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CASE REPORT

Er:YAG laser application for removal of keratosis using topical anesthesia

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Abstract Fear of needle injection is one of the most common problems to affect dental procedures. The patient in this study was a 59-year-old man with contributory medical problems and smoking habits. An Er:YAG laser was used for biopsy of the right buccal tissue and tongue under topical anesthesia (Benzocaine 20%) for 1 minute without needle injection. During laser treatment, only slight bleeding occurred, eliminating the need for suturing. Histopathological examination revealed squamous cell hyperplasia without dysplasia and chronic inflammatory cell infiltration, and shrinkage and crush cells in the cutting margin. Postoperative advantages included lack of swelling, bleeding, and pain, and good wound healing.

Introduction

Oral surgeons have used several different laser wavelengths during oral surgery. The Er:YAG laser (2940 nm) is widely recognized in the field of medical lasers and can be used for ablation of lesions and excision biopsies.[1] It displays several advantages over other lasers including high incision quality, improved coagulation properties, and postoperative benefits for the surgeon and patient.[2]

In dental clinical procedures, many patients are fearful of injections because of painful and traumatic experiences. Therefore, dentists have widely used topical anesthesia to reduce the pain associated with needlestick procedures.

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The Er:YAG laser provides a safe and effective clinical method for the removal of lesions, and can be used with topical anesthesia without the need for needlestick local anesthesia.[3]

In this case report, we provide preliminary information on the clinical effects of the Er:YAG laser on oral soft tissues during oral biopsy, and describe wound-healing characteristics following laser surgery. We present histological evaluations and report the effectiveness of needleless anesthesia obtained from the topical application of benzocaine 20%.

Case presentation

A 59-year-old man was referred to the Zuoying Armed Forces General Hospital from a dental clinic. His chief complaint was keratotic tissues in the right buccal and tongue area for several months. Oral examination revealed that the patient was completely edentulous and his right buccal mucosa showed a nodular and thickened bulge (6 mm × 7 mm). The patient's tongue displayed a rigid round lump (2.5 mm × 2.5 mm) and was severely restricted in movement (Fig. 1A and B). On medical examination, the patient was diagnosed as having diabetes with neurological manifestations (noninsulin-dependent type II), essential hypertension, and hypertrophy (benign) of the prostate. The patient also had smoking habits.

Pre-operatively, a topical anesthetic gel (benzocaine 20%) was applied to the target areas for 1 minute. Biopsy of the right buccal mucosa and tongue was performed using an Er:YAG laser (LiteTouch, Syneron, 2940 nm wavelength, Yokneam Elite, Israel) and the laser settings were as follows: (a) laser energy, 150 mJ; (b) pulse frequency, 35 Hz; (c) tip diameter-length, 0.6—17 mm; (d) distance to target, light contact; (e) tip angle, 60°; (f) water level, 62.5%. The biopsy was then examined by a pathologist to confirm the diagnosis. To minimize bleeding, the Er:YAG laser was irradiated using the following settings: (a) laser energy, 50 mJ; (b) pulse frequency, 10 Hz; (c) tip diameter-length, 1.3—19 mm; (d) distance to target, light contact; (e) tip angle, 60°; (f) water level, 0% to facilitate coagulation (Fig. 1C—F). Using these laser settings, it was possible to cut quickly and painlessly while minimizing bleeding; therefore, suturing and local injection were not needed.

