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ORIGINAL ARTICLE

The effect of different finishing and polishing techniques on surface roughness and gloss of two nanocomposites

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Abstract *Objectives:* The aim of this in vitro study was to evaluate the effect of four finishing and polishing protocols in Surface Roughness (Ra) and Surface Gloss (Ga) of two different nanocomposites.

Materials and Methods: In total, 50 disc samples of a nanofilled resin and a nanohybrid resin were prepared. The samples were assigned randomly to one of the five groups to which different polishing protocols were applied. Analysis of surface roughness was performed using an Atomic Force Microscope (AFM), with the gloss evaluated using a gloss meter.

Statistical evaluation of the results were analyzed using SPSS software, based on one-way

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ANOVA parametric tests along with the Welch correction and the Dunnett test for multiple comparisons of the tested protocols.

Results: The results evidence the significant influence of the applied Protocol Types and Resin Types on Surface Roughness (Ra) and Surface Gloss (Ga). The multiple comparisons between polishing systems highlight the contrast between the most complex protocol, evidencing the lowest average Ra and the highest value Ga, and control protocol, evidencing the highest average Ra and the lowest percentage Ga. Filtek™ Supreme XT provided the best results in both Ra and Ga, in Protocol 4, while Brilliant Everglow™ performed better in Protocols 2 and 3.

Conclusions: Both Ra and Ga are dependent on the type of protocol used, as protocol 4 evidence a higher performance, depending also on the type of resins tested in the research, as nanofilled resin provided the best results. Furthermore, the gloss is influenced significantly by the surface roughness of the composite resin.

Clinical Relevance: In order to achieve excellent aesthetic appearance and high durability of the direct restoration, it is important to select initially the appropriate biomaterial for use and then to base preference for a polishing technique on achieving perfect results in the surface texture.

1. Introduction

In aesthetic dentistry, resin composites are the most frequently used materials in direct rehabilitation of the anterior region of the oral cavity, as they meet all the requirements of preservation of the tooth, aesthetic characteristics, and durability in the medium- and in the long-term (Demarco et al., 2015; Villalta et al., 2006).

In order to preserve the aesthetic features of the tooth to be restored, it is critical to take into account the surface characteristics of restorative materials such as surface roughness, gloss, and colour stability (Kumari et al., 2015; Lainovic et al., 2014; Rocha et al., 2017).

Research has reported that a material should be capable of attaining and maintaining an average roughness value below 0.2 μm *in vitro* (Bollen et al., 1997) since in anything above this value, plaque retention occurs. For this reason, it is broadly assumed that irregularities in restorations affects the accumulation of plaque itself as it does also the durability, discolouration, and aesthetic appearance of the biomaterial used.

In order to maintain or improve the aesthetic appearance of a restorative material, it is essential that the surface roughness is equal to or less than the roughness of tooth enamel in occlusal contact areas (Ferreira et al., 2015; Lainovic et al., 2014). Thus, the surface treatment with a suitable finishing and polishing technique is considered a critical procedure in order to achieve a favourable aesthetic result and to increase the longevity of the tooth restoration (Janus et al., 2010; Jefferies, 2007; Yildiz et al., 2015).

It is known that filler particles provide better physical and mechanical properties to the biomaterial and protect the organic matrix against the force applied to the direct restoration, having a direct influence on the surface properties of the composite such as the roughness and surface gloss (Hilton et al., 2013; Kaizer et al., 2014; Manhart et al., 2000; Rawls et al., 2013).

Theoretically, the resins containing nanoparticles are less susceptible to the loose particles caused by contact with the abrasive material of polishing systems, which will decrease the surface roughness of the resin type mentioned (Ferreira et al., 2015).

On the other hand, nanohybrid resins are hybrid resin composites with nanofiller in a prepolimerized filler (PPF) form, such that they are easily handled and polished, showing a higher retention of polishing and long-term gloss than other types of resin (Aytac et al., 2016).

According to research the appearance of an anterior restoration is also influenced by the degree of gloss on the surface after polishing. This is associated with the amount of light that is reflected by the biomaterial itself. The higher the surface roughness, the greater the light scattering effect, and the lower the gloss of the observed sample (Antonson et al., 2011; Ergücü and Türkün, 2007). Therefore, a smoother surface has a higher gloss, indicating superior clinical durability and better aesthetic appearance, thus inducing better optical compatibility between resin composite and the natural tooth enamel (Antonson et al., 2011; Jung et al., 2007; Lainovic et al., 2014).

Several *in vitro* investigations were carried out as part of the current research, in order (a) to evaluate the effect of different finishing and polishing procedures, (b) to identify the technique that produces the smoothest surface possible, and (c) to identify which increases stain resistance (Türkün and Leblebicioğlu, 2006). This research adds value both to the current literature and clinical practice by creating an additional and more integrated protocol, which incorporates multiple polishing techniques that minimize surface roughness and provide higher surface gloss on two nanocomposites, one nanofilled and one nanohybrid resin.

The tested null hypothesis reinforces the findings that there is a lack of significant difference between the various protocols tested, both for surface roughness and surface gloss of the nanocomposites under scrutiny.

2. Materials and methods

Two resin composites, one nanofilled and one nanohybrid, were used in the current research (Table 1).

Twenty-five cylindrical specimens of each composite resin were prepared in a cylindrical stainless-steel mould: Smile Line USA Inc. (Colorado, USA) of 12 mm in diameter and 2 mm depth.

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