Clinical Considerations for the Use of Er:YAG Lasers in Restorative Dentistry

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ABSTRACT

There are two wavelengths currently available that comprise the erbium family of dental lasers. The Er,Cr:YSGG laser has an active medium of yttrium scandium gallium garnet doped with erbium and chromium ions, operates in a free-running pulsed mode at an emission wavelength of 2780 nm. The Er:YAG laser has an active medium of yttrium aluminum garnet doped with erbium ions and emits free-running pulsed laser energy at a wavelength of 2940 nm. Both wavelengths have a high absorption in water, and are appropriate for ablating oral soft tissue as well as dental hard tissue. With the latter, the rapid vaporization of interstitial water results in an explosive dislocation of target hard tissue.

Advantages of using this laser family in restorative dentistry include precision, selective ablation of target hard tissue and carious lesions, reduced collateral damage that might be due to rotary instrumentation (tactile and thermal damage), and less conductive thermal stimulation of the pulp.

Laser use in restorative dentistry is technique-sensitive, and inappropriate or poor operating parameters can result in less-than-expected results. This paper examines 10 principles of use of these erbium laser wavelengths in clinical restorative dentistry, together with a review of the literature regarding different aspects of the use of laser energy on hard tissues.

Key Words: acid etching, dental; dental bonding; dental enamel; dental pulp capping; dental veneers; dentin; dentin sensitivity; laser ablation; safety, medical device; tooth fractures

SYNOPSIS

This article draws on the principles outlined in the Academy of Laser Dentistry Position Paper on the Use of Laser Energy for Therapeutic Ablation of Intraoral Hard Tissues, published in the *Journal of Laser Dentistry* (*J Laser Dent* 2007;15(2):78-86) and adopted in March 2007 by the Academy of Laser Dentistry.

The authors illustrate 10 principles that govern erbium laser use on tooth structure, and three clinical case examples utilizing a specific Er:YAG laser. The authors utilize only the Er:YAG wavelength in their clinical practices.

INTRODUCTION

Keller and Hibst[1] illustrated the potential of the Er:YAG laser for the effective ablation of dental hard tissues. As a result there followed the development and marketing of free-running pulsed, mid-infrared wavelength lasers during the mid-1990s. This offered advantages in addressing laser wavelengths that were complementary to target tissue elements, allowing clinically significant ablation rates that did not cause pulpal or collateral thermal injury using proper energy levels.[2-7] The erbium YAG and erbium, chromium YSGG laser wavelengths are strongly absorbed primarily by water and to a small extent by hydroxyapatite contained in varying component ratios in hard dental tissue.[8]

The use of the erbium lasers in restorative dentistry can offer multiple advantages and the following 10 guidelines are offered to maximize successful outcomes:

- Basic considerations
- Laser-tissue interaction considerations
- Use of coaxial water spray
- Exceptions to using water spray
- Cavity margin considerations
- Acid-etch considerations
- Avoidance of dehydration
- Choice of composite restorative materials
- Isolation and safety considerations
- Miracles don't happen!

1. Basic Considerations

So that laser-tissue interaction is therapeutically effective and efficient, it is necessary to deliver light energy of sufficient value over time to effect tissue change without causing unwanted collateral

thermal damage by conduction of excess heat into the surrounding tissues.[8] An essential requirement is to establish a rate of interaction that is commensurate with a time frame allowing such interaction to be clinically acceptable. This is achieved through a suitable choice of incident laser energy delivered to the tissue as well as the effects of wavelength, pulse duration, repetition rate, power density, and the thermal relaxation time of the tissue; all of these factors will determine the rate (speed) of ablation of dental hard tissue.[9-11]

The speed of ablation is also affected by the incident angle of the delivery tip relative to the tooth and the presence of ablation products. Addressing the delivery tip parallel to the axis of the enamel prisms in order to access the interprismatic, higher-water content structure maximizes the speed of ablation. Ablation is more efficient and heat transfer is minimized when the pulse width is reduced and peak power values rise.[6, 12-13] In addition, the use of sharp curettes to remove gross caries can reduce laser use to an acceptable time frame.

The depth of laser ablation depends principally on the parameters utilized and is a consequence of the energy used per pulse and the number of pulses delivered. In addition, to avoid and prevent cracks or structural modifications, the tip, where present, must not touch the surface and excess energy must not be applied.