Histopathological examination revealed the mild keratinization of the superficial squamous epithelium, associated with squamous cell hyperplasia without dysplasia and chronic inflammatory cell infiltration (Fig. 2). The pathological diagnosis of the right buccal lesion was a fibroepithelial polyp and that of the tongue lesion was hyperkeratosis. Postbiopsy, the healing process was painless and proceeded uneventfully. Healing was satisfactory after 10 days. Six months later, no new lesions had formed on the buccal mucosa and tongue area (Fig. 1G—L). The lesion had reduced significantly compared to its

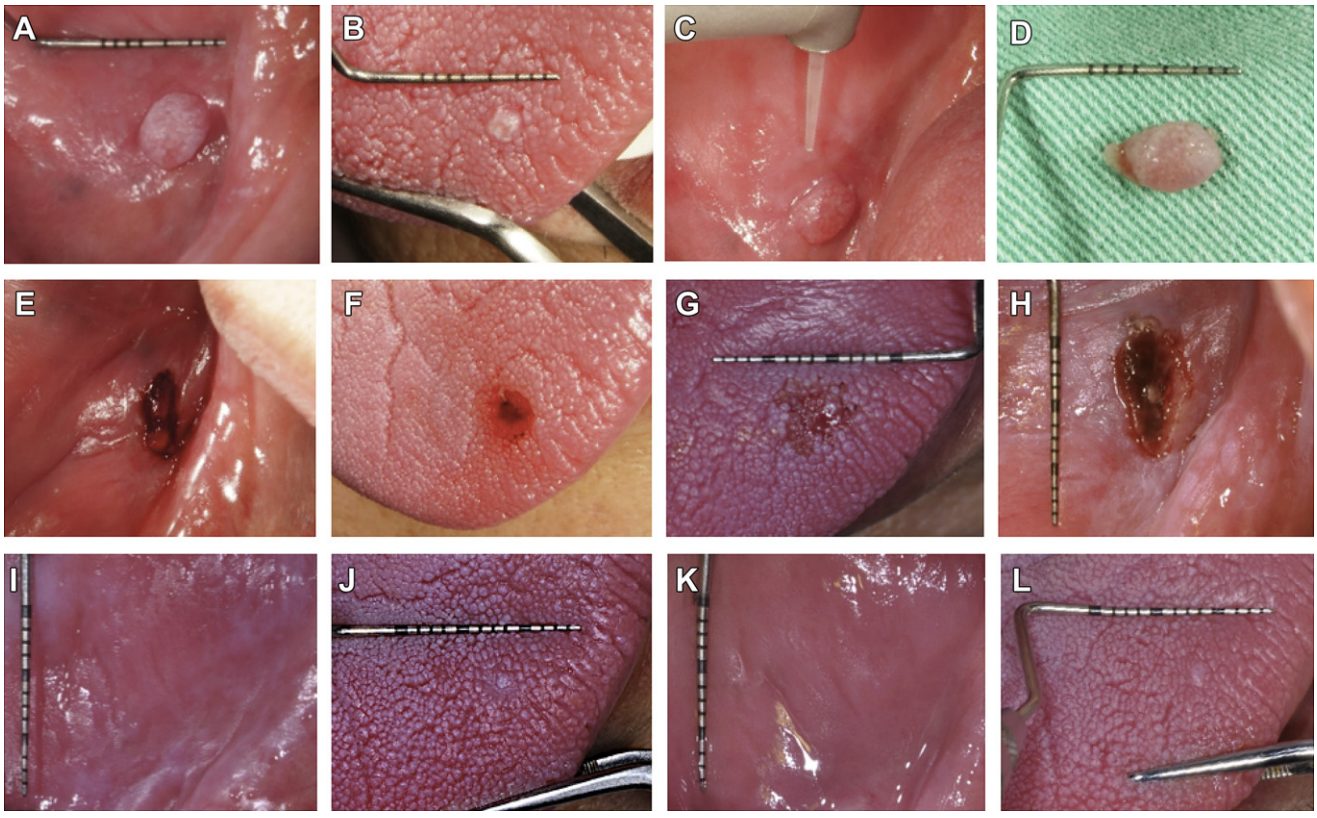

Figure 1 (A) Right buccal mucosa showing a nodular and thickened bulge. (B) Tongue displaying a rigid round lump, which restricted movement severely. (C) Biopsy was performed using a 0.6 mm × 17 mm sapphire tip of an Er:YAG laser. (D) Target tissue removed from the right buccal mucosa. (E and F) Postoperative areas immediately after laser treatment. (G and H) Healing 1 day after laser treatment. (I and J) Healing 10 days after laser treatment. (K and L) Healing 6 months after laser treatment.

