The use of the Er:YAG laser in aesthetic dentistry

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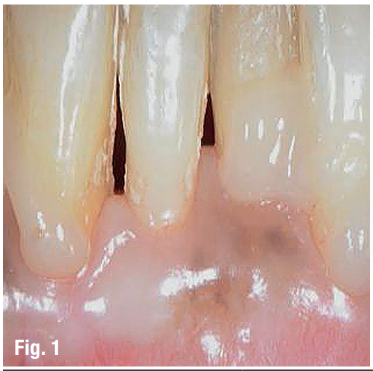
Introduction

The attractiveness of a face depends on a variety of different features and arrangements, with the eyes and smile being among the most important contributing factors. Nowadays, aesthetics plays a significant role in modern dentistry. Several features, such as colour, shape, position and length of the teeth, must be considered when it comes to assessing whether a smile is harmonious. Not only the teeth but the gingiva too play a role in an aesthetically harmonious smile. The colour of the gingivae, the smile line and the amount of gingival exposure are some of the features of the gingivae that have to be taken into consideration.



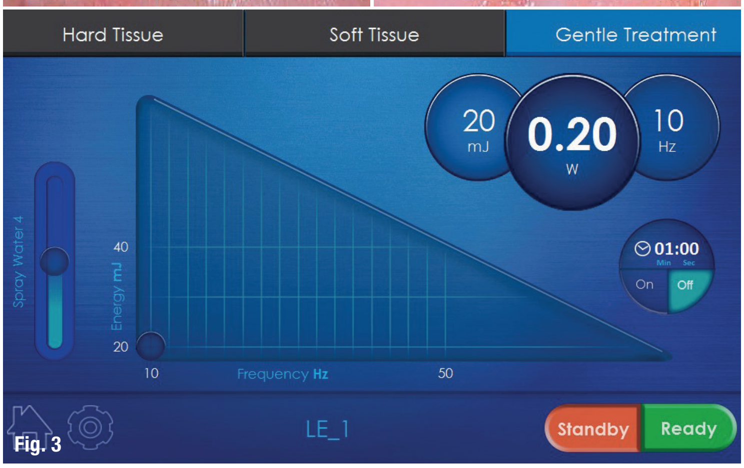


Fig. 1: Gingival melanin hyperpigmentation. **Fig. 2:** The gingiva immediately after melanin hyperpigmentation removal using the LiteTouch Er:YAG laser (Light Instruments). **Fig. 3:** The Gentle Treatment mode of the LiteTouch Er:YAG laser using low energy for the reduction of periodontal pathogens.

An aesthetic smile can be divided into white aesthetics and red aesthetics. White aesthetics concern the improvement of the colour, position, shape, size and alignment of the teeth, and red aesthetics the improvement of the gingival colour, the amount of gingival exposure and the smile line. The Er:YAG laser, applied to hard and soft tissue, as the energy is absorbed by water and hydroxyapatite, can be used for the treatment and improvement of the white and the red aesthetics of a smile.

Red aesthetics

Correction of gingival smile line

The gingival smile line is a specific dentolabial configuration characterised by the exposure of the maxillary anterior gingiva during a full smile. There are some factors associated with the gingival smile line, such as the clinical crown heights of the incisors. Gingival line correction can be performed using an Er:YAG laser in a, minimally invasive microsurgery. The procedure begins by ablating small surfaces using tips of small diameters (0.2–0.6mm), followed by shaping the marginal gingiva with tips of larger diameters (1.0–1.3mm). The surgery can be carried out without any thermal damage to the teeth or the periodontal tissue, also owing to the cooling effect of the air–water spray. The gingivoplasty can be performed in contact or at a distance, ablating the tissue layer by layer, not by tearing it, but by sculpting it. It is important to maintain the gingival biological width of 3mm around the treated teeth.

Treatment of oral hyperpigmentation

Gingival hyperpigmentation is due to the excessive presence of melanin in certain regions of the gingival tissue. Macrophages in connective tissue engulf melanin pigments in individuals with very high amounts of melanin pigment.

