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ORIGINAL ARTICLE

Microhardness of three nanohybrid composite resins according to polishability

Microdureza de tres resinas compuestas nanohíbridas según el pulido

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ABSTRACT

Introduction: minimally invasive dentistry is currently a new paradigm supported by scientific evidence-based dentistry.
Objective: to determine the surface hardness of three nano hybrid resins in relation to their polishing moment.
Methods: 60 resin discs were made according to ISO 4049 and we placed resin, divided into 3 groups of 20 each. One group of Filtek Z350 nanohybrid resin, a second group of Tetric N ceram resin and another of Brilliant resin. Half of each group was polished immediately and the other half 24 hours after polymerization. The Vickers microhardness was determined with a load of 200 g for 10 s. The data were analyzed with the Anova test.
Results: polishing after 24 h obtained surfaces with higher surface hardness compared to immediate polishing, being statistically significant (P= 0,0001). The Filtek Z350 nanohybrid resin presented higher surface hardness than the Tetric N ceram resins and Brillian resin for immediate polishing and polishing after 24 hours, being statistically significant in both cases.
Conclusion: the polishing after 24 hours of polymerization presented values with higher surface hardness for the three nanohybrid resins studied.

Keywords: Resin; Hardness; Dental Polishing; Composite.

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RESUMEN

Introducción: en la actualidad la odontología mínimamente invasiva es un nuevo paradigma respaldado por la odontología basada en evidencia científica.
Objetivo: determinar la dureza superficial de tres resinas nano híbridas en relación con su momento de pulido.
Métodos: se confeccionaron 60 discos de resina según la norma ISO 4049 y colocamos resina, divididos en 3 grupos de 20 cada uno. Un grupo de resina nanohíbrida Filtek Z350, un segundo grupo de Resina Tetric N ceram y otro de resina Brilliant. La mitad de cada grupo fue pulida al momento y la otra mitad a 24 horas posterior a su polimerización. La microdureza Vickers se determinó con una carga de 200 g durante 10 s. Los datos fueron analizados con la prueba Anova.
Resultados: el pulido después de 24 h obtuvo superficies con mayor dureza superficial respecto al pulido inmediato siendo estadísticamente significativo (P= 0,0001). La resina nanohíbrida Filtek Z350 presentó mayor dureza superficial que las resinas Tetric N ceram y la resina Brillian para el pulido inmediato y el pulido a las 24 horas siendo en ambos casos estadísticamente significativo.
Conclusión: el pulido después de 24 horas de su polimerización presento valores con mayor dureza superficial para las tres resinas nanohibridas estudiadas.

Palabras clave: Resina; Dureza; Pulido Dental; Compuesto.

INTRODUCTION

Recent technological trends have changed the vision of dentistry in the 21st century.[1] Currently, minimally invasive dentistry is a new paradigm supported by dentistry based on scientific evidence.[2,3]There are many studies that have been aimed at improving the aesthetic and mechanical properties of resins to achieve a behavior equivalent to the dental structure in the face of different masticatory loads.[4]

In order to resemble these properties, commercial companies that manufacture restoration materials have been perfecting the conditions of the composite resins, evolving and varying the quantity of filling material, to improve their durability and polishing capacity.[5,6] In addition, the surface hardness values will be much higher, in order to obtain optimal and long-lasting restorations.[7]

For several years, composite resins have played an important role in the face of the less-used amalgams, becoming a fundamental necessity in the dentist's daily practice.[8,9,10]

In search of improving these properties, new nanohybrid composite resins are emerging on the market, which are resins with improved physical and mechanical properties.[11] Such as increased wear resistance, higher surface hardness values and better management of shrinkage in the face of polymerization processes, in order to obtain better results.[12,13,14]

These materials made up of nanoparticles are responsible for improving the surface, favoring modeling, as well as the final polishing with a superior finish and shine.[13] However, the performance of these materials depends highly on their load and filler particles in relation to the quantity, composition, dynamics and shape.[14]

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The main reasons for failure of composite resins are mainly post-operative sensitivity as a result of poor handling at the time of contraction during polymerization, micro leaks due to failures in the adhesive process and decreased wear resistance.[15]

In this sense, the hardness of a material is known as its resistance to plastic deformation or its stiffness under wear. It is essential for the clinical success of the restoration. As the hardness value increases, so does the strength, improving surface quality for better polishability.

To improve this property, these restorations must undergo a polishing process to eliminate roughness. Therefore, proper polishing and finishing are necessary to establish a smooth, soft texture, improving the bonding process and ensuring the restoration's longevity.

The purpose of this study was to determine the surface hardness of three nanohybrid resins in relation to their polishing moment.

