Lasers in aesthetic dentistry

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Figs. 1a & b_Crown lengthening before treatment (a). Crown lengthening 6 months after treatment (b).
Figs. 2a & b_Gingival depigmentation before treatment (a). Gingival depigmentation 7days after treatment (b).


Fig. 1a


Fig. 1b


Fig. 2a


Fig. 2b

_The exciting possibilities offered by the world of aesthetic dentistry are being experienced by an increasing number of dentists and patients worldwide as new materials, techniques and tools become widely available.

One such example is the laser, of which there are many for use in dentistry. To appreciate laser dentistry to its fullest, however, it is necessary to gain accurate information from unbiased sources, firstly about laser safety and the physics of laser–tissue interaction, and secondly about the specific uses of lasers in practice.

The most commonly used laser types in dentistry are erbium lasers (with two variants: 2,940 nm Er:YAG and 2,780 nm Er,Cr:YSGG), neodymium lasers (1,064 nm Nd:YAG) and diode lasers (810, 940 or 980 nm). Each type of laser has a different wavelength, and each wavelength has a different interaction with the specific body tissue being treated.

Crown lengthening or gingival levelling (Figs. 1a & b) is a routine procedure for laser-assisted aesthetic interventions. All lasers can be used for this procedure; however, there are two main advantages of using erbium lasers in crown lengthening. First of all, they can be used without anaesthesia, as they do not cause thermal damage to the tissue. This results in a stable gingival height after the procedure.

Since diode and Nd:YAG lasers work in a more thermal manner, a longer healing time should be expected for the tissue to settle. A prerequisite for success in crown lengthening is, of course, to respect biologic width. If there is less than 3 mm between the desired gingival level and the bone, the bone level must be decreased. While this is possible to do with erbium lasers (even flapless), neither diode nor Nd:YAG lasers are suitable for this, since they are only capable of removing soft tissue.

The same conditions are applicable for uncovering implants with erbium lasers, so it is possible to take the impressions for prosthetic procedures on the same day or within a short period. If it is necessary to remove bone or soft tissue for either indication, erbium lasers with adjustable pulse duration (referred to as VSP technology in

Fotona lasers, for example) are the only option without raising a flap.

Tooth preparation for crowns and bridges with lasers is not yet as efficient as one might like it to be; however, new research and technological improvements are ongoing. A diode or Nd:YAG laser can still be helpful during prosthetic work for troughing before taking impressions or desensitising prepared teeth if required. It is also possible to reduce or eliminate dentine hypersensitivity due to periodontal treatment or gingival recession by either modulating the nerve endings or blocking the dentinal tubules using a laser.

Another aesthetic treatment is gingival depigmentation (Figs. 2a & b), which can also be performed by using long pulses of erbium or diode lasers. It is possible to de-epithelialise the surface, as the pigmentation is usually in the basal layer.

Erbium lasers are safer, since they do not penetrate the tissue. The effect is only superficial, and this is exactly where the pigmentation is.

Diode lasers penetrate more deeply, especially if one is not careful and tries to remove tissue that is lighter in colour. As with other treatments, erbium lasers allow the tissue to heal faster; however, there can be mild bleeding during the operation.

Class V caries removal for composite fillings can easily be performed with an erbium laser, quickly, painlessly, and without any thermal side-

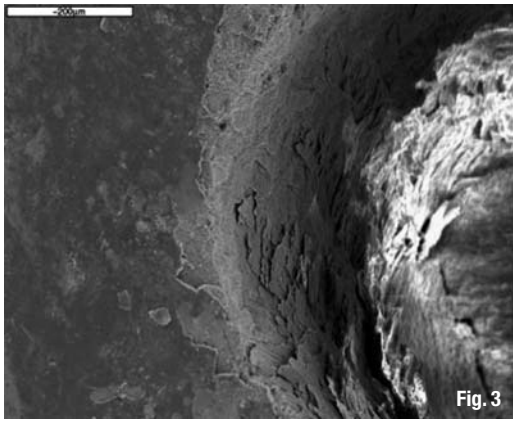


Fig. 3

Fig. 3_SEM image of hard dental tissue after ablation with an erbium laser.

effects, especially if the pulse durations are short enough—typically between 50 and 100 microseconds (Fig. 3). The shorter the pulse duration is, the more effective the laser energy will be at removing hard tissue. The margins of the cavity can even be bevelled for better aesthetic appearance and long-term colour stability if the laser is efficient enough to remove small amounts of sound enamel when needed.

Lasers also work selectively to only remove carious tissue, which has more water content than sound hard dental tissue. Surface modification can also be done with the erbium laser after cavity preparation for repairing composite fillings, or even for restoration cementation. One big advantage is that anaesthesia is not generally required when bloodless gingivectomy is used to uncover the borders of the carious lesion with an erbium laser using pulse durations of between 600 and 1,000 microseconds (Figs. 4a & b).