Under topical anaesthesia, using an Er:YAG laser in gentle treatment mode (low energy), it is possible to modify the gingival colour by removing the gingival hyperpigmentation through a peeling of the epithelial layer of the pigmented gingiva, just into the connective tissue (Figs. 1 & 2). The procedure can be carried out with or without an air–water spray. Using an air–water spray has some advantages, such as better visibility of the treated area and the possibility of treatment under topical anaesthesia. In such cases, coagulation has to be obtained after the melanin tissue ablation owing to the slight bleeding.

The use of an Er:YAG laser in this treatment is beneficial because of the low penetration depth and the air–water spray cooling effect. Indeed, the procedure can be carried out without any damage to the bone and the surrounding tissue, and without inflammation or postoperative pain or discomfort.

Improvement of the colour of the gingivae

The aesthetic colour of healthy gingivae is pink. Red and swollen gingivae are considered symptoms of periodontitis or peri-implantitis. The aetiology of periodontitis and peri-implantitis is a consortium of bacteria that are well organised in a biofilm participating in the initiation and the progression of the disease. After the mechanical therapy of scaling and root planing, which does not completely eliminate periodontal pathogens, as bacteria can persist in the radicular cementum and dentinal tubules, or migrate from reservoirs within the mouth to periodontal sites, a reduction in the level of periodontal pathogens can be achieved with an Er:YAG laser using the gentle treatment mode to control inflammation, which will lead to an improvement in both the gingival colour and the swelling (Fig. 3).

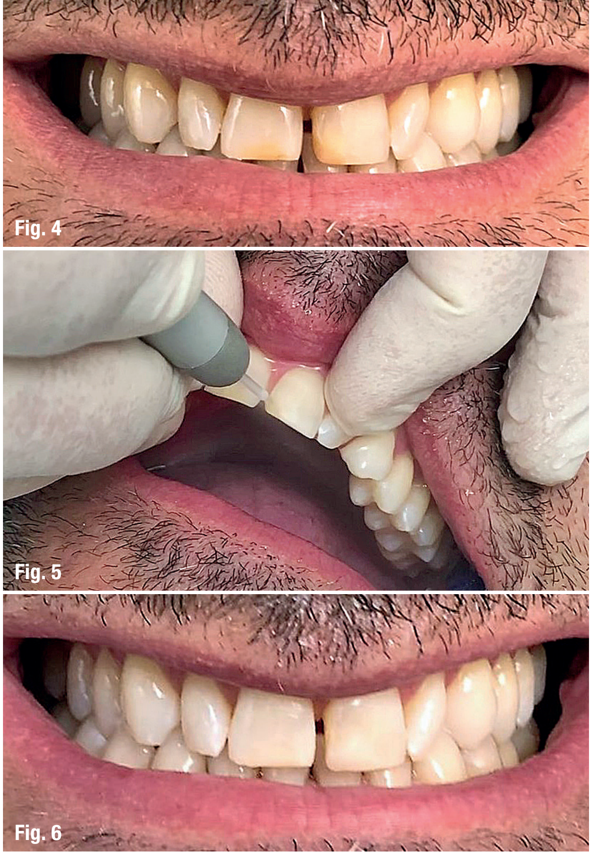


Fig. 4: Teeth #11 and 21 with composite fillers that had changed colour and, therefore, had to be replaced. **Fig. 5:** The removal of the composite material with the LiteTouch Er:YAG laser using a tip of 1.3 mm in diameter and energy of 150 mJ and 20 Hz. **Fig. 6:** Teeth #11 and 21 after bleaching and composite replacement.

White aesthetics

Replacement of resin composites

Today, resin composites are mainly used as restorative materials in aesthetic dentistry, having the advantage of being available in different shades and opacities in order to mimic the optical properties of natural dental structures. One of the advantages in the use of resin composites is that there is no need to sacrifice healthy tooth tissue in order to create mechanical retention features (undercuts). As a result, there is an increase in the fracture resistance of the restored tooth. The concepts of extension for prevention, resistance and retention have given way to minimally invasive dentistry and minimally invasive preparation for composite restorations. The application of the Er:YAG laser for cavity preparation for composite resin restoration adheres to all the minimally invasive dentistry concepts.

