Original paper

Er:YAG laser evaluation in the treatment of benign neoplasms and tumorous lesions of the oral mucosa

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Abstract

Introduction: In the treatment of benign and hyperplastic fibro-epidermal tumorous oral lesions standard surgical techniques as well as Er:YAG lasers are applied.
Aim: Photographic records of chosen clinical cases were used to discuss major advantages of the laser technique. The other aim of this paper was to systematize indications to the procedure and to choose the operating mode depending on clinical condition as well as the size of pathology. Some limitations and disadvantages of the laser method were shown, too, comparing to a conventional surgical treatment.
Material and methods: Clinical records of 25 patients with benign neoplasms and tumourous growths on the oral mucosa qualified for the Er:YAG laser treatment were studied.
Results and Conclusions: The laser method does not make histopathologic examination of the excised tissue impossible. The best quality incision is achieved with the lowest laser power and its highest frequency. Such mode limits disadvantageous thermal load, too. The greatest stromal and epidermal changes affect the smallest tissue fragments. With the haemostasis achieved in the laser technique suturing the wound can often be avoided. No sutures means preservation of the oral vestibule depth and gingival and mucosal contour, what prevents the recurrence of lesions.

Key words: Er:YAG laser, oral benign neoplasms, laser therapy.

Introduction

Benign neoplasms and hyperplastic fibro-epidermal tumorous lesions belong to a group of the most common oral mucosa pathologies. They are often related to a long-term irritation, occlusal trauma, ill-fitting prosthetic appliances and habitual cheek biting. Clinically, these lesions have a clear-cut border of a regular and even line on palpation, are not discoloured, and usually show no ulceration. They are painless and may remain unchanged for many years. The regions in the mouth most often affected by such lesions are the buccal mucosa, especially along the line of occlusion, tongue, alveolar process and palate, the two latter ones being the removable denture bearing area. Their main component is the hyperplastic fibrous connective tissue covered with the hyperplastic or acanthotic epithelium. Bacterial plaque and prosthetic appliances promote *Candida albicans* superinfection [1-3].

Apart from traditional surgical treatment, more and more frequently Er:YAG and CO_2 lasers are used for the removal of these lesions. Laser operations show many peri- and post-operative advantages both for a patient and an operator. So far, greatest controversies arise over the issues of post-operative examinations of the excised lesions, extent of the procedure and the control of thermal stress to the tissues undergoing the operation [1-8]. Laser application for the treatment of benign neoplasms, potentially malignant lesions or even advanced malignant neoplasms of the skin and mucosa has been constantly growing [3, 4, 9].

Aim

The aim of the paper is to present Er:YAG laser treatment results of the patients affected by benign neoplasms and tumorous growths of the oral mucosa. Basing on the photographic records of selected clinical cases, major peri-

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and post-operative advantages of the laser technique are discussed. The other aim of the paper is to systematize indications to the procedure as well as to choose the laser operating mode depending on the clinical condition and size of the neoplasm. Some limitations and disadvantages of laser application compared to conventional surgery are noted, too.

Material and methods

Clinical records of 25 patients (5 men and 20 women) aged 23-77 years (mean: 42.4 years) with benign neoplasms and tumorous growths on the oral mucosa qualified for the Er:YAG laser treatment were studied. All the procedures were carried out using KaVo K. E. Y. Laser 3 and a dental handpiece 2060. KaVo K. E. Y. Laser 3 is an Er:YAG laser of a 2.94 μm wavelength, up to 600 mJ pulse energy, and 1-25 Hz pulse frequency. Pilot beam emits energy of 55 nm/1 mW. It is widely used in conservative dentistry, endodontics, oral surgery, dermatology and periodontology. In dermatology and oral surgery it is applied to treat herpetic lesions, aphthae and leukoplakia, to excise fibroses, tumorous growths and benign neoplasms, to contour hard and soft tissues, to prepare soft tissue superficially, and to perform vestibular and pre-prosthetic plastic operations.

Results

Laser application and subsequent laser-generated thermal stress of the operated soft tissues do not disqualify the material from a histopathologic study. Laser application is not contraindicated to receive results in the histopathologic study. In our group of patients we obtained the following results of the histopathologic study: granuloma fissuratum – 3 patients, granuloma teleangiectaticum – 1 patient, fibroma – 4 patients, fibromatosis palatae – 2 patients, papilloma – 3 patients, epulis fibromatous – 8 patients, epulis gigantocellulare – 2 patients, granuloma pyogenic – 2 patients.

The best quality incision and the smallest thermal damage to tissues are found when using the highest frequency and the lowest power of the laser. The greatest stromal and epithelial changes affect the smallest tissue fragments of less than 7 mm in diameter. Laser application shows bactericidal effects and promotes post-operative healing.

Laser application does not cause soft tissue deformity due to haemostasis, does not result in shallowing the oral vestibule, does not affect gingival contour and therefore prevents future trauma to tissues and the recurrence of lesions (Figures 1 A-D).

The best quality incision and the smallest thermal damage to tissues are observed when using the highest frequency and the lowest power of the laser (Figures 2 A-D, 3 A-C).