The ablation threshold of human enamel has been reported[14] to be in the range of 12-20 Joules/cm^2 and for dentin, 8-14 Joules/cm^2 for both the Er:YAG and Er,Cr:YSGG laser wavelengths, and each available instrument can provide this fluence. It is recommended that the clinician follow the manufacturer's guidelines in establishing laser treatment protocols for a given laser, keeping in mind the differing operating parameters of air / water / spot size and any power losses that may occur within differing delivery systems.

2. Laser-Tissue Interaction Considerations

In determining effective treatment the following factors may apply:

a. Target chromophores
b. Mode of interaction
c. Emission mode (pulsed or continuous wave, chopped) / pulse duration
d. General thermal effects
e. Relationship of laser action to cavity design / restoration retention
f. Speed of "cutting" / power values.

a. Target Chromophores

Both Er,Cr:YSGG and Er:YAG laser wavelengths are well absorbed in water due to the broad absorption band of water around and below 3,000 nm. In addition, there is a small absorption peak at around 2,800 nm by the hydroxyl ion of hydroxyapatite mineral content of the hard tissues. Enamel, dentin, bone, cementum, and carious tissue have relatively descending mineral density and ascending water composition.

b. Mode of Interaction

Constituent water, when exposed to laser energy in this wavelength range, absorbs the light efficiently and the energy is rapidly converted to heat, resulting in a disruptive expansion of water molecules in the tissue. As such, small tissue fragments may be ejected with little or no alteration to the mineral itself. With relatively high fluences it is possible that the laser light is absorbed by the mineral as well as the water resulting in ablation of the mineral and/or disruption with some structural modification.[15-17]

c. Emission Mode

The emission mode of current erbium lasers is defined as free-running pulsed and the pulse durations are close to the thermal relaxation times of enamel and dentin.[18]

d. General Thermal Effect

The use of water-assisted mid-infrared wavelengths allows work on hard tissues with thermal rises of less than 5° C in the pulp. It is necessary to avoid an accumulation of debris at the bottom of the cavity which can lead to conductive heat damage.[7, 17, 19-20]

e. Relationship of Laser Action to Cavity Design / Restoration Retention

Laser irradiation of enamel and dentin results in a micro-cavitated surface. While this roughness might be beneficial for retention of restorative materials, unsupported enamel rods can remain, which could compromise a marginal seal. The lased dentin surface shows an absence of a smear layer.[21]

f. Speed of "Cutting" / Power Values

The speed of ablation is a result of the amount of incident laser energy, the pulse duration, the repetition rate, and the thermal relaxation time. In addition other factors must be considered such as the speed of the movement of the laser handpiece relative to the target tissue, the focus distance of the laser beam, the incident angle of the delivery tip relative to the tooth, and the presence of ablation products.

3. Use of Coaxial Water Spray

Studies have investigated the effects of excessive incident power and the build-up of ablation products, or their removal by means of a coaxial water spray.[7, 22-25] The explosive defragmentation resulting from water-assisted mid-infrared wavelengths allows much of the heat to escape from the cavity carried in the ablated particles, resulting in pulpal thermal rises of less than 5° C. The affinity of mid-infrared laser wavelengths

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Case #1

ER:YAG LASER-ASSISTED TREATMENT OF FRACTURED TEETH

PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A healthy 9-year-old boy presented with three maxillary anterior teeth that were fractured due to an accident. The three broken pieces were kept in milk and the patient was brought to the dental office. The oral examination showed mixed dentition, healthy periodontium and TMJ, and the teeth were in Class I occlusion (Figure 1).

2. Radiographic Examination

Both the panoramic radiograph and the periapical radiograph showed no other abnormalities.

3. Soft Tissue Status

The soft tissue status showed good periodontal health.

4. Hard Tissue Status

Hard tissue test: Percussion was normal, with slight mobility and tenderness to touch and air spray.

5. Other Tests

Tooth vitality: All three fractured teeth tested vital with the electric pulp tester and cold testing.

B. Diagnosis and Treatment Plan

1. Provisional Diagnosis

Three upper frontal fractured teeth #7, 8 and 9.