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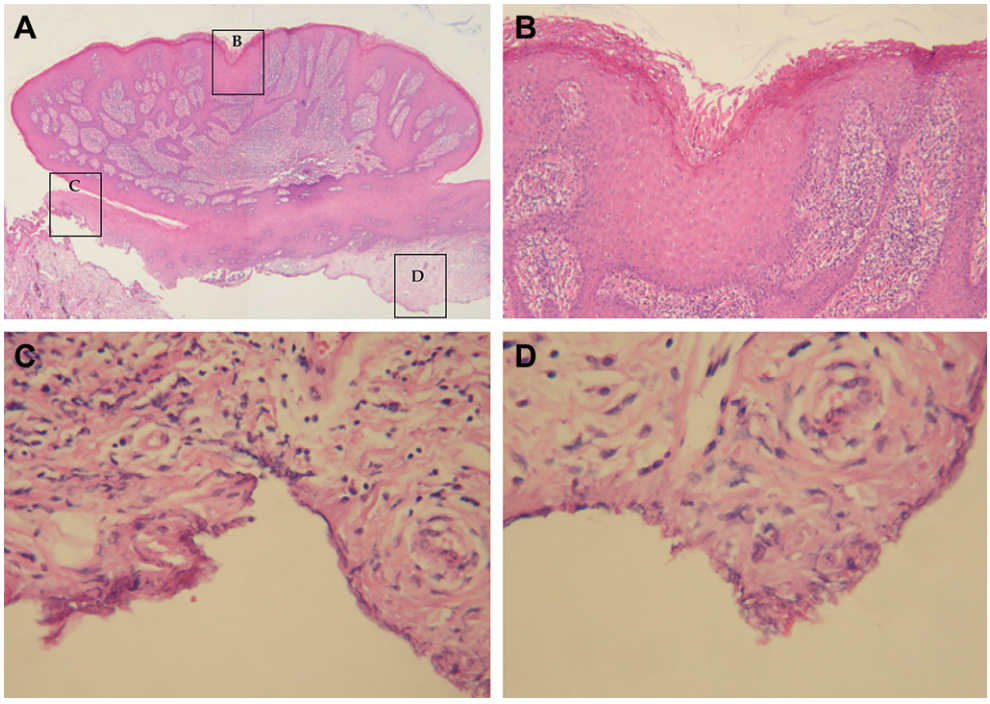

Figure 2 (A) Mild keratinizing tissue of the superficial squamous epithelium (40×). (B) Squamous cell hyperplasia without dysplasia and chronic inflammatory cell infiltration (200×). (C and D) Cells displaying shrinkage, disruption and crushing in the laser cutting margin (400×).

pretreatment size and its appearance had significantly improved.

Discussion

Most patients experience pain when receiving dental injections and can develop fear of needlesticks. Topical anesthesia is typically used to reduce the pain associated with needlestick procedures. The Er:YAG laser used in this study provides an effective clinical option for removal of lesions in soft tissue surgery and can be used with topical anesthesia and without local anesthesia.[3] It is important to select appropriate settings for laser treatment, including pulse energy lower than 150 mJ, output frequency higher than 30 Hz, water level higher than 50%, and distance to target tissue from defocused to light contact.

Reduced pain associated with the use of lasers could be caused by the protein coagulum that forms on the wound surface; thereby acting as a biologic dressing.[4] It could also be caused by the sealing of the ends of sensory nerves.[5] In this study, we applied topical anesthesia gel (benzocaine 20%) and the patient experienced no pricking sensation during the procedure. Atsawasuwan et al reported that the Nd:YAG laser might not require local anesthesia because it generates pulse energy within a short pulse duration that allows for a longer thermal relaxation time.[6] Further investigation should be conducted to evaluate the pain relieving effects of the Nd:YAG and Er:YAG laser systems in comparison with the traditional blade approach.