Laser application does not cause soft tissue deformity due to haemostasis, does not result in shallowing the oral vestibule, does not affect gingival contour and therefore prevents future trauma to tissues and the recurrence of lesions (Figures 4 A-D).

Discussion

In all the presented cases, laser application did not hinder a post-operative histopathologic examination of the excised tissue material. It also made it possible to evaluate the procedure extent. Very tiny lesions, especially of an uneven warty surface, are not suitable for laser operations as the excised material may become fragmented and therefore disqualified from any histopathologic analysis. Thermal effects of the laser depend on three parameters: light to heat conversion, heat transfer and tissue reaction which depends on the temperature and exposure time. These properties may be controlled by power, frequency, emission time, beam size and profile regulation. Such interactions lead to tissue denaturation and destruction [1]. Thermal stress does not only depend on the size of a lesion but also on the applied laser frequency and power. Our experience shows that the best quality incision and the least thermal damage can be achieved with the highest frequency and the lowest laser power. To a lesser degree does this rule apply to tiny surfaces as the smaller tissue fragment the greater thermal stress, irrespective of the frequency and power used. The greatest stromal and epithelial changes are found in the fragments smaller than 7 mm [1]. In most of the cases the operating mode chosen was of 10-15 Hz frequency and 100-300 mJ energy. An insufficient level of energy does not initiate tissue ablation while too high energy leads to charring and thermal damage to the tissues operated on. Fragments of charred tissue absorb the majority of the laser light beam and cause overheating in a short time, what increases detrimental thermal effects. Removal of the charred margins from the surface of the operated tissues is indispensable. Operation precision is of great importance in the proper post-operative healing. The better precision and skill of laser application, the smaller thermal damage to the surrounding tissue. By comparing laser and scalpel cuts some histological changes can be identified. The most important ones are the changes in cell nuclei (pyknotic nuclei, spindle-shaped nuclei), epithelial cell fusion and the loss of cell adhesion. In the connective tissue charring, hyalinization, collagen denaturation, dryness in the form of a compact layer of eosinophiles are observed. Moreover, laser induces numerous vascular changes, mainly thrombi, blood clots, vascular wall collapse [1]. Er:YAG laser has numerous peri-operative advantages. The most important one is pain reduction, both during and after the procedure. It is related to a very short frequency of impulse beats what prevents reaching the pain threshold. Therefore, there is no need to anaesthetize

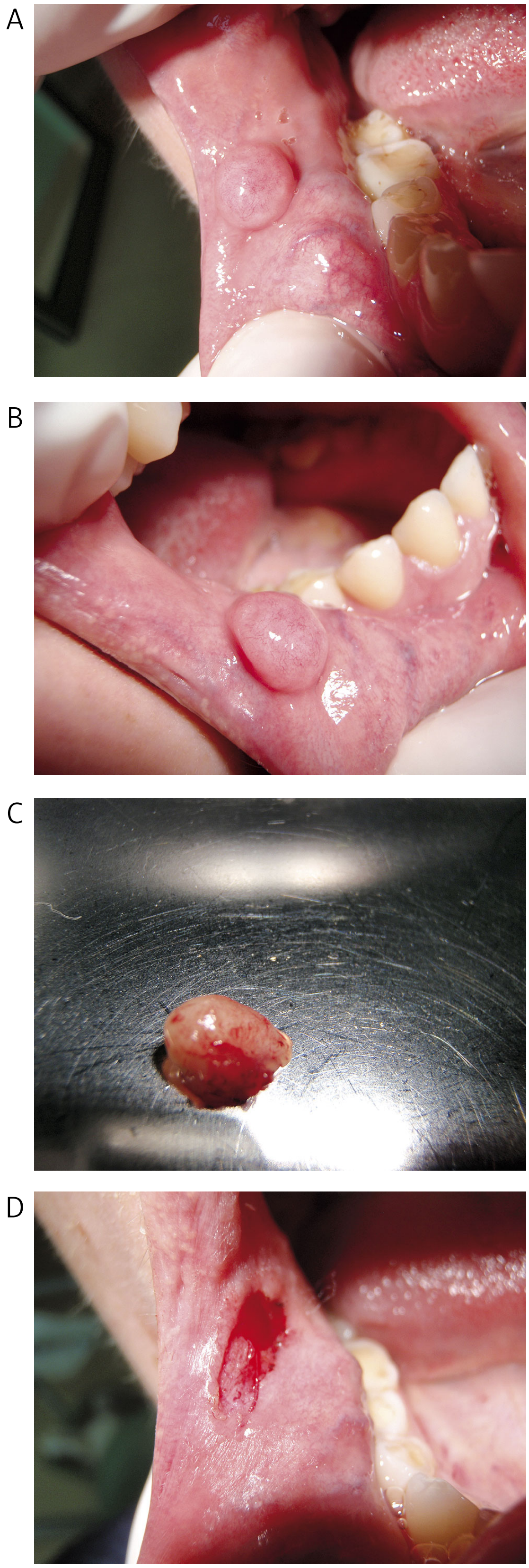

Figure 1. Fibroma of the lip. **A, B** – Status before lesion removal. **C, D** – Status after removal