2. Final Diagnosis

Extensive fractures close to the pulp on teeth #7, 8, and 9.

3. Treatment Plan Outline

The primary objective was to restore teeth #7, 8, and 9 using an Er:YAG laser in the following sequence:

- Ablate the most superficial dentin; prepare the surfaces of the fractured teeth and the fragments so that they could be bonded together.
- Reduce bacteria in areas of the tooth preparation close to the dental pulp, and attach the fragments with composite filling material.
- Refine the composite preparation by shaping, etching, and beveling the enamel. Hybrid composite resin would then be used to both lute the fractured segments to the tooth as well as to veneer the surface of both. Subsequently, the pulpal status would be evaluated.

4. Indications for Treatment

The indications for treatment were: To prepare adequate surface to obtain maximum area of adhesion and attach the fragments to the teeth using composite fillers. The Er:YAG laser wavelength is readily absorbed by hard tissue, therefore it is possible to more easily conserve healthy tooth structure than by using a conventional high-speed handpiece. In addition, the relative lack of tactile stimulation offered by laser treatment compared to a conventional high-speed handpiece often allows the procedure to be performed without the need for needle analgesia.

5. Contraindications for Treatment

There are no absolute contraindications for performing the procedure.

6. Precautions for Wavelength

Good visibility and low power will be necessary for careful preparation in order to avoid both thermal damage and excessive removal of tooth structure.

7. Treatment Alternatives

The treatment alternatives would have been conventional dental drills to roughen the dental surfaces; those burs could cause greater loss of hard tissue, microfractures of the tooth enamel, pulp exposition, and tenderness.

8. Informed Consent

Upon receiving a full explanation of the procedure, with associated risks, benefits, and alternatives, the patient and his parents gave consent to perform the treatment.

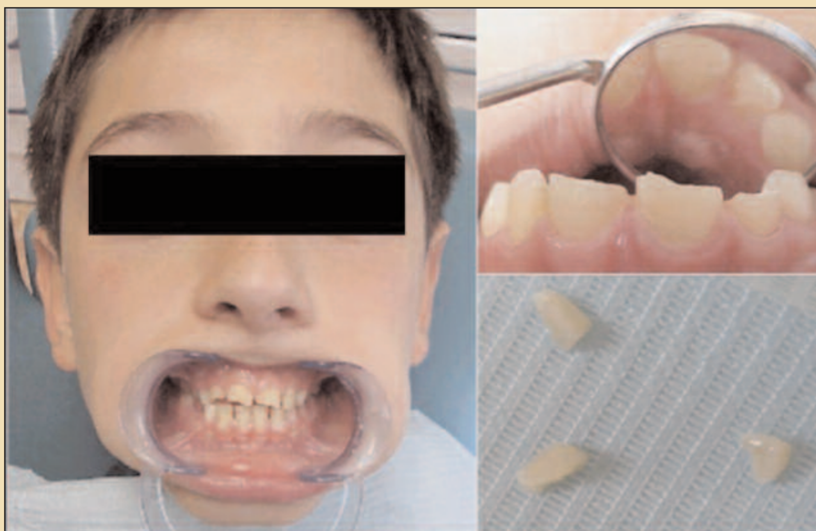

Figure 1: The patient with three fractured frontal teeth, with the fragments displayed separately

TREATMENT

A. Treatment Objectives Strategy

The primary objective was to use

the Er:YAG laser to prepare the two surfaces, one of the fractured teeth and one of the fragments, for maximum adhesion without greater loss of hard tissue or microfractures and without the use of injectable dental anesthetics.

B. Laser Operating Parameters
An Er:YAG laser (DELight, HOYA ConBio, Fremont, Calif.) with a wavelength of 2940 nm was used with its fiber delivery system and a 600-micron quartz tip. It operates in a free-running pulsed mode with a pulse duration of 300 µsec. The laser was used at 1.0 Watt (100 mJ, 10 Hz), quartz tip 80° with air in contact mode for dentin modification, and at 3.2 Watts (160 mJ, 20 Hz), quartz tip 80° with water mist in noncontact mode for dentin ablation (Figures 2-4).

