ABSTRACT

Purpose: This in vitro study was conducted in order to assess using optical microscopy the apical sealing in Nd:YAG laser irradiated root canals in comparison with the conventional treatment method. Material and Methods: 34 extracted teeth with one straight root canal, closed apices and extracted for periodontal reasons were used in this study. All teeth had the root canals biomechanically instrumented at an apical size 30 and .06 taper. The root canals were irrigated with 2 ml 2.5% NaOCl solution. The teeth were divided in two study groups, each of 17 teeth: group A, Nd:YAG laser irradiation after the biomechanical preparation and group B, only biomechanical preparation. The laser irradiation was performed using an Nd:YAG laser (Fidelis Plus II; Fotona d.d., Slovenia; optical fiber of 250 micrometers) and the following parameters: 1.5 W, 15 Hz, 3 exposures/procedure. All roots were filled with AH Plus endodontic sealer and gutta-percha points, using cold lateral condensation and vertical compaction techniques. The samples were then stored in 100% humidity, at 37°C for 24 hours and then embedded in acrylic resin using specially designed cylindrical conformators. For each sample 6 examinations were performed from the apex to 3 mm in coronal direction, by slicing 0.5 mm after each examination. The microscopic examination performed using an optical metallographic microscope, in both reflected and polarized light. Results: The microscopic examination evidenced the presence of voids inside the root canal, microleakage areas being detected between the root canal sealer and the dentine root canal wall, but also at the gutta-percha – sealer interface, mostly in the group where only conventional biomechanical preparation of root canal was performed. Conclusions: The results of this study demonstrated a reduction of microleakage in the apical area when using Nd:YAG laser irradiation in combination with the conventional biomechanical root canal preparation.

Key words: Nd:YAG laser, apical microleakage, root canal, microscopic investigation.

INTRODUCTION

In endodontics, the quality of the root canal filling is the result of the root canal cleaning and shaping, leading to the prevention of leakage.1-3 The process of cleaning and shaping, so called biomechanical preparation, determines the degree of disinfection and the ability to seal the root canal space. There are several authors that have demonstrated the ability of different wavelengths to significantly reduce microbiological populations growing in the root canal system. The Nd:YAG laser was one of the first laser devices applied for this purpose.4-7 There are many reports in which...
the reduction of apical leakage after laser irradiation of root canals was discussed.\textsuperscript{1-3} The occurrence of apical microleakage has been studied in several previous techniques such as dye penetration\textsuperscript{8-10}, but also with the aid of methods based on air pressure\textsuperscript{11} and fluid transport\textsuperscript{12-14}, bacterial microleakage\textsuperscript{15}, electrochemical leakage\textsuperscript{16} and radioisotopes.\textsuperscript{17} In a recent study, Todea et al\textsuperscript{4} used the en-face OCT as non-invasive method to investigate the apical microleakage.

The purpose of this in vitro study was to investigate using the optical microscopy the quality of the root canal filling after Nd:YAG laser-assisted endodontic treatment in comparison with the conventional treatment method.

MATERIALS AND METHODS

Thirty extracted teeth were used in this study. The teeth had all one straight root canal, closed apices and were extracted for periodontal reasons. After cleaning, all teeth underwent a careful microscopic examination (OPMI Pico/Zeiss) in order to exclude those with visually undetectable cracks. The working length was established 1 mm short of the apex and afterwards all teeth had the root canals biomechanically instrumented using the ProTaper system (Dentsply, Maillefer, Ballaigues, Switzerland) and Crown-down sequential technique to the working length at an apical size 30 and .06 taper. The root canals were irrigated with 2 ml 2.5\% NaOCl solution. After the biomechanical preparation, the root canals were irrigated with 10 ml 17\% EDTA (pH 7.7) and 10 ml 2.5\% NaOCl solution and then dried using .06 tapered paper points (Roeko GmbH, Langenau, Germany). The teeth were then divided in two study groups, each of 15 teeth: group A, which received Nd:YAG laser irradiation after the biomechanical preparation and group B, in which only the biomechanical preparation was performed. The laser source was represented by an Nd:YAG laser (Fidelis Plus II; Fotona d.d., Slovenia; optical fiber of 250 micrometers) (Fig. 1) and the irradiation procedure was performed according to the working protocol (VSP mode 1.5 W, 15 Hz, 3 exposures/procedure) established by previous studies.\textsuperscript{18}

All roots were filled with AH Plus endodontic sealer and gutta-percha points. For each sample filing, cold lateral condensation and vertical compaction techniques were applied. The samples were then stored in 100\% humidity, at 37°C for 72 hours, to allow the sealer to set. After complete setting of sealer, the samples were embedded in acrylic resin using specially designed cylindrical conformators. For each sample 6 examinations were performed from the apex to 3 mm in coronal direction, by slicing 0.5 mm after each examination. The microscopic examination was performed using an optical metallographic microscope (Olympus® BX51M) (Fig. 2), in both reflected and polarized light. The image acquisition was done with a digital camera (Olympus® Color View IIIu).
RESULTS

The microscopic examination evidenced the presence of voids inside the root canal, microleakage areas being detected between the root canal sealer and the dentine root canal wall, but also at the gutta-percha sealer interface (Fig. 3). Less defects were noticed in the group were conventional biomechanical preparation of root canal was performed in combination with Nd:YAG laser irradiation (Fig. 4).

DISCUSSIONS

The present study was conducted in order to assess the quality of the root canal filling after Nd:YAG irradiation in comparison to the conventional treatment method. The adhesion depends on a multitude of interacting factors including the surface energy of the adherent (dentine or gutta-percha), the surface tension of the adhesive (sealer), the adhesive’s ability to wet the surfaces and the cleanliness of the adherent surface. Previous studies reported by Gutknecht, showed complete removal of smear layer and closed dentinal tubules through inorganic melting due to Nd:YAG laser application with settings of 15Hz/ 1.5W. According to Moritz et al, because of the physical conditions present in a tooth, the Nd:YAG and the diode laser are not absorbed in the hard dental substances and are thus able to be effective in the deep layers. Our results showed greater defects when using only conventional treatment. However, we also found voids inside the sealer which may be attributed to the sealer’s properties or to the aeric inclusions accumulated during its insertion inside the root canal.

CONCLUSION

The results of this study demonstrated the ability of the Nd:YAG laser in reducing the apical microleakage, subsequently improving the success rate of the endodontic treatment as compared to conventional method.

REFERENCES

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