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Optimizing the treatment of dental caries with laser Er Cr: YSGG 2,790 nm (WaterLase Biolase USA)

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ABSTRACT

Introduction. The increase in the prevalence of dental caries associated with the anxiety reaction of patients for the dental office have led to the emergence of modern, non-invasive and painless methods for the treatment of dental caries. The dental laser is one of these solutions.

Case presentation. The 27-year-old patient presented multiple simple untreated medium and deep cervical carious lesions at 2.2, 3.3, 4.3, marginal secondary caries at 1.1, 2.1, root debris 3.6,4.6. The patient's age and increased carious activity were a reason for instituting a treatment as minimally invasive as possible, while maintaining as much dental vitality as possible and performing reconstructions that can be easily corrected and monitored. We opted for the treatment of caries with Er Cr: YSGG laser (erbium, chrome: yttrium – scandium – gallium – garnet) 2,790 nm and restoration with composite materials and direct restoration techniques. In this way, aesthetic and resistant restorations were obtained which have the advantages related to the performance of the laser working technique, such as increasing the resistance of the dental structures to acid attack and eliminating the risk of secondary caries. Although the duration of the sessions was longer, the patient accepted this solution to overcome her fear of the dental office.

Conclusions. Er Cr: YSGG 2,790 nm laser is a viable alternative for the surgical stage of dental caries treatment ensuring a tissue substrate more resistant to secondary caries and being much more easily tolerated by patients.

Keywords: Er Cr laser: YSGG, tooth decay, composites

INTRODUCTION

Dental caries is a multifactorial, dynamic disease, mediated by biofilm and diet, which results in the loss of minerals from the dental hard tissues [1].

Dental caries is determined by biological, behavioral, psychosocial and environmental factors [2].

The surgical treatment of dental caries has undergone a number of changes over the years. Mechanical drilling with cutters and hand tools produces residual dentinal smear layer that impedes the adhesion process but also some inconvenience to patients (anxiety or pain).

To reduce these drawbacks, advanced treatment methods using laser or ultrasound have been used. The application of laser in dentistry has been a research interest for the last 30 years but has recently grown in popularity. Laser irradiation of hard dental tissue alters the calcium / phosphate ratio and leads to the formation of more stable and less soluble compounds in acid, thus reducing the susceptibility to acid and caries attacks [3].

The erbium laser is used effectively to remove cavities from both enamel and dentin, without causing thermal changes in the tissue of the underlying vital pulp. It can also ablate restorations with glass ionomer and composite resins [4].

Er Cr: YSGG 2740 nm (WaterLase Biolase USA) laser works by evaporating hard tissues. There is no contact with the tooth, there is no frictional force and therefore the heat dissipated in the tissue is minimal and no pain occurs during the operation.

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CLINICAL CASE PRESENTATION

The 27-year-old patient presented for consultation and the establishment of a specialized treatment. She presented multiple simple, medium and deep carious lesions, treated and untreated, marginal secondary caries at 1.1, 2.1. The patient's age and increased carious activity were a reason for instituting a less invasive treatment, while maintaining as much dental vitality as possible, performing reconstructions that can be easily corrected and monitored.

At the clinical examination, carious dental lesions were found at the cervical level at 1.3, 1.2, 2.4, 4.4, deep carious lesions at 2.2, 3.3, 4.3, recurrent carious lesions at 1.1 and 1.2 both mesially and distally, but also marginal lesions cervical at the level of existing fillings. 3.6 and 4.6 are root residues that required extraction (fig. 1). Vitality tests were positive on all teeth with the aforementioned lesions. The patient's symptomatic picture was devoid of painful episodes, edema, dental fistulas. The percussion in the shaft was negative.

A radiological examination was performed which was correlated with the clinical examination, necessary for the establishment of a diagnosis and a correct treatment plan and accepted by the patient (Fig. 2).