C. Treatment Delivery Sequence
Prior to the procedure, the patient was familiarized with the treatment sequence. Subsequently, all laser safety precautions were performed, including, but not limited to, the administering of laser safety glasses to the patient and operators, displaying laser hazard signage, and inspecting the mechanical aspects of the laser. Once safety systems were in place, the laser was test-fired to ensure proper beam function and water spray delivery. The dentin was modified in both contact and noncontact modes. With the same settings, the laser energy was directed at the mating surfaces of the fractured segments. High-volume suction was used continuously. Clearfil SE Bond (Kuraray America, Inc., New York, N.Y.) was applied to enamel and dentin surfaces and a 0.4-micron filler size composite was used as the restorative material. Finishing of the restoration was performed with coarse diamond burs, 12-blade finishing burs, and finishing discs (Figure 5).

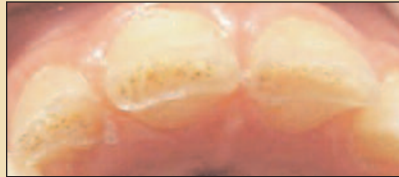
Figure 2: Completed dentin modification. Laser was used in contact mode

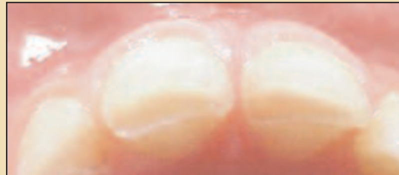
Figure 3: Dentin ablation completed. Laser was used in noncontact mode

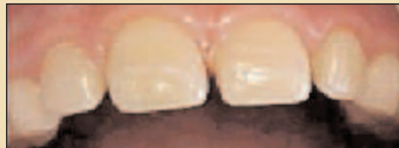
Figure 4: Immediate postoperative view of restorations

D. Postoperative Instructions
The patient was told that he could resume normal activities due to the lack of numbness as a result of no injections. The parents were told to call the office if pain or any other unusual symptoms occurred.

E. Complications
No complications occurred during or after the procedure.

F. Prognosis
The prognosis was good. The patient and parents were informed that the lesions were close to the pulp so that vitality tests would have to be repeated monthly for two years.

G. Treatment Records
Treatment records, including the details outlined above, were included in the patient's chart notations.

FOLLOW-UP CARE

A. Assessment of Treatment Outcome
The objectives originally set were achieved. The entire procedure was comfortably performed without the use of dental anesthetic. In addition, satisfactory esthetic results were obtained.

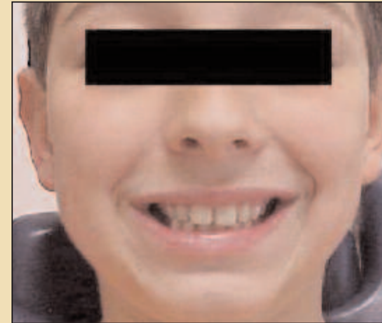
Figure 5: Smile restored

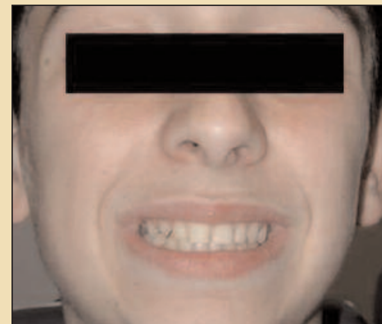
Figure 6: Two-year postoperative view

B. Complications
No complications were encountered during or after the treatment.

C. Long-Term Results
The long-term two-year results are in keeping with the objectives of the original treatment plan. The patient stated that he had experienced no problems with either restoration. The teeth maintained healthy vitality tests and the surfaces were sealed (Figure 6).

D. Long-Term Prognosis
Although the restoration of the treated teeth shows good integrity and function, the long-term prognosis is dependent upon proper correct closure maintenance and the patient's oral lifestyle.

for water allows for selective ablation, whereby greater absorption takes place in demineralized tissue richer in organic material and with a higher percentage of water; this allows some protection of the sound underlying tissue with a reduced penetration of the beam. The accumulation of ablation debris within a deep cavity can lead to "superheating" which can lead to conductive heat damage. Without water use, laser light may be absorbed by the mineral and the crystals themselves may be heated above their melting point.

