

# A multidisciplinary approach with Er,Cr:YSGG

## Aesthetic management of hard and soft tissues

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### Introduction

The use of an Er,Cr:YSGG laser system in every day practice is beyond doubt a very helpful tool in the hands of a trained practitioner. It can be used safely both for hard and soft tissue treatments, with minimal or no use of anaesthesia, and complex cases with many different treatments can be treated in less time. Therefore patients enjoy the benefit of time-saving and pain-free treatments.

The following case report is from a female patient aged 38, who was referred to the Post-graduate Dental Clinic of the Operative Dentistry department, in Aristotle University of Thessaloniki by the Department of Orthodontics. Reason of the reference was the fact that the patient showed no compliance with the orthodontic treatment (Fig. 1). Therefore a faster and conservative aesthetic solution for the front teeth area was decided. Anterior teeth have a signif-

icant psychological and emotional impact on patients owing to their prominent position within the dentition and their main role in a smile. The patient's chief complaint was the color of her teeth and the gaps between the upper front teeth (Figs. 2-6). After obtaining the medical and dental anamnesis, clinical and radiographic examination was performed in order to address any existing therapeutical problems (caries, periodontal, endodontic).

The patient mentioned during dental anamnesis recording that she had performed periodontal therapy one month ago and that she was under observation by the Department of Periodontology. Moreover, it was mentioned that she had worn the brackets for more than five years and that she was reluctant to continue the orthodontic treatment. From the side of the orthodontists it was recorded that she was not consistent with the change of the elastic bands, she omitted a few appointments even when

