Influence of auxiliary lighting, attached to high-speed turbine, in cavity dimensions during replacement of esthetic restoration

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Objective: To evaluate the influence of an auxiliary lightning (ultraviolet and white light), attached to a high-speed turbine, in the cavity dimensions after substitution of Class III composite resin restorations. **Methods:** Class III cavities with vestibular access were prepared in 36 artificial teeth mounted on dental manikin. The cavities were restored using a resin with medium fluorescence and the removal of restorations was performed with high-speed turbine in three different manners ($n=12$): without conventional light (SL); with attached ultraviolet light (UV), and with attached white light (LED). Each sample was weighed in an analytical precision balance after the initial cavity preparation and after the removal of the restoration. The difference between the two weightings was submitted to Kruskal-Wallis and Dunn ($p<0.05$) statistical tests, to evaluate which technique provides the most conservative preparation when replacing the composite resin. **Results:** there was a statistically significant difference comparing groups SL and LED ($p=0.03$), and SL and UV ($p=0.004$). Between UV and LED groups the difference was not significant. **Conclusion:** The use of systems with auxiliary lightning attached to a high speed turbine can be beneficial to the dentist practice in distinguishing resinous materials when replacing esthetic restorations, preventing unnecessary wear to occur and, as a result, the weakening of the dental structure. **Keywords:** Fluorescence. Dental cavity preparation. Dental restoration. Permanent.

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INTRODUCTION

The restorative treatment represents a large part of dental treatment performed in dental clinics. One of the most used restorative materials is the composite resin, mainly for its direct application and wide range of colors.[1-4]

The fluorescence is a characteristic of the material that allows the behavior of the composite resin against light to be similar to the behavior of dentin, making it even less noticeable the presence of the restoration.[5] However, during the visual inspection in the clinic, when exposed to light of the reflector, the distinction of the resin-tooth interface can become more difficult if the resin presents fluorescence similar to the tooth.[6]

The reasons for the replacement of aesthetic materials are usually complex because in addition to the causes of failure due to the person who is carrying out the task, some failures occur because the own restorative material and others as a result of the patient's habits that contributes to degradation of the restoration. The indiscriminate replacement of restorations leads to an increase in the dimensions of the cavity, with consequent weakening of the remaining tooth structure.[7] Therefore, more accurate methods to assist in the removal of esthetic restorations, in order to make this procedure less invasive, less time consuming and less destructive, have been increasingly needed in dental clinical practice.[8,9]

It has recently been introduced to the market a high speed turbine with auxiliary light (ultraviolet) which highlights the fluorescence of the restorative material in contrast to the dental structure, making it easier for the selective removal of the composite and reducing unnecessary damage that extend the prepared cavity. According to Takahashi et al. (2008), when the tooth structure and the composite resin restoration absorb ultraviolet light, they emit light waves visible in the blue spectrum. For this reason, when using this engine during removal of the restoration, the resin and the tooth will look blue, but blue intensity will vary according to the tooth and resin fluorescence.

Thus, the goal of this study was to evaluate the influence of a system of auxiliary light (ultraviolet and white light) attached to a high speed turbine in the cavity dimension after the replacement of class III restorations of composite resin comparing it to the use of conventional system with high speed turbine without light attached.

Methodology

Thirty-three artificial upper anterior teeth were mounted in a dental model and in a simulator head (Pronew, Rio de Janeiro, RJ). On each tooth, a class III Black cavity was made in the mesial side without making bevel (Fig 1). The cavities were prepared with vestibular access, using spherical diamond edges 1014 (KG Sorensen, Cotia, SP) mounted on a high-speed turbine and refrigerated with air/water spray

After cleaning and preparation of the cavity, the teeth were weighed on precision analytical scale (GH-202, A&D, Japan), precision of 0.0001g, and restored with composite resin, according to conventional adhesive technique. The cavities received application of adhesive system Single Bond 2 (3 m-ESPE, St. Paul, United States) in two layers, in 10 seconds, and the adhesive films were thinned with a blast of air, though keeping the shiny surface and afterwards they were photopolymerized with Radii-Cal (LED Radii, SDI, Australia, 1200 mW/cm^2) for 10 seconds. Then, the restorations were performed with the medium fluorescence resin Z250 (3M-ESPE, St. Paul, United States) in color A2, with the insertion of oblique increments of maximum thickness of 2 mm until restoration is complete. Each increment was photo-

Figure 1: Class III Cavities made in proximal sides of upper anterior teeth.

polymerized during 20 seconds. The excesses of resin were removed by scalpel blade number 11 and the surface of the restoration was polished with Enhance finishing rubbers (Dentsply, York, United States), so that there was no excess of material except for the edges of the cavity.