Furthermore, any lack of water can lead to cracks in enamel or can result in melting of dentin with consequent flat adhesion surfaces. Thus negative effects for the enamel mean possible marginal leakage, and for the dentin possible nonadhesion of the completed restoration.

4. Exceptions to Using Water Spray

There are two clinical situations the restorative dentist might encounter which can be treated with lasers without the simultaneous use of a coaxial water spray:

a. Desensitizing Technique

This technique must be done without water and without contact with the tooth, for a short time only and with low power (using low Hz and low mJ).[26]

b. Pulp Capping

This technique must be carried out without water but with air cooling, and the tip must touch the surface for only a few seconds.[27]

5. Cavity Margin Considerations

A succession of studies has identified the fragility of laser-irradiated enamel, relative to the stability of the postrestoration margins. Studies have proposed an approach of combined laser-irradiation, acid-etch techniques to overcome such potential problems. Laser irradiation of enamel is not a valid alternative to acid-etching pretreatment for resin composite materials adhesion.

Irrespectively, there may well remain the need to remove grossly overhanging and unsupported enamel with a rotary bur, in order to either expedite cavity preparation or provide a stable postrestoration margin.[28-33]

6. Acid-Etch Considerations

While the surface produced by the laser is similar to the conventionally prepared, etched enamel surface, it still requires acid etching to obtain an equivalent

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Case #2

USE OF AN ER:YAG LASER TO PREPARE TEETH FOR VENEER PLACEMENT

PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A healthy 27-year-old female nonsmoker presented with two old restorations in the upper frontal teeth #8 and 9, and with gingival retraction on tooth #8; she presented for preparation for veneers. The oral examination showed healthy periodontium and TMJ, and the teeth were in Class I occlusion (Figure 7).

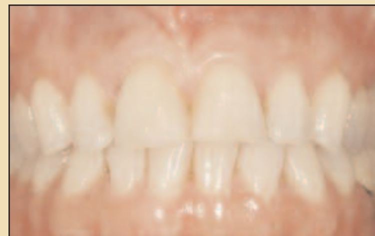

Figure 7: Preoperative view

2. Radiographic Examination

The periapical radiograph showed no radicular lesions.

3. Soft Tissue Status

The soft tissue status showed good periodontal health except the gingival retraction on tooth #8.

4. Hard Tissue Status

Hard tissue test: The teeth responded normally to percussion, were not tender to touch, and were not sensitive to air spray.

5. Other Tests

Tooth vitality: The teeth tested vital with the electric pulp tester and cold testing.

B. Diagnosis and Treatment Plan

1. Provisional Diagnosis

Two old restorations in the upper frontal teeth and gingival retraction on tooth #8.

2. Final Diagnosis

Two old restorations in the upper vital teeth #8 and 9, with gingival retraction on tooth #8.

3. Treatment Plan Outline

The primary objective was to prepare the teeth #8 and 9 using an Er:YAG laser in the following sequence:

- Prepare the two surfaces to obtain maximum surface for adhesion
- Decontaminate bacteria in the prepared areas.
- Use a bur to remove unsupported enamel and to smooth the preparation surfaces.
- Finally, place the veneers.

4. Indications for Treatment

The indications for treatment were: to prepare adequate surface to obtain maximum area of adhesion. The Er:YAG laser wavelength is readily absorbed by hard tissue, so the obtained craters allowed an increase in the surface area for adhesion. In addition, the relative lack of tactile stimulation offered by laser treatment compared to a

conventional high-speed handpiece often allows the procedure to be performed without the need for needle analgesia.

5. Contraindications for Treatment
There are no absolute contraindications for performing the procedure.

6. Precautions for Wavelength
Adequate water spray must be maintained as the procedure is being performed. Good visibility and low power will be necessary for careful preparation in order to avoid both thermal damage and excessive removal of tooth structure.

7. Treatment Alternatives
The treatment alternatives would have been conventional dental drills to roughen the dental surfaces; those burs could cause greater loss of hard tissue and increase of pulp temperature.

8. Informed Consent
Upon receiving a full explanation of the procedure, with associated risks, benefits, and alternatives, the patient gave consent to perform the treatment.

TREATMENT

A. Treatment Objectives Strategy
The primary objective was to use the Er:YAG laser to prepare the two surfaces for maximum adhesion without greater loss of hard tissue or microfractures and without the use of injectable dental anesthetics.

