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and experienced reduced discomfort with laser. See for example a long-term case of vestibuloplasty from 2003 by Prof. Dr. Gerd Volland, where no gingiva was attached at the lower jaw front (Fig. 1). After treatment with Er:YAG laser (1,000 µs, 15 Hz, 400 mJ, no water, no air), only very low bleeding occurred and a gain of 10 mm was noted (Fig. 2). Three days after the surgery, the periodontal dressing was removed (Fig. 3), and the patient was free of pain seven days after the surgery (Fig.4). The healing was completed six weeks after the surgery and a gain of 7 mm was observed (Fig. 5). Three years later, the final gain was set at 5,5 mm and no scarring occurred (Fig. 6). A follow-up in 2009 showed no recessions and stable results (Fig. 7).

Pathology of the salivary glands

Mucoceles, ranulas or sialolithiasis can result in obstructive salivary-gland pathologies. Mucoceles are produced by an accumulation of mucin from a ruptured salivary-gland duct, usually caused by local trauma. They are characterised by a high percentage of relapse. Two approaches to removing mucoceles have been suggested in the literature: resection by either scalpel or CO_2 laser. Yagüe-García et al.[41] compared the effectiveness of using a scalpel with that of a CO_2 laser in removing mucoceles in their study. They treated 38 patients using a scalpel and 30 patients using a CO_2 laser (5–7 W). The results showed a repetition rate of 8.8 % for the conventional scalpel ablation. In 13.2 % of the cases, complications such as fibrous scars arose. In the laser group, a follow-up study at 12 months showed no complications or recurrence. The authors therefore recommend laser treatment, since its results are more predictable and its recurrence rate is lower than that of the traditional treatment. Furthermore, fewer complications occur. Huang et al.[43] contributed to this line of argumentation in reporting on laser vaporisation, a procedure that they recommend for children and non-cooperative patients especially.

Ranulas are due to an accumulation of mucin caused by the obstruction of a salivary-gland duct (generally that of the sublingual and submandibular glands), which is usually the result of previous local trauma. Marsupialisation, the removal of the ranula with or without the sublingual gland, laser splitting, and vaporisation of the ranula have been proposed as possible treatments. Lai and Poon[44] present a series of three cases in which ranulas were removed and the injuries vaporised using CO_2 laser. The authors state that this treatment can be recommended because of the precision of excision, a clear and sterilised operating field and the low risk of damage to the Wharton's duct and the gingival nerve. Furthermore, CO_2 laser treatment results only in minimal or no recurrence. Zola et al.[45] present an alternative method for removing ranulas. They used an Er,Cr:YSGG laser (1.5 W). The authors found their treatment to offer advantages similar to those found by Lai and Poon.[44]

Sialolithiasis is the mechanical obstruction of salivary glands or their excretory ducts owing to the formation of concretions. It accounts for 30 % of salivary gland pathologies and mainly affects the submaxillary glands (83–94 %), followed by the parotid (4–10 %) and sublingual glands (1–7 %). Yang and Chen[46] present 19 clinical cases entailing the removal of stones from the Wharton's duct in their article. All of the patients were treated with a CO_2 laser (4–6 W). Their success rate was 95 % and only very few complications occurred. For this reason, the authors advocate CO_2 laser treatment as the first technique to be used to treat this pathology.

Bisphosphonates

The clinical scope of avascular necrosis caused by bisphosphonates ranges from a single fistula to large areas of exposed necrotic bone tissue. Additional symptoms are paraesthesia, pus, swelling, pain and even fracture. The treatment and management of avascular necrosis resulting from bisphosphonates has proven to be challenging, as no treatments have been effective in the long term. Depending on the patient's health, possible treatments are the temporary or permanent suspension of bisphosphonate use, use of local or systemic antibiotics or hyperbaric oxygen, and surgical debridement of the lesions. The combination of these therapies may bring about more predictable results.

The use of LLLT has been increasingly favoured as an alternative for treating this type of pathology. In their 2010 review of the treatment of avascular necrosis by LLLT, Vescovi and Nammour[47] explain the effects of the laser on the healing process. Laser stimulation increases organic bone matrix, osteoblast proliferation and capillary growth. Owing to its strong affinity to water and hydroxyapatite, the Er:YAG laser can be easily applied to both soft and bone tissue. Necrotic bone is vaporised in the course

Fig. 4_ Long-term case of vestibuloplasty. Fibrin cover seven days after surgery. Patient free of pain.