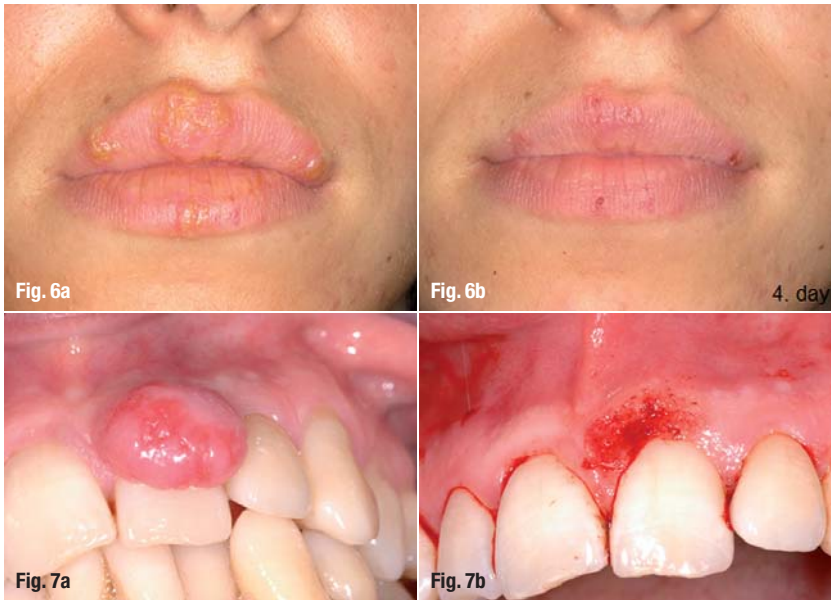

Fig. 4a


Fig. 4b


Fig. 5a


Fig. 5b

Figs. 4a & b_Clinical case before treatment (a). Immediately after gingivectomy and carious lesion removal (b).
Figs. 5a & b_Before (a) and after TouchWhite procedure (b).



Figs. 6a & b_Before (a) and four days after treatment of herpetic lesions (b).
Figs. 7a & b_Before removal of overgrown tissues (a) and immediately after the removal with an erbium laser (b).

For tooth whitening, lasers can also be used for activation of the bleaching gel (Figs. 5a & b), which decreases the treatment time as well as post-operative sensitivity. As the laser is absorbed by the appropriate gel, the heat is only superficial and the contact time is decreased, leading to less or no sensitivity.

The Er:YAG laser beam is uniquely absorbed in the water molecules that are contained in all gels. The more water content (the more the gel is "soft" and a bit runny), the better the resulting bleaching interaction (known as the TouchWhite™ procedure, patented by Fotona). The colour is not of importance for this interaction, unlike with Nd:YAG and diode lasers, which are absorbed more efficiently in pigments and therefore require specially coloured gels to be effective.

Nd:YAG and diode lasers have very specific indications, such as the treatment of herpetic lesions (Figs. 6a & b) and non-invasive haemangioma, which can present aesthetic problems too. The advantages of treating a herpetic lesion by laser are that the pain is relieved shortly after lasing, the lesion heals faster and reoccurrence is less frequent in the treated area.

For haemangioma treatment, the lesion is coagulated by the strong absorption of the laser energy in haemoglobin, after which it is either left to be removed by mast cells or ablated.

The bio-modulation effect of these lasers is also advantageous, helping to increase cell turnover and blood circulation (with an anti-inflammatory effect), eliminate pain, improve nerve transmission, promote myo-relaxation, stimulate the release of growth hormones, and improve many more aspects of healing.

Other procedures like frenectomy or removal of overgrown tissue (lasers can be used to safely and easily remove tissues, like overgrowth, pigmentation, etc. but it is essential to be certain about the nature of the tissue that is being removed) can be carried out for aesthetic reasons in the anterior region (Figs. 7a & b).

Erbium lasers are preferred for soft-tissue surgeries like these because they are fast, require minimum anaesthesia and do not cause a delay in healing. It is important, however, to be able to modify the parameters: if the pulse duration can be increased above 600 microseconds, preferably up to 1,000 microseconds, the quantity of heat delivered will rise—still without damaging the tissue—and cause haemostasis. If this cannot be achieved with the particular Er:YAG laser system, then a second wavelength must also be employed, such as diode or Nd:YAG in order to effect haemostasis.

Diode and Nd:YAG lasers can be used from start to finish for all soft-tissue interventions to yield blood-free surgery; however, this requires more anaesthesia and a longer healing time.

All of these benefits and many more increase the comfort of the patient and give dentists more reasons to enjoy their profession. For achieving a full and successful integration of laser technology into a clinician's treatment offering, and to make effective use of the investment made, as well as to ensure the health and safety of patients, it is necessary to obtain an adequate education in both the biophysical interactions underlying these treatment protocols and the specific properties of each laser device._

All procedures presented in this article were performed using a LightWalker AT dental laser system (Fotona).

_contact laser

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