B. Laser Operating Parameters
An Er:YAG laser (DELight, HOYA ConBio, Fremont, Calif.) with a wavelength of 2940 nm was used with its fiber delivery system and a 600-micron quartz tip. It operates in a free-running pulsed mode with a pulse duration of 300 µ sec. The laser was used at 0.65 Watt (65 mJ, 10 Hz) quartz tip 30° with water mist in noncontact mode.

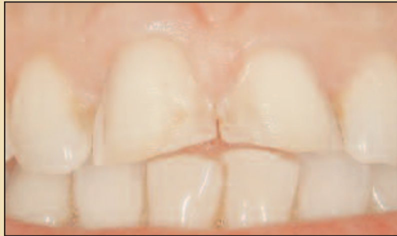

Figure 8: The final preparations after using the laser and burs

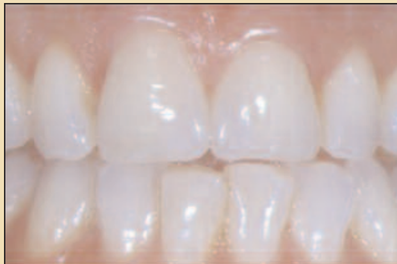

Figure 9: Immediate postoperative view showing final restorations

C. Treatment Delivery Sequence
Prior to the procedure, the patient was familiarized with the treatment sequence. Subsequently, all laser safety precautions were performed, including, but not limited to, the administering of laser safety glasses to the patient and operators, displaying laser hazard signage, and inspecting the mechanical aspects of the laser. Once safety systems were in place, the laser was test-fired to ensure proper beam function and water spray delivery. After the preparations for veneers were completed with a bur, the laser was used to produce craters to increase the surface area for adhesion. A bur was used as a final step to remove any unsupported enamel and to smooth the surface of the preparation (Figure 8). High-volume suction was used continuously.

The Variolink II (Ivoclar Vivadent AG, Schaan, Liechtenstein) composite system was used for the adhesive luting of the two veneers (Figure 9).

D. Postoperative Instructions
The patient was told that she could resume normal activities due to the lack of numbness. The patient was also told to call the office if pain or any other unusual symptoms occurred.

E. Complications
No complications occurred during or after the procedure.

F. Prognosis
The prognosis was good.

G. Treatment Records
Treatment records, including the details outlined above, were included in the patient's chart notations.

FOLLOW-UP CARE

A. Assessment of Treatment Outcome
The objectives originally set were achieved. The entire procedure was comfortably performed without the use of dental anesthetic. In addition, satisfactory aesthetic results were obtained.

B. Complications
No complications were encountered during and after the treatment.

C. Long-Term Results
The long-term results were considered to be excellent and in keeping with the objectives of the original treatment plan. The patient stated that she had experienced no problems. The teeth maintained healthy vitality tests.

D. Long-Term Prognosis
Although the restoration of the treated teeth shows good integrity and function, the long-term prognosis is dependent upon proper correct closure maintenance and the patient's oral lifestyle.

bond strength. Laser irradiation of enamel is not a valid alternative to acid-etching pretreatment for resin composite materials adhesion.[28-40]

7. Avoidance of Dehydration of Dentin

As stated above, laser ablation of dentin does not produce a smear layer so this layer cannot impede adhesion to laser-irradiated surfaces. Nevertheless when the erbium lasers are used, there is a selective ablation of organic tissue so that after acid-etching and laser conditioning of dentin there is less collagen left to be exposed and consequently to be hybridized. The weakest point with laser-treated dentin is the region immediately below the dentin layer infiltrated by resin.[36] A study by Ceballos and colleagues[37] using transmission electron microscopy showed a 3-4 nm altered dentin subsurface, with collagen fibrils without cross-banding and fused together, and elimination of interfibrillar space. Thus a bonding system must be used to ensure restoration retention.[38]

8. Choice of Composite Restorative Materials

The choice of composite materials must be made on the basis of the depth and width of dentin craters, and the use of composite nano- or micro-fillers is fundamental to the proper restoration of laser-ablated cavities. Whenever possible, the use of a first layer of composite flow is advisable.

