل لحشوات الكمبوزيت والزجاج المعدل مقبولة الا أن اقراص السوفتليكس تعطي سطوحاً اكثر صقلاً ونعومةً.

In this study, surface roughness of three esthetic materials namely composite resin, resin-modified glass ionomer, and a compomer were examined using three finishing and polishing systems. Thirty samples of each material were prepared. Ten samples from each material were then finished and polished with one of the three systems (Sof-Lex discs, a combination of diamond and silicone points, and carbide finishing burs). Surface roughness (R_a) of the samples after finishing and polishing were measured using a perthometer. The results showed that Sof-Lex discs and a combination of diamond and silicone points produced significantly better finished and polished surfaces on composite resin than on the other two materials. The roughest surfaces were obtained by carbide burs on glass ionomer (Photac-Fil). Although a combination of diamond and silicone points could provide acceptable finishing and polishing surfaces for composite resin and resin-modified glass ionomer surfaces, Sof-Lex discs provided smoother surfaces.

Introduction

Achieving a favorable esthetic restoration is critical, especially in anterior regions of the mouth. Proper finishing and polishing of tooth colored restorations enhances the esthetic and longevity of the restored teeth, leading to increased patient satisfaction.[1] Plaque retention, surface discoloration and gingival inflammation are influenced by the smoothness of the restoration surface.[2,3]

Different restorative materials are available for esthetic restorations. The dentist has to choose the suitable material that can give the best results. Composite resin is one of the main and most commonly used restorative materials,[4] followed by glass-ionomer cement (GIC).[5] Compomers which is a combination of composite resin and GIC are also appropriate for Class III restorations and Class V cavities on anterior teeth.[6,7]

Direct esthetic restorative materials are finished and polished using a variety of instruments. The most popular systems used are: carbide burs, diamond points and abrasive impregnated discs.[8] Finishing and polishing abilities of these systems on different esthetic materials have been studied.[9] It has been found that composite resins gave the smoothest surfaces using different finishing and polishing systems compared to other restorative materials.[10,11] Finishing and polishing of GIC and compomer were less satisfactory than that obtained on composite resin.[10]

The aim of this study was to investigate surface roughness of three esthetic materials as follows: composite resin, resin-modified GIC, and a compomer using three finishing systems.

Materials and Methods

The esthetic materials used in this study were composite resin (Pertac II),* resin-modified GIC (Photac-Fil),* and compomer (Hytac).* A total of 90 samples, 30 from each material, were prepared using a round teflon mold (10 mm diameter and 3 mm depth). Button-like samples were prepared using the esthetic materials according to the manufacturers' instructions. The esthetic materials were injected in each disc and condensed with plastic instrument. The top surface of each sample was left overfilled with the materials. All materials were light cured from both top and bottom surfaces, using a light curing unit! for a total of 60 seconds on each surface. Samples were examined for obvious surface voids using explorer No. 5.!! In case voids were found, more materials were added to the surface of the samples and light cured. Presence of voids might affect the accuracy

Received 2 March 2002; Revised 19 November 2002
Accepted 26 January 2003
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of surface roughness readings. To make the polishing time standard for all materials, all samples were kept in humid atmosphere (incubator) at 37°C for 24 hours.

The samples of each material were randomly divided into three groups of 10 each. Each specimen group received a different surface preparation. Group I from each material was finished with Sof-Lex discs.[!!!] Medium (40 µm), fine (24 µm) and super fine (8 µm) were mounted on a slow-speed handpiece operating at 5000 rev/min for 20 seconds. Group II was finished with E-Denta finishing system, combination of superfine diamond burs, white Arkansas stone, and silicone points. High speed turbine with water spray coolants was employed with diamond burs and the Arkansas stone for 20 seconds with rotary movement while slow-speed handpiece was used with the silicone points. Group III was finished with a combination of tungeston carbide burs 18 and 30 µm. A high speed turbine with water spray coolant for 20 seconds was used with each bur.

Each sample was finished and polished in one direction in order to standardize striations until the surface of the material was flushed with the surface of the mould. Surface roughness was measured using a perthometer. For recording roughness profile R, according to DIN 4768, the cut-off lengths of 0.25, 0.8 and 2.5 mm are selected on the perthometer. Waviness profile W were made by using the cut-off length 0.25 mm. The R_a was selected to represent average surface roughness based on its use in similar studies.[11,12] R_a is the arithmetic average height of roughness component irregularities from the mean line measured within the sampling length.

