International
Laser Congress

Athens, Greece
25-28 September 1996

Microleakage in Class V composite resin restorations prepared conventionally and prepared with the Er:YAG laser

A. RAMOS, C.P. EDUARDO, E. TANJI
and D. ZENZELL *

Departamento de Dentística de Faculdade de Odontologia da Universidade de São Paulo (BR)
** Instituto de Pesquisas Energéticas e Nucleares (IPEN), São Paulo (BR)*

SUMMARY

This *in vitro* study aimed to examine the microleakage in Class V composite resin restoration prepared conventionally in comparison with those prepared by the Er:YAG Laser. Twelve human premolar teeth were divided into three groups. Group I was prepared with a conventional high-speed drill and etched with 35% phosphoric acid. Group II was prepared with Er:YAG Laser and etched with 35% phosphoric acid and Group III was prepared and etched only with the Er:YAG Laser. The cavity was restored with light cure composite resin (Z100 - 3M). The specimens were immersed in a 50% silver nitrate solution. They were sectioned and observed under optic microscopy. Leakage was observed in groups I, II and III. The results were analyzed with the Kruskal-Wallis test and their comparison showed no significant differences ($p > 0.05$) among the groups.

INTRODUCTION

The technology of composite resin has improved a lot since the introduction of the acid conditioning technique, a concept originally proposed by BUONOCORE[1] in 1955, who studied the use of acid in providing an enamel surface more appropriate for adhesion.

One of the greatest problems of Restorative Dentistry is the lack of adhesion between the restorative materials and the mineralized tissues, which can cause profuse microleakage at the tooth restorative interface.

According to CARVALHO et al.[2] (1996) in a cavity preparation restored with adhesive systems and resin composites, the marginal integrity of the restoration is limited by the weakest bond. The contraction stresses that develop during polymerization of the resin may cause rupture of cementum bond which is usually weaker than enamel bonds. This may permit bacteria to colonize the dentin surface and shed products into the dentin that may irritate the pulp.

KUMAZAKI[4] (1994), reported that the Er:YAG laser is a promising means for preparing cavities. The wavelength of 2.94 μm emitted by this laser is absorbed by water in such way as to transform it instantaneously into vapor, producing a pressure high enough to allow the ablation process to cut the tooth easily.

According to FRENTZEN and KOORT[3] (1992), this radiation is also absorbed by the hydroxyapatite which is present in the enamel and dentin, thus producing ablation of this hard dental tissue.

The purpose of this paper was to compare the level of microleakage in Class V composite resin restorations prepared conventionally with those prepared and etched with the Er:YAG laser

MATERIALS AND METHODS

Twelve human pre-molar teeth, recently extracted, and properly stored in a 0.9% NaCl solution were equally divided into 3 groups for Class V composite resin restoration, with an approximate depth of 1 mm at the dentinoenamel junction, 4 mm in width and 2 mm in height.

Group I was prepared conventionally with a high speed diamond burr # 1090 drill and the final preparation of the cavity surface was done with the same

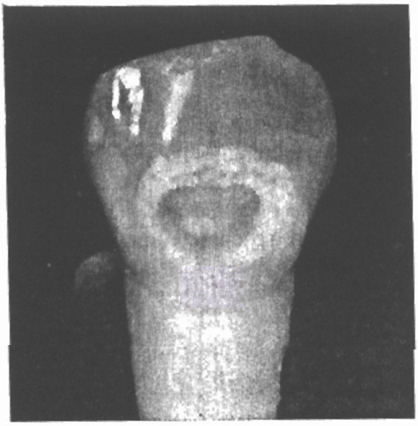

Fig. 1. Cavity prepared and etched with the Er:YAG Laser.

drill but at a low speed. The cavosurface bevel was done with a diamond burr # 1012 and the entire preparation etched with 35% phosphoric acid for 15 seconds. In group II, the cavity and the enamel cavosurface were prepared with the Er:YAG laser and afterwards, were etched with 35% phosphoric acid for 15 seconds. Group III was prepared with the Er:YAG laser and the enamel cavosurface and the dentin were etched with the laser (Fig. 1).

The laser used in the present study for cavity prepartion and dental tissue etching was the Er:YAG laser (KaVo KEY 2), at a wavelength of 2.94 μm and a pulse duration of 250-500 μs. The preparation of the cavities was done with a focused laser light, with an energy of 400 mJ, a frequency of 6 Hz and an energy density of 56.43 J/cm^2. For the preparation of the enamel cavosurface of groups II and III, a focused laser light was used with the energy reduced to 60 mJ, the frequency increased to 10 Hz and an energy density of 8.46 J/cm^2.

All Classe V restorations were restored by the increment technique with Z100 (3M), color A 3.5, following the application of the adhesive system Scotchbond Multi Use plus (3M). After restoration, the specimens were stored for 7 days in distilled water and all the restorations were polished with Sof-Lex (3M) disks. For the effect of ageing the restorations, the specimens were thermally stressed for a total of approximately 700 cycles, at temperatures of 5° C and 55° C. Afterwards, the specimens were made impermeable with a cosmetic red enamel layer applied over the entire surface, except on the area of the restoration and on the surrounding areas.