FIGURE 1. *Clinical examination – initial appearance*

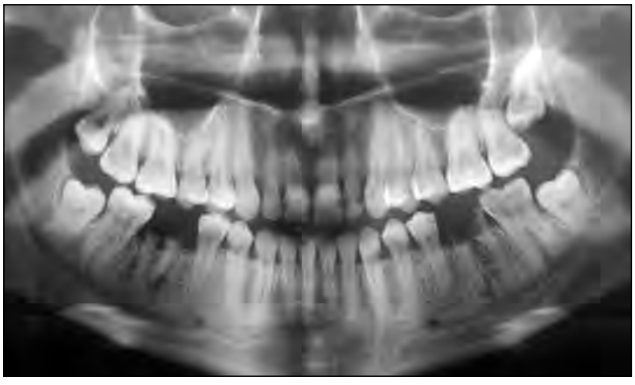

FIGURE 2. *X-ray examination*

Periodontal examination showed the presence of gingival retractions. No dental tartar is present, hygiene is correct without bacterial plaque.

The occlusal examination shows a normal occlusion without changes, class I Angle at the posterior level. The guide is a group one, made within physiological limits. At the anterior level there is reverse gear at the level of the upper lateral incisors, and end to end at level 1.1 with 4.1-4.2. This gear and the gingival retractions determined the appearance of dental caries with root location as well as cervical abrasion lesions. We could also include the structural genetic factor in the anamnestic details of the patient.

TREATMENT PLAN

The use of the laser to ablate the altered dental tissue made the anesthesia procedure unnecessary, thus facilitating the permanent control of the depth of the lesion by correlating it with the patient's painful symptoms during the operations.

The altered dental tissue of the caries was removed with the help of the Er, Cr: YSGG 2,740 nm laser to increase the resistance of the enamel to the cariogenic attack, at the end coronary restorations were made by direct veneering technique for a superior aesthetic appearance. The treatment, which was divided into two sessions, began with injuries to the jaw and then to the mandible.

THERAPEUTIC PROTOCOL

After setting the color, the operator field was highlighted with Optragate (Ivoclar Vivadent). Caries for cleaning decayed tissues and old fillings with the Er Cr: YSGG (WaterLase Biolase USA) laser were performed.

Working parameters used:

- H mode
- Turbo piece
- Turbo type
- Working distance 3-4 mm
- Power: 5.5 W in enamel areas and 4-4.5 W in deep dentin areas
- Frequency 25 Hz
- Water 40%-35%
- Air 40%

FIGURE 3. *Er Cr: YSGG laser (WaterLase – Biolase USA) with working parameters set in the case described*

After complete removal of the affected tissue, gingival eviction thread was inserted (Fig. 4).

FIGURE 4. *Final appearance of the preparation*

At level 2.2 the cavity resulting from the preparation has a major profile, without the dental pulp being affected at that time. At the level of the cavity in the deepest area is highlighted the reaction dentin deposited with hard glassy consistency. The dentin wound was decontaminated with the Epic Biolase diode laser (940 nm) using a 3 mm, non-contact type for 3 minutes. It was then applied with a special MTA paste injection device as a basic filling, then Vitrebond liner. We opted for a double pulp protection in this situation, in order to have a superior control over the preservation of vitality at this level. In the deep cavities it was used as a basic liner Virebond liner (3M ESPE). The 7th generation adhesive system Adhese One F (Ivoclar Vivadent) was applied with special tips, then light-cured.

At level 1.1 and 2.1, there were old cervical restorations. These were partially removed with the Er Cr: YSGG laser, because during the preparation a good deep integration was found and only the surface degradation. Marginal infiltrations were eliminated (Fig. 5).

FIGURE 5. *The frontal aspect of the old cervical fillings after the partial ablation*

The stratification of the composite for direct veneering began with the deepest areas, with dentin-type composite.