Results

The data were analyzed using one way ANOVA and Tukey's HSD pairwise comparison. The means and standard deviations for the roughness values (R_a) for each material after finishing with the different finishing systems are presented in Table I. Sof-Lex discs produced the lowest roughness values (0.27±0.14, 0.77±0.42 and 0.92±0.19) on the three tested materials: the composite resin, the compomer and the resin-modified GIC, respectively. Also, the R_a values obtained by Sof-Lex discs were significantly lower on Pertac II than on Hytac ($P < 0.001$) and Photac-Fil ($P < 0.0001$). On the other hand, carbide finishing burs gave significantly higher roughness values than the other systems ($P < 0.0001$). Moreover, the R_a values obtained by using carbide burs on Photac-Fil (2.97±0.68) were significantly higher than that on Hytac ($P < 0.0001$) and Pertac II ($P < 0.0001$). No significant difference was found between Sof-Lex and E-Denta on Photac-Fil (P=0.158).

Table 1. Means and the standard deviations (µm) of roughness values (Ra).

Material	Mean R_a ± SD using the finishing systems		
	E-Denta	Sof-Lex	Carbide
Resin Modified Glass-Ionomer (Photac-Fil)	1.28±(.20)	0.92±(.19)	2.97±(.68)
Compomer (Hytac)	1.28±(.33)	0.77±(.42)	
~~1.79±(.30)~~			
Composite Resin			

Discussion

The importance of a smooth surface to the success of a restoration has been well documented. The rougher the surface finish of a restoration, the more chance there is for bacterial accumulation and possibility of recurrent caries or periodontal disease.[2]

In this study, Sof-Lex discs produced the best surface finish on all tested materials and the best surface finish was obtained on Pertac II composite resin. This finding was in agreement with some previous studies,[8,12,13] and confirms that composite resin polishes best as was demonstrated by Tate and Powers.[11]

On the other hand, carbide finishing burs produced the roughest surfaces especially on Photac-Fil. The results obtained on Photac-Fil using carbide finishing bur in the present study were similar to those obtained by others[9,10,12,14,15] who explained that the use of carbide finishing burs on surfaces of glass-ionomers appeared to affect the material matrix causing surface disruption. Also, the rough surface obtained after using carbide burs could be attributed to the large particle size of Photac-Fil. Large glass particles could be dislodged during finishing leading to voids. However, in the present study, Photac-Fil was shown to be best polished using Sof-Lex discs or a combination of diamond and silicon points (E-Denta system). In another study,[12] the best

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surface finish of resin-modified glass-ionomer cement was obtained by diamond points alone or by carbide finishing burs followed by Sof-Lex discs. Therefore, the use of carbide burs should be limited to gross contouring and removal of excess restorative material.

Although Hytac is a compomer which exhibits a closer chemical relationship to composite resin,[6,7] it did not behave like composite resin as far as finishing and polishing are concerned. There were significant differences between Hytac surfaces finished by Soflex and E-Denta, and those surfaces of Pertac resin finished by the same finishing systems. It has been found that different factors can affect the quality of finished surfaces of the restorative materials, such as material composition including filler particles as previously discussed with Photac-Fil.[11,16] Composition and hardness of the abrasive system, also, proven to affect the surface finish of a restoration. Increasing the grit number reduces the depth and number of surface irregularities, the time spent for finishing and orientation of the abrading surfaces were also factors affecting the surface finish.[14] Moreover, type of motion employed during use plays a part.[14] Sof-Lex discs are used by planar motion where the axis of rotation of the abrasive is perpendicular to the surfaces being smoothed. This type of motion produces smoother surfaces than rotary motion because discs tend to sand the surfaces without gouging into the material.[17] On the other hand, diamond and carbide burs grind into the surfaces because they are used by rotary motion where the axis of rotation is parallel to the surfaces being smoothed.[17]

Generally, clinicians are advised to use an esthetic material with its corresponding finishing and polishing system that is manufactured to perform optimally for that type of material.

The findings of this *in vitro* study are relevant only to clinical situations where there are accessible and relatively flat surfaces. The effectiveness of finishing procedure might be different in clinical situation where accessibility is limited. Also, finishing quality might be changed when finishing convex surfaces such as Class V restorations or concave surfaces like occlusal surfaces. Further research is needed to simulate these clinical situations.

Conclusions

Within the limitations of this study design, Sof-Lex discs significantly produced lower roughness values on composite resin surfaces compared with the other systems. On the other hand, there was no significant difference in the roughness values obtained by Sof-Lex and E-Denta system on resin-modified glass-ionomer surfaces. Carbide finishing burs gave the highest roughness values compared with the other systems. However, their use might be limited to surface contouring of the restorations.

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