COMMENTARY

SURFACE ROUGHNESS AND STAINING SUSCEPTIBILITY OF COMPOSITE RESINS AFTER FINISHING AND POLISHING

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There are two aspects of finishing a composite restoration: finishing and polishing. During the finishing process, the restoration is contoured to match tooth form and to establish good margin integrity at the tooth restoration interface. To accomplish this, rough abrasives and cutting instruments are used to remove excess cured composite material on the restoration surface. The finishing process, regardless of the instrumentation used, leaves moderate to deep scratches or irregularities on the material surface.

Polishing involves the application of sequential abrasives with finer and finer particle sizes to significantly reduce or remove the width and depth of these scratches. The profilometer tracing of a smoothly finished surface should have minimal waviness with small peak-to-valley distances. The resulting final surface should have a satin or glossy appearance, depending upon the composition of the restorative material. The finishing and polishing process is influenced by the composition of the substrate material, the degree of cure of the polymer, the hardness and particle size of the abrasive, the pressure applied, and the time of application. Sequential techniques are usually used to improve efficiency in obtaining the smoothest possible surface.

In concept, a highly polished clinical surface that is similar to adjacent enamel should have minimal plaque retention, healthy adjacent tissue, and light dispersion that enhance esthetics. The independent variables in this paper are three composite substrates (a nanofill, a minifill, and a microfill material) and three finishing systems (Sof-Lex, Enhance plus PoGo, and FlexiDisks plus Enamelize). The dependent variable is the average surface roughness in Ra units. The authors of this article have selected three composite substrates with essentially different filler content and particle morphology, but there is some significant overlap among the materials (see particle size range and volume fraction in Table 1). Thus, it makes it almost impossible to separate out the true effect of filler particle size on surface roughness. This may explain why there is either no difference among the materials or a statistical overlap in significant differences. The variation in fillers among these materials is not as much in the filler size or morphology as it is in the modal distribution of different particle sizes within the materials, except for the microfill, which is more homogeneous. The other issue is that small statistically significant values that lead to conclusions in laboratory studies may not be clinically significant as far as performance is concerned. Given the small roughness (Ra) values and standard deviations reported in this and other current roughness studies,[1,2] there is a real question as to whether the values correlate at all with the clinical markers for esthetics or tissue health. This is visually evident in the SEM photographs in Figures 1 through 3. According to the analyzed data, the microfill material is significantly smoother than the other two composites when finished with the FlexiDisc/Enamelize system. However, this difference is not evident visually when comparing Figures 1B, 2B, and 3B at 500× magnification. Thus, what is statistically significant may not be clinically significant when choosing a polishing system.

The staining of composite resin materials is of two types: intrinsic and extrinsic staining or discoloration. Extrinsic staining is the accumulation of stain from foodstuff and ingested liquids and is exacerbated by smoking. It is more closely associated with surface roughness and is frequently localized adjacent to composite restoration margins. A composite margin can be overcontoured, undercontoured, or open to penetration of the tip of an explorer. All of these defects can lead to the accumulation of stains from food or the bacterial action in the adjacent plaque; therefore, margin adaptation is a critical operator-controlled variable that can contribute to visible staining.[3] This type of stain can usually be removed during a prophylaxis, by repolishing the restoration. In extreme cases, localized stained

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composite can be removed with a small bur, and the surface repaired or veneered with a new material that matches the tooth shade. This is not the type of staining assessed in this study.

Intrinsic stain, on the other hand, is within the bulk material and is more closely related to the composition and structure of the composite resin matrix. Material factors, such as a hydrophobic polymer, water sorption from saliva, water diffusion rates within the material, effective silanation processing of the filler, or insufficient polymerization, can lead to discoloration of the material over time in the oral environment. Hydrophobic surfaces repel moisture and thus inhibit the absorption of water into the material.[4] Absorbed saliva that diffuses into the polymer hydrolyzes the polymer matrix and releases the unreacted catalyst and by-products resulting from the polymerization reaction, which all contribute to bulk discoloration of a restoration. In this article, the authors are addressing color instability more than surface staining. The factors that led to color loss over time are more a function of the manufacturing process than operator-controlled factors. However, the clinician can improve color stability by extending the curing light exposure sufficiently and minimizing the thickness of each increment added in a buildup. Both water sorption and surface staining can also be limited by minimizing the incorporation of air voids during handling of the material.

In this paper, the authors have picked two physical properties that affect the clinical durability of a composite resin under function: surface roughness and material discoloration. By analyzing for bulk discoloration, it is not clear if they are trying to establish a relationship between the two properties. The literature indicates that surface roughness can contribute to surface staining but not to bulk discoloration.[5]

Therefore, the Conclusion statement does not fully summarize the findings of the study. The authors have shown that a restoration finished sequentially with the appropriate abrasives can produce a very smooth surface texture, although the nanofill and minifill composites were not as smooth as the microfill for two of the three polishing systems. They have also shown that bulk discoloration with methylene blue stain was minimal in all composites, although the nanofill composite had significantly less than the minifill or the microfill for all three finishing systems.

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