The 2 mm thick composite was applied and then light curing was performed. Dentin was applied until the color defects were completely covered over the entire coronary surface. Over the dentin type composite layer was added the enamel type composite, from the cervical level where the shade A2 was applied, opening the color to the incisal, where the shade A1 was applied. Dentin was not added at the incisal level, according to morphology. The stratification of the enamel-type composite started with the central central area, on each element, then photopolymerized, following the proximal areas, reconstructed with the help of celluloid matrices. Photopolymerization was done through these matrices. At the end, a light curing was done on the entire field of work. Occlusal adaptation was checked with articulation paper, in propulsion, laterality. Premature interference and contact with fine-grained pear-shaped diamond cutters has been removed. Interproximal areas were finished with interdental abrasive strips. Sof-Lex abrasive discs were used to finish the vestibular faces. Gum and cotton filaments were used for polishing, obtaining a satisfactory final appearance (Fig. 6).

At the mandibular level, the cavities were prepared at the level of the package, respecting the previous protocol and the restoration was performed with fillings of the same composite (Fig. 7).

FIGURE 6. *Direct veneers made at the maxillary level – Final appearance*

Subsequently, root residues 3.6, 4.6 were extracted and implants were applied.

FIGURE 7. *Final appearance with direct composite veneers*

The case will be monitored and direct reconstructions can be replaced with ceramic veneers after reducing the cariogenic potential and preserving the dental structures.

DISCUSSIONS

The use of laser, in addition to the benefit of minimally invasive therapy, has multiple advantages.

Thus, studies show that the use of the Er Cr: YSGG 2,790 nm laser increases the resistance of the enamel to the action of acids, thus reducing the risk of secondary caries. This may lead to the conclusion that one of the indications for its use would be patients at high risk of caries [5].

In general, the enamel surfaces irradiated with the Er Cr: YSGG 2,790 nm laser do not show evidence of carbonization, in the end the surface obtained is flat, rough. The enamel does not show additional microfractures because the vibration characteristic of mechanical therapy does not occur [6].

It should be noted, however, that it is very important to set all parameters that can increase or decrease the absorption of water and hydroxyapatite and thus reduce the negative effects of the laser ablative process (power, fiber diameter, pulse rate, amount of water and air used).

The direct adhesive technique requires acid demineralization at the level of the enamel for an ideal adhesion. Using the Er Cr: YSGG 2,790 nm laser produces the enamel surface configuration to ensure a good connection to this interface. Studies have shown that there is no statistically significant difference between laser enamel demineralization and acid etching. Laser enamel irradiation does not interfere with the performance of 2-step etch-and-rinse systems and universal adhesives [7].

However, Baygin et al. showed that laser irradiation with Er Cr: YSGG (2 W, 20 Hz or 2 W, 40 Hz) did not eliminate the need for acid etching and negatively influenced the marginal sealing, with the appearance of marginal microinfiltrations [8].

The dentinal surface does not show signs of melting or carbonization, it has open dentinal canals and the absence of the state of smear layer [9].

The absence of smear layer could lead to the use of new adhesive systems in the treatment of carious lesions.

The ablation of infected dental tissues by using erbium lasers with wavelength specific to these treatments is superior in that they significantly reduce the use of local anesthetics, making possible treatments in situations where anesthetic procedures are prohibited or limited. Symptomatic pain control during ablative maneuvers may make it safer to preserve pulpal vitality [10].

The results of the studies showed that the elimination of carious tissues with the Er: YAG laser is

not accompanied by bacterial contamination and seems to be an effective way of treatment without causing excessive temperatures, which could negatively affect the vitality of the pulp [11,12].

There is also less post-treatment sensitivity in Er: YAG laser-treated teeth compared to traditional cavity preparation methods. Lasers can also treat hypersensitive root surfaces with minimal invasiveness, demonstrating effective results [13].

Although some authors believe that there is insufficient evidence to show that laser light removal of cavities is more effective than traditional mechanical technique, they have shown that the technique has safe advantages, related to pain control, the need for anesthesia and patient comfort [14].

CONCLUSIONS

Er Cr: YSGG 2,790 nm lasers are a valuable state-of-the-art tool that has been shown to be effective in eliminating carious lesions. They have advantages over the classic method, which include increasing the strength of dental structures by reducing the occurrence of secondary caries, lack of cracks in the enamel and detritus in the teeth. The treatment of deep caries can be done by preserving the dental vitality and facilitating the reaction dentin deposition at the level of the dental pulp.

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