The Effect of Finishing and Polishing Systems on the Surface Roughness and the Color Change of Injection Moulding Composite Resin.

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INTRODUCTION

The composite injection moulding technique is a minimally invasive approach to reconstructing teeth in a functional and aesthetic way. This method provides the clinician with predictable treatment options that can be performed quickly and accurately and gives patients appealing choices other than crown/veneer work. Thanks to advancements in injectable composites, we can place restorations with high wear resistance and a smooth finish for exceptional long-lasting results. A desirable outcome can be achieved with minimal tooth preparation. The new form of the teeth is transferred and added with the help of a transparent silicone mold and a flowable composite. Thus, the previously planned shape of the teeth is transferred from the planning model to the teeth, which are then finished and polished. A strict polishing protocol ensures an excellent finish to each tooth.

METHODS & MATERIAL

This research is based on a literature review to discuss the injection moulding composite technique, characterization of injectable composite material nanohybrid composite G-aerial Universal (220803A, GC, Tokyo, Japan) and polishing systems, and the effect of finishing and polishing systems on the surface roughness and the color change of injection moulding composite resin.[1]

DISCUSSION

Based on the literature review composition of restorative materials, particle characterizations, and performed finishing and polishing procedures are the factors that determine the surface roughness and susceptibility to discoloration.

Various studies have reported that external factors, for example, liquids such as tea, coffee, cola, and red wine cause staining on composite resin restorations at different degrees.

The particle sizes and amounts of the restorative materials, the organic matrix, and inorganic filler types, and the finishing and polishing materials applied define the properties and polishability of the restorations.

Studies reported that smooth restoration surfaces reduce bacterial plaque accumulation, the level of gingival inflammation, the risk of discoloration of the restorative material, and the risk of long-term secondary caries. A smooth restoration surface extends the life of resin materials and improves their appearance, on the other hand, a rough surface does vice versa- promoting bacterial attachment, elevating gingival inflammation, and increasing the risk of secondary caries.

Composite resin materials should have low surface roughness after polishing and should be maintained during long-span in the oral environment. The finishing and polishing techniques used distinctively with the type of restorative materials. It applies different effects based on the composition of the polishing materials used, the size and the number of abrasive particles, the amount of pressure applied during the polishing process, the difference in hardness between the abrasive material and the restorative material, the direction of the abrasive application surface, the time spent with each abrasive tool, and the geometry of the abrasive tool also affect the surface roughness of the restoration.

A great variety of abrasives are available for finishing and polishing restorative materials. These include carbide compounds, aluminum oxide, silicon dioxide, diamond particles, zirconium silicate, and zirconium oxide. Studies have shown that the polishing system and the restorative substance have a direct impact on the result of finishing and polishing procedures.

Various studies have reported that many beverages consumed in daily life cause varying degrees of discoloration in restorations In the studies conducted by Güler et al.(Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects of different drinks on stainability of resin composite provisional restorative materials. The Journal of Prosthetic Dentistry. 2005;) the effect of nine different beverages consumed in daily life (distilled water, coffee, sweetened coffee, tea, sweetened tea, red wine, artificial cream, cola, and cherry juice) on the coloring of composite resins were evaluated and restorative materials were examined. The interaction of restorative materials and staining agents was found to be statistically significant ($p = 0.0001$). Well-polished restorative material surfaces increase aesthetic quality by minimizing surface porosity and discoloration.

INJECTABLE COMPOSITE

G-ænial Universal Injectable composite material features 150nm glass fillers densely packed and individually silane-bound within a hydrophobic resin in an injectable consistency. Contains Methacrylate monomers, barium glass, and silica. The particle size is 0.15µm. Filler ratio 69% by weight50% by volume. The heightened structural density is the foundation for its universally superior physical properties-superior wear resistance and improved polish retention. This composite is characterized by high radiopacity -252%Al. It varies in 16 shades in three translucency levels.

RESULTS

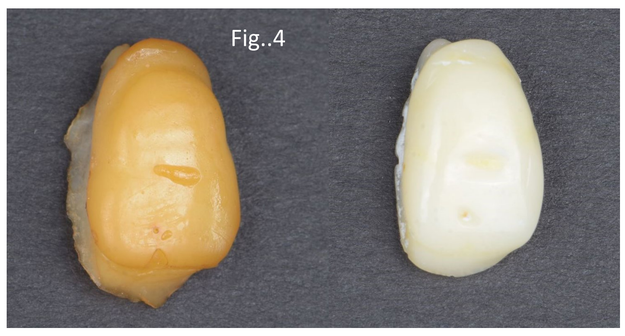
A total of 9 samples, 3 from each 3 distinct shades of G-aneal universal injectable composite were created based on manufacturers instructions and placed in distilled water for color stability at 37 degrees temperature for 24 hours without applying the final polishing system. The texture of the composite restoration can be described as rough and porous. (See PFig1).

Composite samples have been placed in coffee, cola, and soy sauce for 24 hours without polishing. Staining unpolished injectable composite material resulted in dramatic visual discoloration of G-aneal samples in the order A1>B1>BW. (See Fig.2)

After performing the staining test, samples were polished using a universal composite polishing system (See Fig.3).

Step1-Green(M)PRE-POLISH,8000RPM. Step2-Gray(F) POLISH, 4000RPM. Flex Discs: Coarse_– Starts the finishing process by helping you contour surfaces, remove imperfections and define margins. Medium – Completes the finish and removes small scratches. Fine – Creates a beautiful polish. Superfine – Enhances your polish to an enamel-like luster.

Top Finisher – Final smooth. (See Fig.4)



CONCLUSION

To review research by Schmitt et al. the researchers examined the color change and surface roughness of samples containing nanofillers and micro-hybrid composite resins after they were subjected to Sof-Lex and Pogo finishing and polishing systems. They reported that the Sof-Lex polish system produced higher color stability and lower surface porosity, similar to the current study. The abrasive particles need to be harder than the filler particles to be able abrade the resin matrix and prevent the filler particles from protruding. On the other hand, in order to prevent scratches on the composite surface, the abrasive particles must be small in structure. Due to the smaller particle size of the discs coated with aluminum oxide, the Sof-Lex polishing system creates lower surface roughness values and high color stability.

Various studies with a positive correlation between color change and surface roughness have been identified in the literature evaluating the color change and surface roughness of restorative materials. In the current study, it was determined that there was a statistically significant relationship between surface roughness and color change of injectable composites, and that materials with higher surface roughness showed more coloration.

Moreover, applying proper finishing and polishing systems on the discolored composite samples reversed discoloration significantly, which means that life-span of injectable composite G-aneal Universal can be predictable and maintainable with the care of patients and the doctor. The longevity and aesthetic success of restorative materials are directly related to the materials' surface smoothness and color stability. It is very important to obtain bright and smooth restoration surfaces for restorations that are aesthetic, long-lasting, and easily tolerated by the patient.

References

https://www.researchgate.net/publication/351276103_Effect_of_finishing_and_polishing_systems_on_the_surface_roughness_and_color_change_of_composite_resins

Presented at the 99th Annual Session of the Greater New York Dental Meeting in 2023.