Study of the resin removal efficiency using the traditional tungsten bur or a laser as an alternative for orthodontic treatments.

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Abstract

After bracket removal in orthodontic treatment with fixed appliances, the tooth surface presents some left over resin. These remains shall be removed, preventing the appearance of plaques and stains. The aim of this study is to analyze the efficiency of the use of a Er:YAG, Nd:YAG or CO_2 (superpulsed mode) laser for the in vitro resin removal in comparison to the removal promoted by the traditional tungsten burn. Brackets were glued to human premolar surface and then removed by traditional methods. After that, the samples were divided into four groups. Group I, was irradiated by Er:YAG laser under the following parameters: 60 mJ, 80 mJ, 100 mJ and 400mJ. Group II was irradiated by Nd:YAG laser, under the following parameters: 60 mJ, 80 mJ and 100 mJ. A single superpulse from the CO_2 laser was applied to Group III, under the following parameters: 5 J , 7 J and 9 J. Group IV represents the control group (not irradiated) where the residual resin was removed by the tungsten burn. The energies mentioned are the total energy applied to each specimen. All the samples were analyzed under the scanning electron microscope JSM-5900LV of the Laboratório de Microscopia Eletrônica (LME/LNLS), Campinas. The obtained results show that the Er:YAG laser did not promote the carbonization and fusion of the irradiated sample surface. Both Nd:YAG and CO_2 laser generated fusion of the irradiated surface, enamel and resin, but Nd:YAG laser generated fusion and carbonized regions. Group IV proved to be the most efficient in the removal of the residual resin. In all laser applications the appearance of craters were observed. The depth of these craters increases with the energy density of the applied laser beam.

Introduction

After brackets removal in orthodontic treatment with fixed appliances, the tooth surface presents some leftover resin. These remains shall be removed preventing the appearance of plaques and stains. The laser-tissue interaction has been an interesting research area for Dentistry in the past few years bringing a lot of advances for many treatment techniques. [1,2,3].

The aim of this study was to analyze the enamel surface after the removal of the resin by using an Er:YAG laser, a Nd:YAG laser, a CO_2 laser (superpulsed mode) or a tungsten bur.

Experimental Setup

Twelve human embedded premolars were used in this in vitro study and brackets were glued to their surfaces. After bracket removal by traditional methods, the samples were divided into four groups. Group 1 was irradiated by the Er:YAG laser with energy varying from 60 mJ to 400 mJ. Group 2 was irradiated by Nd:YAG laser under the following parameters: 60 mJ, 80 mJ and 100 mJ. A single superpulse from the CO_2 laser was applied to Group 3 with energies of 5 J , 7 J and 9 J. Group 4 was separated as a control group receiving no irradiation. Its residual resin was removed by a tungsten bur. Effects of surface melting, carbonization, and enamel or dentin invasion were analyzed under Scanning Electron Microscopy, at the Brazilian Synchrotron Light Laboratory (LNLS).

Results and Discussions

The results show that both Nd:YAG and CO_2 lasers generated fusion of the irradiated surfaces of the enamel and the dentin (Figs. 1 and 2). Group 2 also presented some carbonized tissue regions. No sign of carbonization or fusion was found on the ablated surface of Group 1. The tungsten bur applied to Group 4 proved to be the most efficient method for the removal of the residual resin (Fig. 3). The morphologies observed on the photomicrographs reveal some aspects of the interaction mechanisms of each laser wavelength with the orthodontic resin, as well as with the hard dental tissue.

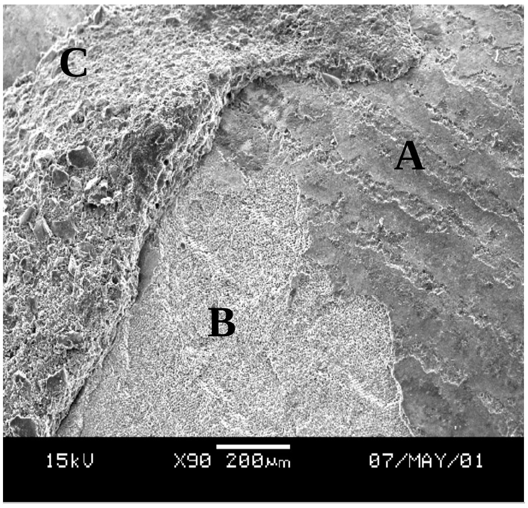


Figure 1: Sample irradiated by the Nd:YAG laser (100 mJ). Region A shows the intact enamel, B shows the irradiated one and C the leftover resin. (SEM 90 X)

