A COMPARATIVE EVALUATION OF SURFACE ROUGHNESS AND IMMEDIATE COLOUR STABILITY OF TWO NANOCOMPOSITES AFTER POLISHING WITH TWO DIFFERENT POLISHING SYSTEMS:

AN IN VITRO STUDY

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Abstract

Introduction

Use of synthetic resins in restorative dentistry has markedly increased in recent years due to increased demand of aesthetics. Fillers in composite restorations have multiple roles: to reduce polymerization shrinkage as well as the coefficient of thermal expansion and water sorption and solubility, to mechanically reinforce the material, to improve optical characteristics and aesthetics of the material, to enable better initial polishing and polish retention, and to reduce wear during the masticatory forces.

Nanofillers have been developed with the aim of combining the advantages of hybrid and microfilled composites in the same restorative material. Nanofillers are described as “the discrete particles which have all of three dimensions in the range of about 1–100nm. Finishing and polishing of composite restorative material is a common clinical practice with the aim to improve its longevity and esthetics. Surface roughness can be measured up to nanoscale by qualitative methods such as scanning electron microscopy or quantitative methods such as profilometry. In recent years, atomic force microscopy (AFM) has been largely used in dentistry to study characteristics of different materials which allows a 3D imaging at a nanometric resolution and does not need to neither work in vacuum nor any preparation of the specimen. This technique has emerged as the most reliable in the evaluation of surface roughness.
The colour stability of composites is an important factor from an esthetic point of view. The colour value can be measured using colorimeter and spectrophotometer.

This *in vitro* study was done to estimate the surface roughness using AFM and colour stability using spectrophotometer of two nano-hybrid composite resins - Tetric evo ceram and IPS Empress Direct after polishing with two different polishing systems - Astropol and Astrobrush.

**Aims and Objectives**

**Aim** - To compare the surface roughness and immediate colour stability of Tetric evo ceram and IPS Empress Direct after polishing with astropol and astrobrush.

**Objectives**: To assess the surface roughness of the nanocomposites polished with two different polishing systems using atomic force microscopy and their immediate colour stability using spectrophotometry.

**Methodology**

A total of sixty samples were prepared in the study. The commercially available composite materials used in this study were Tetric evo ceram and IPS Empress Direct. Orthodontic bands of thickness 0.006 inches were used to make cylindrical metallic moulds of the dimensions 10mm diameter and 6 mm height. The composite material was placed in increments of 2mm or less and packed into the cylindrical metallic mould using a teflon coated composite placement instrument. A transparent matrix strip was applied on top of each increment of
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Composite with a constant pressure to extrude excess material, to flatten the surface and to reduce voids at the surface. Each increment of composite were light cured for 40 seconds using LED light curing unit of intensity 400 milli watts/cm². Following complete curing of the composite, the metallic moulds were separated using a scalpel to obtain cylindrical composites of the specified dimensions. Colour stability of the flat surfaces were evaluated before polishing using spectrophotometer. The specimens were randomly divided into six groups of ten specimens each. Groups used in the study were as follows: Group - I - Unpolished Tetric evo ceram, Group -II - Unpolished IPS Empress Direct, Group - III(a) - Tetric evo ceram polished with astropol, Group -III(b) - Tetric evo ceram polished with astrobrush, Group -IV(a)- IPS Empress Direct polished with astropol, Group – IV(b)- IPS Empress Direct polished with astrobrush. Each of the flat surfaces of the samples were polished unidirectionally (four strokes each) for eight seconds each using the two different polishing systems, 1. Astropol with its finishing grit, polishing grit and high gloss polishing grit respectively. 2. Astrobrush at low speed using a micro motor hand piece. Immediate colour stability was evaluated after polishing using spectrophotometer. The cylindrical composite specimens were placed in normal saline before evaluating the flat surfaces for surface roughness using AFM. The data were statistically analyzed using one-way analysis of variance (ANOVA), Post hoc and Dunnett’s test.
Results and Observations

The results showed that among the experimental groups the maximum root mean square value of $1.93\pm0.03$ nm$^2$ was observed for group IV(a) [ Tetric evo ceram polished with astropol ] when compared to Groups-III(a), III(b), IV(b), (P<0.05), is considered statistically significant.

The minimum root mean square value of $0.22\pm0.02$ nm$^2$ was observed for Group-IV(b) [ IPS Empress Direct polished with Astrobrush] when compared to Groups - III (a), III (b), IV (a) , (P<0.05), is considered statistically significant.

The results showed that there is very minimal changes in colour values of groups before and after polishing with the two different polishing systems , (P>0.05), is considered statistically insignificant.

Conclusion

Superior polish was obtained when the composites were polished with astrobrush when compared to those polished with astropol. There was very minimal difference in the colour stability of the composites before and after polising using the two different polishing systems.

Clinical Significance

The esthetics and longevity of composite restorations strongly depends on the quality of the surface finishing and polishing as well as its colour stability. The presence of irregularities or change in its colour can influence appearance, plaque
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retention, surface discoloration, gingival inflammation. In addition, the surface roughness of composites can reduce the hardness and increase the wear of these restorations, hence the importance of proper finishing and polishing as well as the colour stability of composite restorations.

Keywords: Nano composites, Polishability, Immediate colour stability, Atomic force microscopy, Photo spectrometry