The restorations were removed with spherical diamond edge 1014 mounted on a high-speed turbine with air/water spray. The teeth were divided into three groups (N = 12), in accordance with the way of restorations removal: SL - conventional turbine without light (Aro Gnatus 32, Ribeirão Preto, SP), UV - ultraviolet light turbine attached (Cobra Ultra Vision System®, Gnatus, Ribeirão Preto, SP) - Figure 2 and with LED - white light attached (Cobra System PB Led, Gnatus, Ribeirão Preto, SP).

After the removal of restorations, teeth were again weighed on a precision analytical scale, in order to evaluate the difference in weight between the first and the second weighing, which means before and after removal of the restoration, in order to permit it to evaluate whether the use of ultraviolet light provides higher preservation of tooth structure during a procedure of restoration replacement.

The data obtained was submitted to Shapiro-Wilk statistic test and for presenting non-parametric distribution, was analyzed through Kruskal-Wallis test ($p < 0.05$) and Dunn test for multiple comparisons.

RESULTS

The results and comparisons between groups SL, UV and LED are represented in Table 1.

Figure2: Phase of removal of restorations using the auxiliary ultraviolet light system.

Table 1: Comparison of the medians of groups Without Light, LED and ultraviolet.

GROUPS	MEDIANS	COMPARISONS
Without light	0.001753	a
LED	-0.00144	b
Ultraviolet	-0.00241	b

* Different Letters are significantly different ($p < 0.05$). **Kruskal–Wallis ($p<0.05$).

There is statistically significant difference when comparing group SL with LED ($p = 0.03$), and SL with UV ($p = 0.004$). On the other hand, between groups LED and UV the difference was not significant.

DISCUSSION

The results of this study showed that SL group presented higher difference between the initial and the final weight after removal of restorations, indicating an additional tooth wear. However, negative facts for groups LED and UV show that the final weights were higher that the initial ones, that is, there was no complete removal of restorations, resulting in the presence of residual material in the cavity.

As the esthetic restorative materials must have fluorescence compatible with properties of natural teeth[10,11] in order to produce a camouflage effect, the restorations made with fluorescent composite resins may represent greater challenge in diagnosis because clinical visual-

ization becomes difficult during the conventional inspection procedure.[6,9,12-15] Maybe that's why SL group presented the biggest difference between the initial and final weight compared to other groups, indicating that there was a higher wear, thereby increasing the dimensions of the prepared cavity.

The search for better alternatives to the distinction of interface in adhesive restorations has increased nowadays. As a strategy, the use of ultraviolet light can be a useful technique to identify whether the resin composite was totally removed from the cavity.[9] This tool can be recommended because, in most cases, there is a noticeable contrast between the resin and tooth structure, which makes it possible to distinguish the materials clearly.[15] The results of this study showed that ultraviolet light prevented the excessive wear to occur; however, it can be observed, on the negative view, that the material was not completely removed.

The white LED light system, as well as the ultraviolet light auxiliary system attached, also guaranteed positive results though numerically lower than the ultraviolet light. A study comparing the fluorescence intensities emitted by different resin composites using quantitative technology of light-induced fluorescence demonstrated the contrast between the composite and the tooth were higher using Blue fluorescent light than for colors observed in images made with white light.[16] For this reason, the results suggest that the material in this study was most evident using ultraviolet light, thus removing the higher amount of restorative material, when compared to white light.

However, the quality in the removal of restorations depends on the experience of the person in charge and on his/her ability to work with the equipment available. That could justify the presence of restorative material on the cavities after removal with high-speed turbines with auxiliary light attached. Besides that, the ultraviolet light can identify more easily the difference in tooth/restoration fluorescence if the spotlight is off, making it difficult to have a perfect view of the bottom of the cavity. Another factor that may have influenced is that the auxiliary light is on only when the turbine is running. The cavity humidity caused by the air/spray water turbine also made it difficult to see the residual resin. One way to avoid this kind of issue would be to dry the cavity and with the spotlight on, apply the tip of an exploratory probe internally, in order to make the identification of the remaining composite resin easier.

One of the limitations of this study is that artificial teeth were used, which do not have compatible dental tissue fluorescence. On the other hand, these teeth allowed complete drying after removal of restorations, permitting reliable weighing results. Studies in this continuity are recommended, using natural teeth and resin-based composites with different levels of fluorescence in order to confirm benefits of using an auxiliary UV light system during removal of aesthetic restorations.

CONCLUSION

The use of systems with auxiliary light attached to high-speed turbine can benefit the dentist in the distinction of resin materials when replacing esthetic restorations, avoiding the occurrence of unnecessary wear and, as a consequence, the weakening of tooth structure.

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