Apicoectomy using Er:YAG laser—a clinical study

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Abstract

Surgical endodontics was performed using an Er:YAG laser on 23 patients (4 males, 19 females) exhibiting periapical pathosis. After mucoperiosteal flap reflection, osteotomy was performed over the lesion using a low-speed dental engine with a round bur (#6–8). Root-end resection was then performed using an Er:YAG laser (100 mJ, 10 pps) with copious saline coolant. The root apex cavity for the retrograde root canal filling was prepared using either an ultrasonic device or Er:YAG laser. The clinical condition of the patients was evaluated at 1 week, 1 month, and 3 months after surgery. The mean irradiation time (± S.D.) for apicoectomy using the Er:YAG laser was 123.9 ± 113.2 s. No adverse reactions were seen during the laser irradiation procedure, and no harmful sequelae were observed during the follow-up periods. It is concluded that apicoectomy using the Er:YAG laser would be both safe and practical. However, improvement of the laser device to limit the operation time would offer considerable advantages.

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1. Introduction

While various types of lasers have been advocated for use in the dental clinic, the Er:YAG laser is promising in its ability to ablate dental hard tissues, since its wavelength of 2.94 µm coincides with the main absorption peak of light in enamel and dentin as well as in water. In 1989, Hibst and Keller [1,2] demonstrated that the Er:YAG laser could ablate dental hard tissues effectively without causing thermal injury to the surrounding...
tissues. Since then, the Er:YAG laser has had various dental applications, most notably for the removal of dental caries [3].

We have previously shown the application of the Er:YAG laser to apicoectomy in vitro [4,5]. However, few studies have reported on the clinical application of the Er:YAG laser in this respect. The current study was designed to examine the utility of the Er:YAG laser for apicoectomy in the clinical setting.

2. Materials and methods

Twenty-three patients (4 males and 19 females) exhibiting periapical pathosis and requiring apicoectomy participated in the study. Informed consent was obtained from those subjects for whom the use of the Er:YAG laser was proposed. Preoperative examinations, including roentgenography, were performed before periradicular surgery at the Dental Hospital of the Tokyo Medical and Dental University. After local anesthesia and reflection of a mucoperiosteal flap, all procedures were performed as microsurgery. Osteotomy was performed over the periapical lesion using a low-speed dental engine with a round bur (#6–8), and inflammatory soft tissue located around the root apex, including radicular granulomas and cysts, was removed. Root apices were resected using an Er:YAG laser prototype (Morita, Kyoto, Japan) with copious saline coolant. The laser beam was collimated through a flat-end contact tip (Morita) at 100 mJ, 10 pps, and the working time was measured. Root–apex cavities were prepared for the retrograde root canal filling using either an ultrasonic device (Device:Piezon master 400, Shofu, Kyoto, Japan, Ultrasonc retrotip: CT1, EIE/Analytic ) or an Er:YAG laser. Super EBA cement (Stailine, Staident, Middlesex, England) was invariably used as a filling material. Finally, the flap was repositioned and sutured. At 1 week, 1 month, and 3 months after surgery, periapical radiographs were taken, and any clinical signs or symptoms, when present, were recorded. These included spontaneous pain and discomfort, tenderness of the apicoected tooth to percussion, and appearance of swelling.

3. Results

The Er:YAG laser was safely and successfully used in all cases, and the required irradiation time for apicoectomy was $123.9 \pm 113.2$ s (mean \pm S.D.). No adverse reactions were seen during the laser irradiation, and visual examination of the root surface and surrounding tissues confirmed that there was no carbonization of these tissues. In most cases, patients exhibited no or minimal discomfort during and after the operation.

4. Discussion

During the apicoectomy procedure, 3 mm of the root tip is invariably resected perpendicular to the long axis of the root using an air turbine or micromotor. Patients sometimes feel uncomfortable during this procedure, due to the noise of the turbine or
vibrations from the instruments. Moreover, aerosol-producing handpieces cause concerns about infection control. Keller and Hibst [3] previously showed that the Er:YAG laser could be employed for caries removal and cavity preparation in an acceptable preparation time and with minimal patient discomfort. The advantages of using the Er:YAG laser for apicoectomy procedures would be the absence of uncomfortable vibration, less risk of trauma to the adjacent tissues, and decreased risk of cross-contamination compared with conventional methods. From the present results, it is concluded that apicoectomy by Er:YAG laser is both safe and practical. However, results of an in vitro preliminary study suggested that cutting with the Er:YAG laser required significantly more time than was required with a dental micromotor [4], and some improvement in laser equipment would be required to overcome this.

References