One of the main clinical disadvantages of composites is their technical sensitivity and contraction, which can cause marginal staining, colour changes, secondary caries or microleakage, necessitating replacement of the composite restoration. The Er:YAG laser can be used for replacing composite resin restorations in a minimally invasive way. The replacement preparation is performed without any damage to the tooth structure, ensuring maximum conservation of dental tissue (Figs. 4–6).

Secondary caries around aesthetic composite

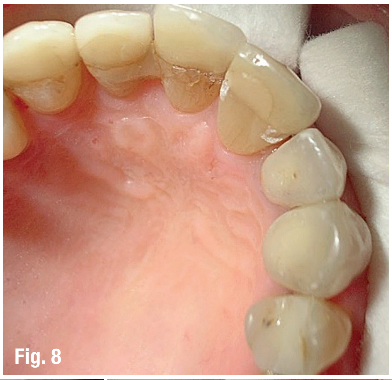
The Er:YAG laser can ablate secondary carious tissue around aesthetic composite restorations in a very precise manner. Using small tips of 0.6–0.8 mm in diameter, the Er:YAG laser ablates just the carious tissue, maintaining the integrity of the restoration. The non-contact mode and the transparent colour of the tips, made of sapphire, make it possible to see what is occurring during the ablation.

Secondary carious tissue around laminate veneers

Porcelain laminate veneers are widely accepted as the treatment of choice for non-invasively restoring the aesthetics and function of anterior teeth. Poor oral hygiene and a lack of flossing, in particular, can cause secondary caries in the proximal areas of the dental crown. The Er:YAG laser can ablate secondary carious tissue around or next to veneers in a very precise manner, conserving the integrity of the restoration. Since the laser ablates selectively and does not vibrate, there are no consequent microcracks or other damage to the veneers (Figs. 8–10). As gingival retraction may occur around the veneer over time, secondary caries can arise at the dental crown collar, just under the veneer. In such cases, the Er:YAG laser can also ablate secondary carious tissue around veneers precisely, conserving the integrity of the veneers.

Veneer debonding

Veneer removal is usually performed using a rotary instrument. In this manner, however, the veneer removal is relatively time-consuming, the veneer is damaged and the underlying tooth structure can also be easily traumatised or damaged. The most common reason for removal of a veneer is caries around its margins, requiring



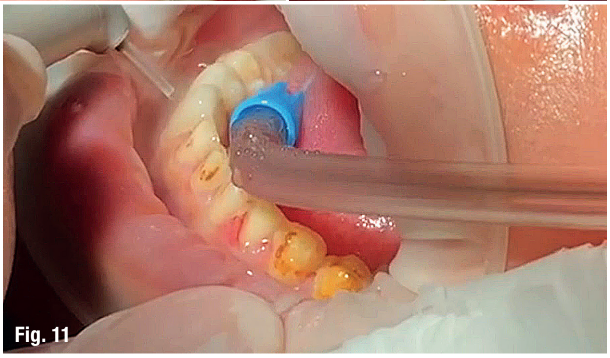


Fig. 7: Mesial and distal caries around the veneer of tooth #21. **Fig. 8:** The cavities after caries removal with the LiteTouch Er:YAG laser. **Fig. 9:** The case after composite reconstruction. **Fig. 10:** Removal of mesial secondary caries around the veneer of tooth #21 with the LiteTouch Er:YAG laser using a tip of 0.4 mm in diameter and energy of 200 mJ and 20 Hz. **Fig. 11:** Debonding of eight veneers with the LiteTouch Er:YAG laser using a tip of 1.3 mm in diameter at a distance of 4 to 5 mm from the veneer surface and energy of 100 mJ and 20 Hz.

an extended tooth preparation. Another reason for the removal of a veneer may be the patient's dissatisfaction with the final result.