The Er:YAG laser produces invisible light with a wavelength of 2940 nm, which is maximally absorbed by water. It removes the epithelium using direct ablation induced by a water-mediated photothermomechanical process, which ablates all living cells within penetration range layer by layer. When Er:YAG laser energy is highly absorbed by water molecules, it heats and vaporizes the water molecules to produce massive volume expansion and explosion.[7] Laser radiation energy predominantly vaporizes water; therefore, causes minimal heating of the tissue and its surroundings. This phenomenon avoids tissue scarring and enables faster wound healing.[8]

In our reported case, postoperatively, the right buccal area and tongue healed uneventfully and the oral tissues achieved complete healing. On histopathological examination, we identified some cells with shrinkage, disruption, and crushing in the laser cutting margin. This finding differed from results obtained using a scalpel for biopsy, in which the cutting margin showed intact cells without shrinkage and crushing. The resulting zone of thermal necrosis and serious thermal damage hindered histopathological interpretation, when compared to results from a study using a carbon dioxide laser.[9] However, in the study by Fujii et al, the Er:YAG laser induced minimal thermal damage and tissue penetration (15 μm).[10] In our reported case, the Er:YAG laser system equipped with air- and water-cooling effects induced a zone of necrosis in five to 10 cell layers only.

In modern dentistry, the primary area for clinical usage of lasers is soft tissue management. Surgical biopsy is a common procedure within the field of oral surgery. In our study, we observed precise cutting and excellent tissue coagulation in the incision margin following use of the Er:YAG laser. Because of good coagulation, postsurgical

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suturing was not necessary and the operation time was extensively reduced. In conclusion, the Er:YAG laser provides an effective and reliable method for the removal of tissue of the buccal mucosa and tongue area with satisfactory clinical outcome.

References

1. Holcomb JD. Versatility of erbium YAG laser: from fractional skin rejuvenation to full-field skin resurfacing. *Facial Plast Surg Clin North Am* 2011;19:261—73.
2. Alster TS, Lupton JR. Erbium:YAG cutaneous laser resurfacing. *Dermatol Clin* 2001;19:453—66.
3. Azzeh MM. Treatment of gingival hyperpigmentation by erbium-doped:yttrium, aluminum, and garnet laser for esthetic purposes. *J Periodontol* 2007;78:177—84.
4. Fisher SE, Frame JW, Browne RM, Tranter RM. A comparative histological study of wound healing following CO2 laser and conventional surgical excision of canine buccal mucosa. *Arch Oral Biol* 1983;28:287—91.
5. Schuller DE. Use of the laser in the oral cavity. *Otolaryngol Clin North Am* 1990;23:31—42.
6. Atsawasuwan P, Greethong K, Nimmanon V. Treatment of gingival hyperpigmentation for esthetic purposes by Nd:YAG laser: report of 4 cases. *J Periodontol* 2000;71:315—21.
7. Tal H, Oegiesser D, Tal M. Gingival depigmentation by erbium: YAG laser: clinical observations and patient responses. *J Periodontol* 2003;74:1660—7.
8. Berger JW, D'Amico DJ. Modeling of erbium: YAG laser-mediated explosive photovaporization: implications for vitreoretinal surgery. *Ophthalmic Surg Lasers* 1997;28:133—9.
9. Krause LS, Cobb CM, Rapley JW, Killoy WJ, Spencer P. Laser irradiation of bone. I. An *in vitro* study concerning the effects of the CO2 laser on oral mucosa and subjacent bone. *J Periodontol* 1997;68:872—80.
10. Fujii T, Baehni PC, Kawai O, Kawakami T, Matsuda K, Kowashi Y. Scanning electron microscopic study of the effects of Er:YAG laser on root cementum. *J Periodontol* 1998;69:1283—90.

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