Fig. 5_ Long-term case of vestibuloplasty. Situation on 28th of July, 2003: healing complete. Gain of 7 mm.


Fig. 4


Fig. 5

of conservative surgery until healthy bone is reached. Another advantage of Er:YAG laser treatment is its bactericidal action, which increases the healing of bone tissue. Er:YAG laser treatment therefore appears to be a promising technique, since it is regarded as safe, well tolerated by patients and allows minimally invasive treatment of the disease in the early stages.

In a study in 2008, Vescovi et al.[48] present their clinical results of the treatment of 28 patients affected by osteonecrosis. They treated the four groups of patients with an Nd:YAG laser in combination with medical and surgical treatment. Group I was treated medically only, for example via antibiotics and antiseptics. Group II was treated medically and surgically. Group III was treated medically and via LLLT. Finally, group IV was treated medically, surgically and using LLLT. Twelve of the 14 patients treated with LLLT showed significant clinical improvement and reduction in symptoms, nine patients exhibited complete clinical success. The authors state that while the results of their study were not conclusive, the results indicate that Nd:YAG laser treatment has significant potential to treat lesions caused by bisphosphonate-associated osteonecrosis.

In 2010, Vescovi et al.[49] published the results of a similar study. Between 2004 and 2008, 91 patients underwent stomatological observation and 55 sites affected by osteonecrosis were examined. These were divided into four groups and different therapeutic modalities were studied. Group I comprised 13 lesions that were treated medically (1 g amoxicillin three times a day and 250 mg metronidazole twice a day, orally) for a minimum of two weeks. Group II consisted of 17 lesions that were treated medically and via LLLT using an Nd:YAG laser (1,064 nm) once a week for two months. Group III consisted of 13 cases of avascular necrosis treated surgically by the removal of necrotic bone, debridement, alveolar removal and corticotomy. Finally, group IV comprised 12 lesions treated using an Er:YAG laser (2,040 nm) in combination with LLLT using an Nd:YAG laser.

All of the lesions treated with the Er:YAG laser showed a clinical improvement of 100 % and complete healing in 87.5 % of the cases. The group IV results differed significantly from those of the other groups. The authors suggest that the reason for this is increased accessibility to both soft and bone tissue using the Er:YAG laser. They therefore highlight the role of the Er:YAG laser in the treatment of osteonecrosis and conservative surgery. Consequently, a surgical approach combined with LLLT can be considered the most efficient treatment method for bisphosphonate-associated osteonecrosis.


Fig. 6


Fig. 7

Fig. 6_Long-term case of vestibuloplasty. Situation on 15th of May, 2006: no scars. Final gain of 5,5 mm.
Fig. 7_Long-term case of vestibuloplasty. Situation on 25th of November, 2009. Stable results, no recessions.

_Conclusion

In the last 20 years, lasers have become an excellent tool in oral surgery. Especially in soft-tissue surgery, laser enables the practitioner to excise tumors of different types in a safer and more precise manner than with conventional techniques using a scalpel or electrotome.

Modern laser application is based on our knowledge about absorption and other aspects of working with a laser beam. Over the past ten years, 980 nm and 810 nm diode lasers have evolved in particular. They are relatively inexpensive and provide a good compromise between superficial visible absorption and penetration, in favor of achieving optimal coagulation without necrosis in the depths of the tissue.

As a consequence, fibromas, papillomas or lipomas can be removed even from sites like the lips and the cheek with a clear operating field and predictable results. In addition, sutures can be reduced to a minimum and scar formation is also reduced. For hard tissues, erbium lasers appear to be the best choice because of their high absorption in water. Their effect is based on thermomechanical principles, unlike diode lasers, which interact thermally. Therefore, water spray is essential. This way, bone can be removed without inhibiting healing owing to thermal necrosis. Thus applied, laser can increase the positive effects of oral surgery by providing reliability for the surgeon and comfort for the patient._

_contact laser

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