In order to observe the interface of the tooth-restoration, the specimens were immersed in a 50% silver nitrate solution for 8 hours, in the absence of light. They were embedded in acrilic resin tubes and sectioned in a vertical plane with the Isomet saw. The samples were exposed to a light of 250 W, *Photoflood* (G.E.) for 5 minutes, in order to reveal the silver nitrate. The specimens were observed under an optic microscope in a double blind situation by 3 different examiners who were unaware of the 3 types of preparations of the specimens, and unaware of the results of the other examiners.

The level of microleakage was classified following the criteria proposed by RETIEF et al.[5] (1982): 0= no microleakage; 1= microleakage up to dentinoenamel junction; 2= microleakage reaching lateral wall; 3= microleakage reaching axial wall.

The results were analysed under Friedman and Kruskal-Wallis statistical tests.

RESULTS AND CONCLUSION

The Friedman test verified that there was agreement among the examiners; then, the levels most frequently stated among examiners (table 1) were submitted

TABLE 1. Evaluation of the microleakage in Class V composite resin restorations. (Level most frequency stated among examiners).

Sepecimen	Group I High speed + acid	Group II Er:YAG + acid	Group III Er:YAG
1	2	1	1
2	0	0	1
3	2	2	1
4	0	3	1

0 = no microleakage; **1** = microleakage up to dentinoenamel junction; **2** = microleakage reaching lateral wall and **3** = microleakage reaching axial wall.

to the Kruskal-Wallis non-parametric test, verifying that there were no significant differences *($p > 0.05$)* among the three groups.

Despite the theoretical possibility of the laser facilitating retention, no reduction in microleakage was observed in the samples prepared conventionally or in those prepared with the Er:YAG laser (Fig. 2, 3 and 4). However, it should be noted in table 1 that there were lower values of microleakage in the group prepared and etched with the Er:YAG laser. (group 3), with more homogeneous results. This suggests that the Er:YAG laser is a viable means for preparing Class V cavities.

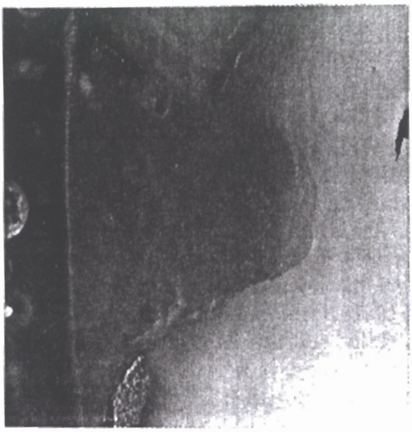

Fig. 2. Group I - Microleakage reaching lateral wall.

However, further studies with a greater number of samples are necessary in order to verify whether there is a difference in the levels of microleakage in the cavities prepared with the Er:YAG laser.

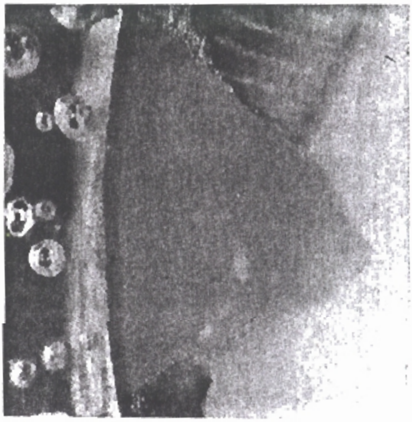

Fig. 3. Group II - Microleakage up to dentinoenamel junction.

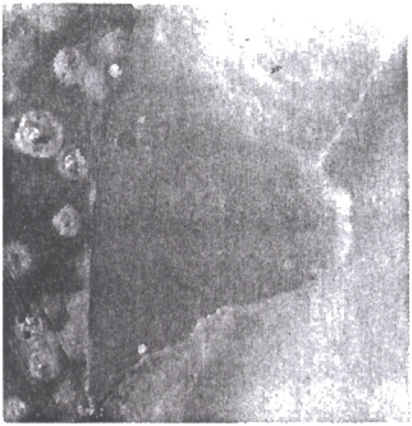

Fig. 4. Group III - Microleakage up to dentinoenamel junction.

ACKNOWLEDGEMENTS

This study was partially supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and 3M of Brazil.

REFERENCES

1.BUONOCORE, M. G. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. **J Dent Res**, 34, p. 849-853, 1955.

2.CARVALHO, R. M.; PEREIRA, J. C.; YOSHIAMA, M.; PASHLEY, D. H. A review of polymerization contraction: The influence of stress development versus stress relief. **Operative Dentistry**, 21, p. 17-24, 1996.

3.FRENTZEN, M.; KOORT, H. J. Histological investigation of mid infrared laser ablation of dental hard tissues.In: International Congress on Lasers in Dentistry, 3. Salt Lake City, Aug. 6-8, 1992. **Proceedings**. s.1. International Society of Laser in Dentistry, p. 243-244, 1992.

4.KUMAZAKI, M. Removal of hard dental tissue (cavity preparation) with the Er:YAG Laser. In: International Congress on Lasers in Dentistry, 4. Singapore, Aug. 6-10, 1994. **Proceedings**. s.1. International Society of Laser in Dentistry, p.151-157, 1994.

5.RETIEF, D. H.; WOODS, E. JAMESON, H. C. Effect of cavosurface treatment on marginal leakage in Class V composite resin restorations. **J Prosth Dent**, v. 47, n. 5, p. 496-501, May, 1982.