METHODS

The research was An experimental, comparative, prospective, and longitudinal study. The sample consisted of 60 nanohybrid resin discs divided into three groups, each of which was then subdivided into two groups: one for immediate polishing and the other for polishing after 24 hours. The discs were 20 FiltekZ350 resin discs, 20 Tetric N Ceram resin discs, and 20 Brilliant resin discs.

To prepare these samples, three master molds were used, one for each resin, which met the requirements of the ISO 4049 standardization standard. This international standard details the specifications for restorative materials intended for use in direct or indirect restorations in dental cavities.

RESULTS

Measuring 10 cm long by 3 cm wide, they are divided into two rows, each containing 10 circular spaces with standard dimensions of 6 mm in diameter by 2 mm in height, for the respective resin stratification, with upper and lower outlets for subsequent removal of the resin disc. (Figure 1)

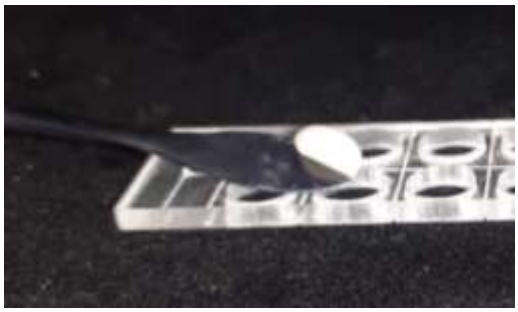

Fig. 1 Resin disc.

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Once the master model was obtained, following the recommendations of the manufacturer of each of the resins, it was placed on a glass base to ensure the stability and parallelism of the mold, and three increments of each resin of 2 mm each were introduced with a Hufriedy brand Teflon spatula for resin, in each established space, avoiding creating free spaces, with the help of a marten hair brush for resin, gel glycerin will be placed to inhibit the oxygen layer, in the last increment.

Finally, a 5mm thick glass tile was placed on top of the master mold to provide parallelism and homogenize the composite resin samples.

Finally, we continued with the polymerization process using the Bluephase lamp (NM8100 – 240V) from Ivoclar Vivadent for 20 seconds, the time required for the composite resin to fully polymerize. (Figure 2)

Fig. 2 Polymerization using the Bluephase lamp.

Resin Disc Polishing Immediate Polishing

Once the resin samples had polymerized, the resin discs were immediately polished in the same master mold with sandpaper discs for finishing and polishing. The TDV brand was manufactured in Brazil and registered with ANVISA (National Institute of Statistics and Censuses) 10291220030. This was followed in the manufacturer's order and finally with a cloth disc at low speed to homogenize and obtain smooth, free surfaces so that the necessary surface microhardness tests could be performed and more accurate results obtained. Vickers hardness was measured immediately after polishing. (Figure 3)

Fig. 3 Immediate polishing of resin discs with sanding discs.

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Polished after 24 hours
Once the resin disc samples were ready, they were placed in a plastic container where they were stored in a physiological solution at 37° (room temperature) for 24 hours. This was done in order to monitor the humidity of the samples to prevent them from drying out and prevent the resins from being altered due to lack of water.

After 24 hours, the stored discs were removed from the saline solution and the discs were immediately polished with TDV brand finishing and polishing sanding discs, with the varied range that it presents, which was coarse, semi-coarse, fine and ultra-fine grain, following the arrangement indicated by the manufacturer.

And finally, with the help of a felt disc at low speed, this was done to homogenize and obtain smooth, free surfaces so that the necessary surface microhardness tests could be performed and more accurate results obtained. The post-polishing hardness test was performed 24 hours later.

Hardness Test
The Vickers hardness test method was used for the type of material being analyzed. Using a durometer, four different points were indented on each sample under a 200g weight for 10 seconds. (Figure 4)

Fig. 4 Vickers hardness method.

DISCUSSION

This hardness test was performed at the National University of Engineering, Faculty of Engineering, Mechanics Laboratory No. 1, using a Leitz Vickers Durometer (WETZLAR, Germany). A pyramid-shaped diamond indenter was used for the Vickers test. Great care had to be taken with the base on which the durometer was placed because it could become uncalibrated. The surface on which the load was applied had to be perfectly polished. The load was placed on the back of the Vickers durometer. The specimen was placed on the durometer base and the load was applied. The test load had to be inserted and removed smoothly without shocks or any type of vibration. The time for applying the test weight was 20 seconds.

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All diagonals of the indented indentation were measured, and their average was used as the basis for calculating the Vickers surface hardness. It was recommended that the measurement be made with the indentation as centrally as possible within the optical field of the durometer.[15]

CONCLUSIONS

Polishing after 24 hours of polymerization showed higher surface hardness values for the three nanohybrid resins studied.Data collection was carried out on a data collection sheet for each sample group. A comparison analysis was performed between each group using the ANOVA and Kruskal-Wallis tests, depending on the data's similarity to the normal distribution. The analysis of the collected information was carried out with a 95 % confidence level and a 5 % margin of error.

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