**Fig. 1**\_Initial clinical image after reference from the orthodontic department.

**Fig. 2**\_Initial frontal view upper and lower arch.

**Fig. 3**\_Initial frontal view of the upper teeth.



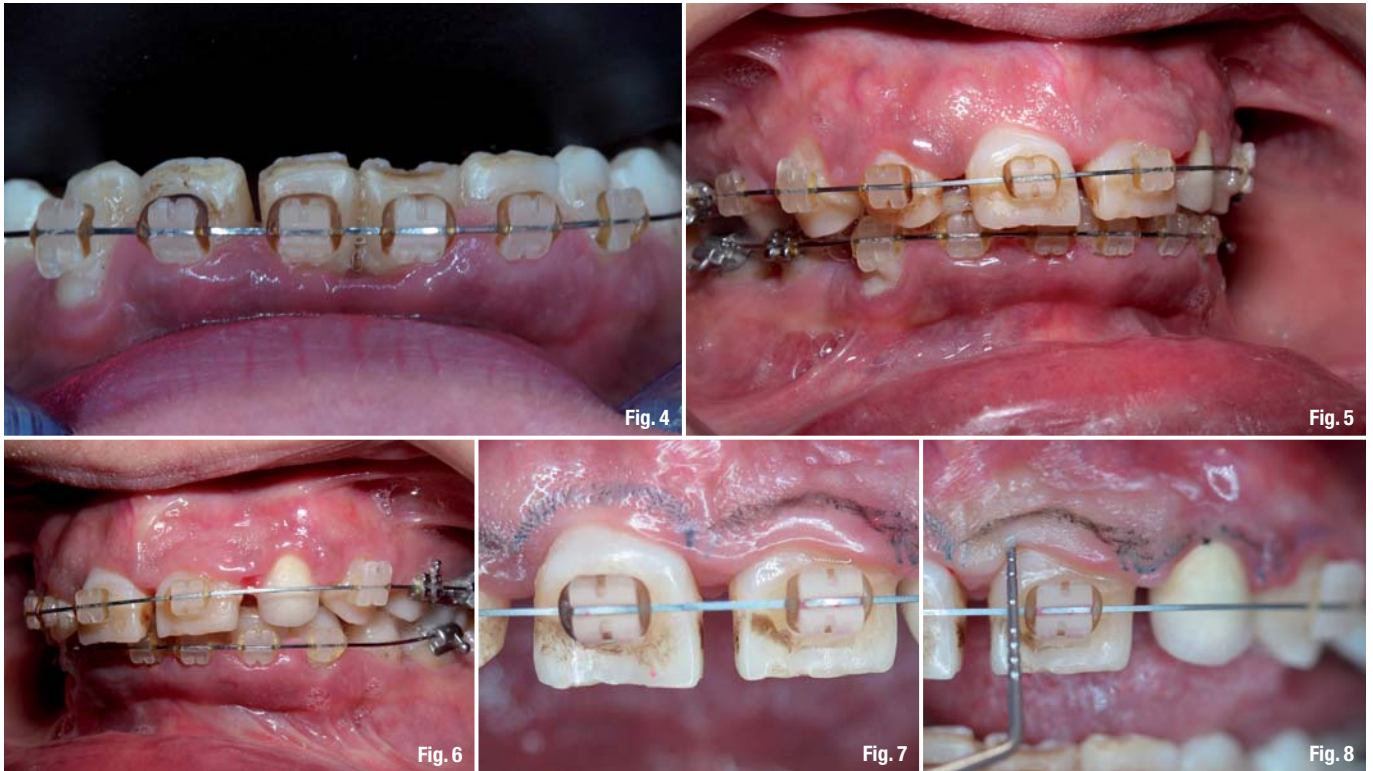
Fig. 1



Fig. 2



Fig. 3



brackets were debonded and that she maintained no proper hygiene. Additionally, it was made clear that it is contra-indicated to further continue with the orthodontic treatment, as the risk of root absorption was high due to the long-time activation of the brackets.

Clinical examination revealed poor oral hygiene, gums hyperplasia, visible discoloration around the brackets due to smoking, caries on the right upper canine and a PFM crown on the left lateral incisor (Figs. 2–6). Mild demineralisation around the brackets was also noted after they were removed. It was also observed that the teeth’s central mid-line did not correspond with the facial mid-line (Fig. 1). Clinical and radiographic examination showed no problem at the posterior teeth.

According to our findings, respecting the patient’s wishes and taking in consideration her financial limitations, the aesthetic rehabilitation should include a multidisciplinary approach. It was decided to perform the following treatment plan:

- Gingivectomy on upper and lower gum line
- Bleaching on upper and lower arch
- Diastema closure between teeth #11–21, #11–12 and #21–22

In order to allow proper soft tissue healing and following the guidelines for adhesive restorations performed after bleaching, a two-week interval was scheduled between each appointment. The demineralisation around the brackets was decided to be handled with fluoride gel application.

### Gingivectomy

Periodontal plastic surgery introduced by Miller in 1993, includes surgical procedures performed to correct or eliminate anatomic, developmental or traumatic deformities of the gingiva or alveolar mucosa.<sup>1</sup> It is often combined with aesthetic rehabilitation of the smile with conservative composite restorations or with veneers. The goal is to eliminate the periodontal pockets by excision of the excessive soft tissue.

**Fig. 4** \_Initial frontal view of the lower teeth.  
**Fig. 5** \_Right side initial view.  
**Fig. 6** \_Left side initial view.  
**Fig. 7** \_The pattern of gingivectomy was designed on the gingival tissue.  
**Fig. 8** \_Periodontal sulcus depth was checked prior to surgery.

Tooth Number	12	11	21	22
Width	7	9	9	7
Height	7,5	9	8	8
Width: Height Ratio	0,93	1	1,125	0,87

**Table 1** \_Central and lateral incisors dimensions.



**Fig. 9** Immediate image after gingivectomy in the upper arch.

**Fig. 10** Two-weeks post-operative image and healing of gingival tissue in the upper arch.

**Fig. 11** Immediate image after gingivectomy in the lower arch, following the same procedure.

**Fig. 12** Two-weeks post-operative image and healing of gingival tissue in the lower arch.

The gingival architecture in the upper arch was not even and gum hyperplasia was noted at areas #21–22 and #22–23, owing to chronic insufficient plaque removal and possibly to the PFM crown placement on tooth #22. Moreover, study of the casts showed that in order to attain an optimal length-width ratio of 62–80%, crown lengthening should take place prior to diastema closure. Normally, the gingival margin is 1 mm coronally to the cemento-enamel junction. The above-mentioned problems can be solved by removing the excessive gingiva via precisely planned incisions. When crown lengthening is planned to increase the tooth length, the biological width needs to be considered and not encroached upon, as this may lead to periodontal breakdown.