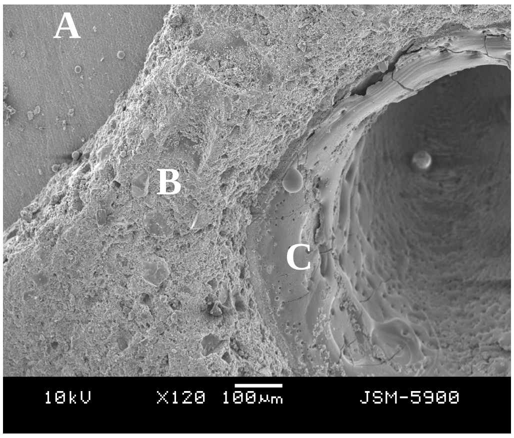


Figure 2: Sample irradiated by the CO_2 laser (7 J per pulse). Region A shows the intact enamel and B the intact leftover resin. The melted resin and enamel are shown in region C. (SEM 120 X)

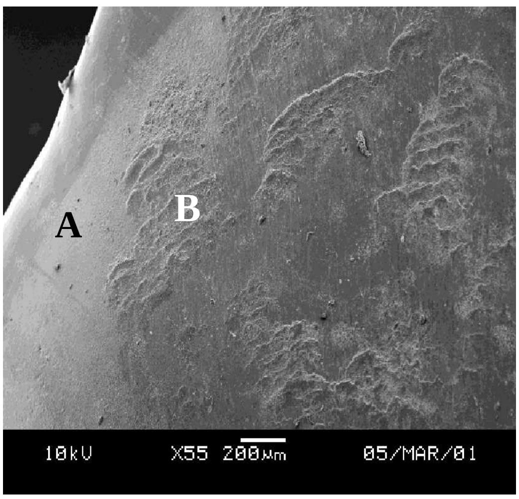


Figure 3: Control sample with leftover resin removed by a tungsten bur. Region A shows the intact enamel and B the removed leftover resin. (SEM 55 X)

The samples were submitted to Energy Dispersive Spectroscopy (EDS), to verify the precise elemental composition of materials on the melted regions. With these informations enamel, resin and dentin could be differentiated. In Graph 1, we can observe the EDS result for a resin region marked with a white square in Fig. 4.

The traditional method for the removal of the resin using the tungsten bur presented the most effective result for that application. The low capability of the laser radiation to act selectively only in the orthodontic resin may be pointed out as the barrier to use the laser in the proposed application.

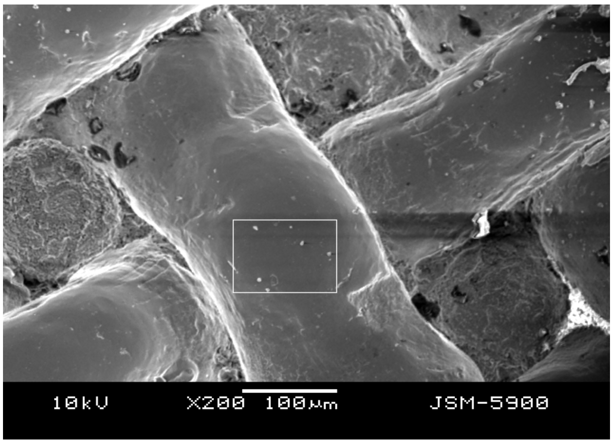
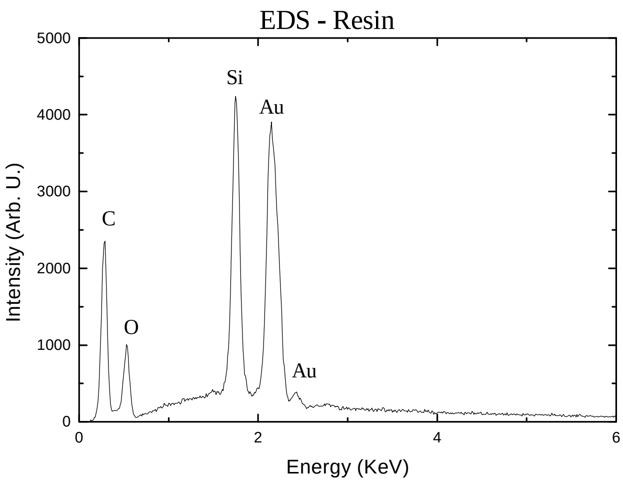


Figure 4: SEM photomicrograph of the leftover resin after the removal of the bracket. The white square represents the region submitted to the EDS analyzes. (200 X)



Graph 1: EDS analyzes of the leftover resin.

Conclusions

The traditional method for the removal of the resin using the tungsten bur presented the most effective result for that application. The low capability of the laser radiation to act selectively only in the orthodontic resin may be pointed out as the barrier to use the laser in the proposed application.

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