The Er:YAG laser can be used for veneer debonding by degrading the cement without damaging the veneer or overheating the pulp. The laser irradiation is not absorbed by the materials of the porcelain veneer, but is transmitted through the veneer and absorbed by the organic components and H_2O/OH groups in the resin cement. When enough cement has been ablated, the veneer slides off the tooth surface. In this way, veneers can be removed without damaging any tooth structure or the porcelain itself and the veneers can be reused (Fig. 11). Er:YAG laser energy can also successfully be used to efficiently debond all-ceramic full-contour crowns from natural teeth without damage to the underlying tooth structure.

Tooth whitening

In order to accelerate the whitening process in a dental office, different types of energy (heat) can be used, such as halogen, LED or plasma arc. The advantage is the ability of the light source to heat the peroxide, thereby increasing the rate of decomposition of oxygen and accelerating the release of free radicals with higher kinetic energy, thus, enhancing the rupture of stain-containing molecules. The Er:YAG laser wavelength has its absorption peak in water; thus, the Er:YAG laser energy is highly absorbed in bleaching gels, preventing energy penetration (heat) into the tooth's hard tissue or pulp. In this manner, the energy of the Er:YAG laser heats up the gel without compromising the safety of the tooth and the pulp.

Conclusion

The use of Er:YAG laser in aesthetic dentistry has gained increasing importance in recent years. Er:YAG laser applications for aesthetic oral treatments, such as correction of the gingival smile line, gingival melanin depigmentation, replacement of resin composites, minimally invasive cavity preparation in anterior teeth, and veneer debonding, seem to be effective and reliable. The clinical cases shown in this article prove that these treatments can be performed safely and effectively by means of the Er:YAG laser, resulting in better healing and a significant improvement in aesthetics.

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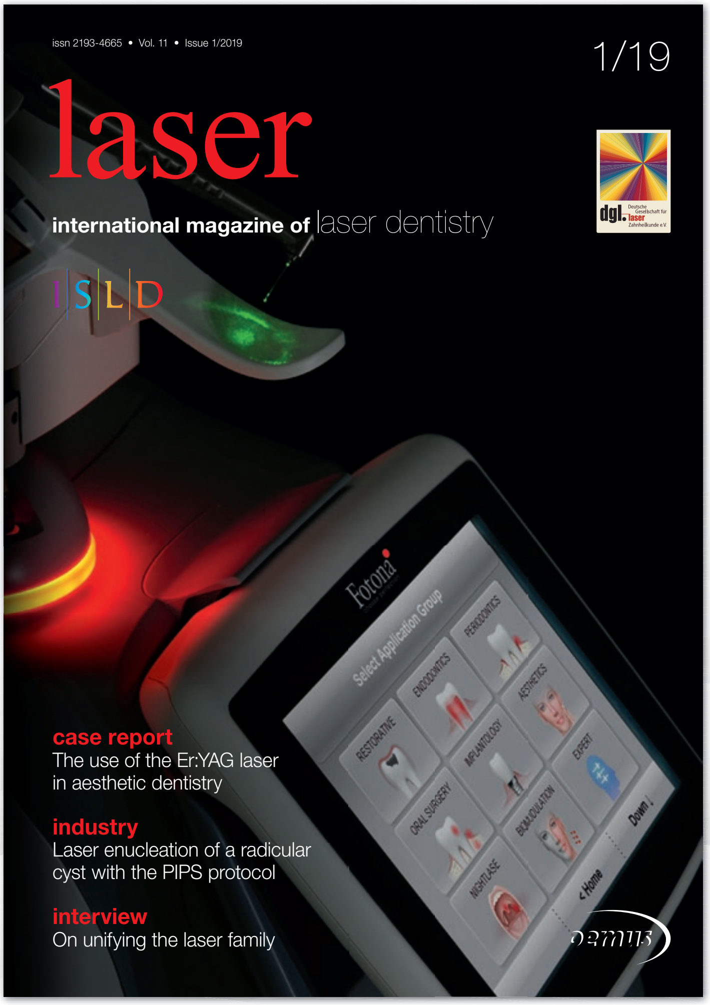

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