Therefore, periodontal measurements of the sulcus depth were recorded and in accordance with the preferred tooth dimensions, tooth width, height and their ratio was recorded prior to surgery (Table 1). Ideal ratio would be 0,8–0,9. Once the appropriate proportion was determined, the outlines were marked on the gingiva with a waterproof marker (Fig. 7). Since the clinical crown was measured to be shorter than the anatomical crown, approximately 2 mm of gingiva were calculated to be removed (Fig. 8). The gingival tissue was of a thick biotype and had adequate attached gingiva. Gingival recontouring was performed with the following parameters.

Average output power was set to 2,5 W, with a pulse duration of 700 µsec (S-Mode) and a pulse repetition rate of 50 Hz using an MZ5 tip under minimal water spray (Air: 10%–Water: 10%). Gum hyperplasia areas were treated first and a scalloped excision pattern was followed (Fig. 9). As a final step, a pleasing gingival symmetry was created and the gingiva was allowed to heal for two weeks before the next treatment phase (Fig. 10). The patient reported slight bleeding at the next day following the gingival treatment, but no pain or soreness. Gingivectomy in the lower jaw (Fig. 11) was performed at the next appointment, together with bleaching of the upper teeth, and was allowed to heal for two weeks (Fig. 12).

### Er,Cr:YSGG assisted teeth bleaching

In order to achieve the best clinical results without harming dental tissues, it is crucial to follow the procedure carefully and take all safety measures. Before starting the first session, the patient was also informed that the result of the procedure is not permanent and is dependent on the age of the patient and the use of tobacco and extrinsic staining by deposition of tannins found in coffee, red wine, tea and cola beverages. The average duration expectancy is three to four years for non-smokers. The patient was instructed that if teeth sensitivity or pain was felt dur-

ing teeth bleaching, we should be notified so the treatment could be paused or stopped.

Periodontal therapy has been performed in the Department of Periodontology. Before starting with the teeth bleaching, it was checked that the teeth were free of plaque, calculus and extrinsic staining (Fig. 10). In order to prevent unwanted proteins and enzymes of saliva's biofilm to interfere with the bleaching agent, mild cleaning of the teeth to be bleached was performed, with the application of a prophylaxis paste. In the Post-graduate Dental Clinic of the Department of Operative Dentistry at the Aristotle University of Thessaloniki, we operate an Er,Cr:YSGG laser (2,780 nm, Waterlase MD, Biolase, USA) and a yellow-colored bleaching agent used for in-office bleaching with a concentration of 38% H<sub>2</sub>O<sub>2</sub> (Power whitening, WHITEsmile GmbH, Germany). The tip used is a 6 mm long Z-type glass tip (MZ8) of an 800 μm diameter, used with the gold handpiece of the laser system. The power settings that we have used were: output power 1.25 W, pulse duration 700 μsec (S-mode), while the pulse repetition rate was set to 10 Hz.

The dentist, the dental assistant and also the patient evaluated initial tooth color. In our case, the patient's initial color was evaluated as A3 in the VITA Classical Shade Guide. Both the patient and the personnel in the laser working area must wear safety goggles in advance. Lip protection cream was applied and the working area was isolated with a cheek and lip retractor. After drying teeth and gums with gentle air stream, a liquid gingival barrier was carefully ap-

plied both on upper and lower teeth and was polymerised with a fanning motion for 40 seconds.

The bleaching agent was applied in a 1-2 mm thick layer on each tooth, except from #22, due to the PFM crown. With the power settings mentioned above we activated the bleaching agent for two intervals of ten seconds on each tooth (Fig. 13), keeping the laser handpiece on a 2.5 cm distance from the teeth. After the procedure, the activated bleaching agent was left for 15 minutes and then carefully removed with high-power dry suction from the teeth. This procedure was repeated twice at the same appointment. Upper and lower arch were bleached in separate appointments. Upper teeth's bleaching was performed at the same appointment with the gingivectomy of the lower arch, thereby pointing out the advantage of the use of laser, in terms of absence of pain and bleeding. No soft tissue irritation was noticed, nor did the patient report feeling pain or soreness. Final color evaluation took place from the dentist, the dental assistant and the patient. Two repetitions of the process at the same appointment were adequate to move the color of the teeth to B1 according to VITA Classical Shade Guide (Fig. 14). The patient was satisfied with the color of her teeth and the next appointment was arranged in order to close the diastemas.