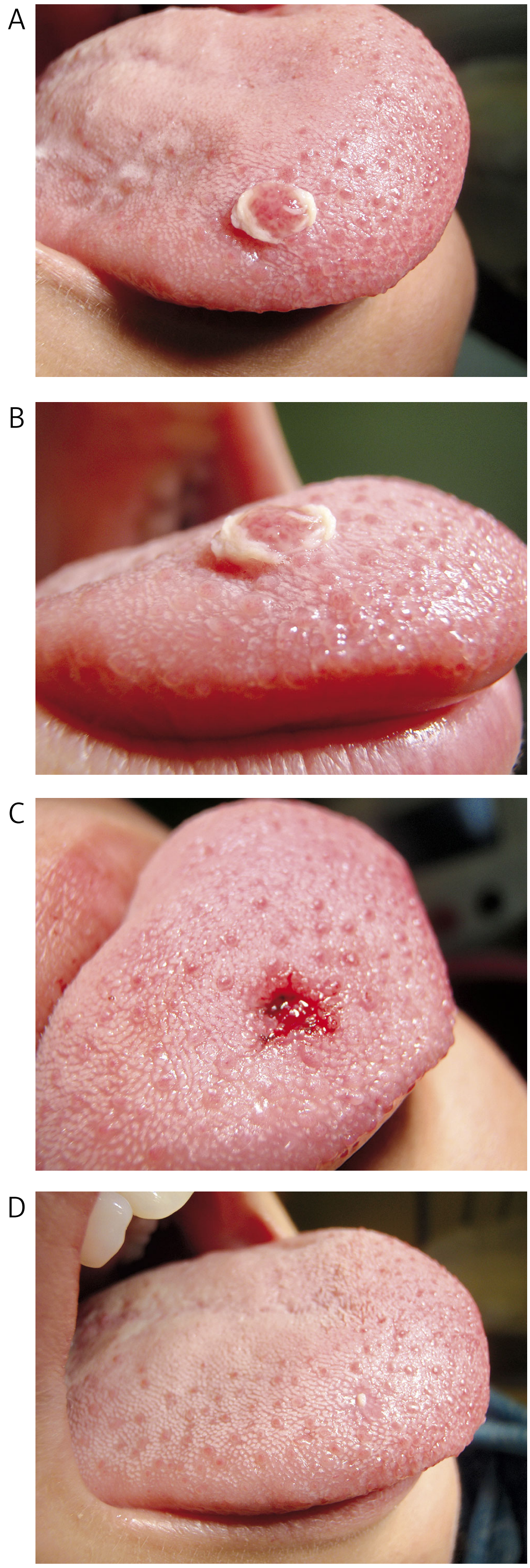

Figure 2. Papilloma of the tongue. **A, B** – Status before removal. **C** – Status after lesion removal. **D** – Status 7 days after removal

A B C


Figure 3. Fibroma along the line of occlusion. **A** – Status before procedures. **B** – Status after removal. **C** – Status 7 days after removal

the patient. Moreover, the laser tip does not vibrate or emit irritating noise. These properties make the laser technique very well accepted by patients. Another advantage of a laser impossible to achieve in the conventional surgery is its bactericidal effect. Marked absorption of water by the laser beam disturbs the inner environment of bacterial cells. They are filled with fluid and rupture easily. The cell membrane breaks. Bactericidal properties of a laser beam reduce the risk of post-operative inflammatory complications and promote healing. This is of utmost importance in the operations carried out in the oral cavity where varied bacterial flora modifies healing.

A B C D


Figure 4. Granuloma teleangiectaticum. **A**, **B** – Status before removal. **C** – Status after removal. **D** – Status 7 days after removal

The bactericidal effect achieved with an Erb:YAG laser is weaker, though, than in the case of a CO_2 laser [2, 10, 11]. Laser-assisted coagulation and haemostasis reduce perioperative bleeding and very often eliminate the need to suture the wound. Comparing to other types of lasers, mainly to CO_2 and Nd:YAG lasers, Er:YAG does not always provide proper homeostasis during the procedure. It usually requires the tissues to be pressed up. Therefore, it is not suitable for the removal of big vascular lesions. CO_2 laser coagulates vessels of less than 0.5 mm in diameter and can be used e.g. in patients affected by the Rendu-Osler-Weber disease, while Nd:YAG laser is suitable for closing blood vessels as big as 7 mm in diameter and is applied in the treatment of cavernous angiomas. Substantial elimination of disadvantageous thermal stress and its limitation to tissue margins only in the case of Er:YAG laser results in decreasing this laser's haemostatic and coagulatory properties [2, 11, 12]. Post-operative wounds when using Er:YAG laser heal markedly faster than following the conventional surgery. Wound suturing very often leads to shallowing of the oral vestibule and changes physiological contours of the gums and oral mucosa. Each change in tissue layout, retracting the mucosa after conventional surgeries and wound suturing in the areas exposed to chronic irritation may predispose to pathology recurrence. Therefore, laser operations are significantly better and less predisposing to recurrences [13-17].

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