### Diastema Closure

Diastema closure was scheduled after two weeks in order to achieve high-quality bond strength between the enamel and the composite resin (Ittipuriphat and Leevailoj 2013).<sup>2</sup> Casts were studied prior to

**Fig. 13** Laser-assisted bleaching of the upper teeth. Note that tooth #22 has a PFM crown.

**Fig. 14** Immediate colour evaluation after bleaching.

**Fig. 15** Evaluation of gold proportions in casts prior to diastemas closure.

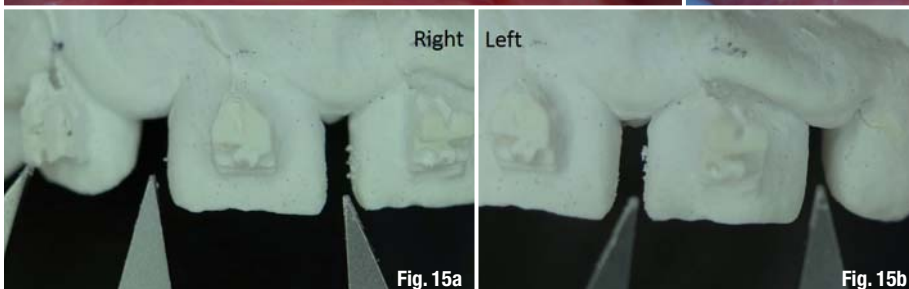
**Fig. 16** Preparation of Class V cavity on tooth #13.



**Fig. 13**



**Fig. 14**



**Fig. 15a**

**Fig. 15b**



**Fig. 16**



**Fig. 17** Etching of enamel with laser at the lateral surfaces of the teeth to be restored with composite resin and around a Class V cavity on tooth #13.

**Fig. 18** Additional acid etching was performed on enamel.

**Fig. 19** Final frontal view of restored teeth.

**Fig. 20** Final palatal view of restored diastemas.

**Fig. 21** Final right side view.

restorations; appropriate tooth proportions were calculated and checked with the golden proportions tool, which can simultaneously define the width of central incisors in comparison to the lateral incisors, or the width of the laterals in comparison to the canines (Fig. 15). This gives an idea of the ideal placement of the composite resin regarding its placement at the proximal area of two neighboring teeth and how many millimeters of composite resin are required for mesial and distal closure of a specific diastema. During this planning, the difference in facial and dental mid-line was also considered (Fig. 1) in order to achieve an even result. Prior to aesthetic rehabilitation, caries on #13 was removed using an Er,Cr:YSGG laser (2.780 nm, Waterlase MD, Biolase, USA, Fig. 16). Average output power was set to 6W, with a pulse duration of 140µsec (H-Mode) and a pulse repetition rate of 15Hz using an MZ6 tip under water spray (Air: 50%-Water: 80%). All margins and enamel were etched with the same laser device (Fig. 17). Power settings for bond preparation were (MZ6 tip, average output power 4,5W, pulse repetition rate 50Hz, H-mode).

Restorative procedure took place free-handedly after placement of a rubber dam. Enamel was additionally etched with 37% phosphoric acid while the mesial surface of the PFM crown was etched with 9% hydrofluoric acid (Fig. 18). Thus, resin composite bond to enamel will benefit both from laser etching and from acid etching. Starting from the central incisors, diastemas were closed using a single composite resin shade (A3 Shade, Beautifil, SHOFU Inc), first palatally

and then buccally. It was decided to use a single composite shade, as teeth presented high color saturation and no prominent translucency or special characteristics. Special attention was given to the proximal transition lines in order to create the illusion of narrower teeth. Microstructure was created after polishing with fine and ultra-fine diamond burs, with decreasing roughness of polishing discs, silicon points and brushes coated with diamond paste for the final gloss. The incisal plane could not be evened, despite the patient's wish, due to occlusional restraints. Final adjustments were made during polishing at the proximal curvature and at the incisal plane, to enhance the natural-looking effect. The final outcome is shown at Fig. 19 buccally and Fig. 20 palatally. Side photographs were also taken (Figs. 21 and 22). Note that, in order to gain in aesthetics, the diastema between #11-12 was decided not to be fully restored (Fig. 21). Otherwise, we would end up with very wide central or lateral incisors, which would compromise the final aesthetic result. At the same appointment, lower jaw bleaching was performed, with the same procedure described above. Fluoride gel was then applied at the end of the treatment at the demineralised areas around the brackets, in the buccal surfaces of 11, 12 and 21. Patient recall was at seven days post-op (Fig. 23).

## Results

The aesthetic rehabilitation of this complex case was completely performed with the use of an Er,Cr:YSGG laser. Laser treatment was performed



Fig. 22



Fig. 23

with no local anaesthesia. Patient reported no sensitivity at any stage of the procedure. During gingivectomy, no side-effect or comment was reported and fast healing was exhibited. Regarding diastema closure, it was decided to use a single composite shade as the teeth presented high colour saturation and no prominent translucency or special characteristics. No silicon-key was used and composite was placed free handed, after an initial evaluation of the interdental gaps made at the casts, with the golden proportion tool. Final adjustments were made during polishing to enhance the natural effect. It is more than evident that the use of an Er,Cr:YSGG laser system as a multi-tasking tool allows the scientifically trained clinician to address the vast majority of dental treatments. By combining soft and hard tissue aesthetics, a desirable

gingival architecture and tooth proportion could be offered to the patient.

*Editorial note: A list of references is available from the publisher.*

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**Fig. 22**\_Final left side view.

**Fig. 23**\_The patient smiles in the seven-days post-operative control.

## Kurz & bündig

Der vorliegende Artikel beschreibt einen multidisziplinären Ansatz der Lasertherapie mithilfe eines Er,Cr:YSGG-Lasers anhand des Fallbeispiels einer 38-jährigen Patientin. Diese wurde an den Autor überwiesen, nachdem eine kieferorthopädische Behandlung aufgrund schlechter Mundhygiene und mangelnder Compliance gescheitert war.

Die Hauptanliegen der Patientin waren die Zahnfarbe und eine Zahnücke zwischen den oberen Frontzähnen. Die klinische Untersuchung zeigte neben einer schlechten Mundhygiene eine Gingivahyperplasie, eine sichtbare Verfärbung im Bereich der Brackets durch Rauchen, Karies auf dem rechten oberen Eckzahn und eine Metallkeramikkrone auf dem linken lateralen Schneidezahn. Nach Entfernung der Brackets wurde zudem eine leichte Demineralisierung der Zähne sichtbar. Weiterhin entsprach die zentrale Mittellinie der Zähne nicht der des Gesichts. Die klinische und röntgenologische Untersuchung zeigten jedoch keine Probleme im Seitenzahnbereich.

Unter Berücksichtigung des Befundes und der Wünschen der Patientin wurde ein multidisziplinärer Behandlungsplan aufgestellt: Gingivektomie des oberen und unteren Zahnfleischrandes, Zahnaufhellung des oberen und unteren Zahnbogens sowie ein Diastemaschluss an den Zähnen #11–21, #11–12 und #21–22.

Diese komplexe ästhetische Rehabilitation wurde mithilfe eines Er,Cr:YSGG-Lasers durchgeführt. Obwohl auf lokale Betäubung verzichtet wurde, berichtete die Patientin, dass sie während der gesamten Behandlung keine Schmerzen verspürt habe. Während der Gingivektomie gab es keinerlei Nebenwirkungen. Eine schnelle Wundheilung konnte beobachtet werden. Zusammenfassend kann eine Vielzahl dentaler Behandlungen mithilfe des Er,Cr:YSGG-Lasers durchgeführt werden, was multidisziplinäre Behandlungssätze wie im vorliegenden Fall begünstigt. Durch die Kombination zwischen Hart- und Weichgewebsästhetik wurde der Patientin eine ansprechende Ästhetik sowohl hinsichtlich der Gingivafläche als auch der Zahnproportionen geboten.