Studies have shown that the seal at enamel margins in Er:YAG laser-irradiated preparations depends on the resin composite formulation of the corresponding adhesive.[39-40]

9. Isolation and Safety Considerations

Studies have shown that the Er:YAG laser demonstrates bactericidal potential for dentin.[41-42] A rubber dam isolation technique

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Case #3

ER:YAG LASER-ASSISTED TREATMENT OF AN ENAMEL DEFECT

PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A healthy 56-year-old male presented with an enamel defect of tooth #7 (Figure 11). The oral examination showed healthy periodontium and TMJ, and the teeth were in Class I occlusion.

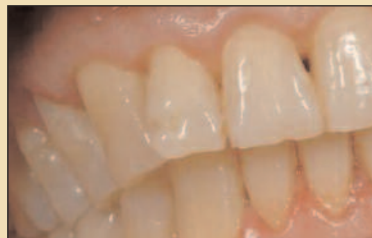

Figure 11: Preoperative view of enamel defect in tooth #7

2. Radiographic Examination

The radiographic exam showed no periapical lesions.

3. Soft Tissue Status

The soft tissue status showed good periodontal health.

4. Hard Tissue Status

Hard tissue test: Percussion was normal, with no mobility or tenderness to touch and air spray.

5. Other Tests

Tooth vitality: The tooth tested vital with the electric pulp tester and cold testing.

B. Diagnosis and Treatment Plan

1. Provisional Diagnosis

Tooth #7 with an enamel defect.

2. Final Diagnosis

Vital tooth #7 with an enamel defect.

3. Treatment Plan Outline

The primary objective was to restore tooth #7 using an Er:YAG laser in the following sequence:

- Prepare the cavities of the tooth
- Decontaminate bacteria in the treated surfaces.

Another objective was to prepare the margins using a bur to remove unsupported enamel and smooth the surface, and then to restore the cavities with hybrid composite resin.

4. Indications for Treatment

The indications for treatment were: to prepare an adequate surface to obtain maximum area of adhesion and restore the cavities with hybrid composite resin. The Er:YAG laser wavelength is readily absorbed by hard tissue, therefore it is possible to more easily conserve healthy tooth structure than by using a conventional high-speed handpiece. In addition, the relative lack of tactile stimulation offered by laser treatment compared to a conventional high-speed handpiece often allows the procedure to be performed without the need for needle analgesia.

5. Contraindications for Treatment

There are no absolute contraindications for performing the procedure.

6. Precautions for Wavelength

Adequate water spray must be maintained as the procedure is being performed. Good visibility and low power will be necessary for careful preparation in order to avoid both thermal damage and excessive removal of tooth structure.

7. Treatment Alternatives

The treatment alternatives would have been conventional dental drills to roughen the dental surfaces; those burs could cause greater loss of hard tissue,

microfractures of the tooth enamel, and tenderness.

8. Informed Consent
Upon receiving a full explanation of the procedure, with associated risks, benefits, and alternatives, the patient gave consent to perform the treatment.

TREATMENT

A. Treatment Objectives Strategy
The primary objective was to use the Er:YAG laser to prepare the surfaces of the cavities in order to obtain the maximum adhesion without greater loss of hard tissue or microfractures and without the use of injectable dental anesthetics.

B. Laser Operating Parameters
An Er:YAG laser (DELight, HOYA ConBio, Fremont, Calif.) with a wavelength of 2940 nm was used with its fiber delivery system and a 600-micron quartz tip. It operates in a free-running pulsed mode with a pulse duration of 300 µsec. The laser was used at 5 Watts (200 mJ, 25 Hz), quartz tip 80° with water mist in noncontact mode for enamel ablation, and at 3.2 Watts (160 mJ, 20 Hz), quartz tip 80° with water mist in noncontact mode for dentin ablation.

C. Treatment Delivery Sequence
Prior to the procedure, the patient was familiarized with the treatment sequence. Subsequently, all laser safety precautions were performed, including, but not limited to, the administering of laser safety glasses to the patient and operators, displaying laser hazard signage, and inspecting the mechanical aspects of the laser. Once safety systems were in place, the laser was test-fired to ensure proper beam function and water spray delivery. After enamel and dentin ablation was completed (Figure 12), a bur was used to

Figure 12: View of preparation after laser use

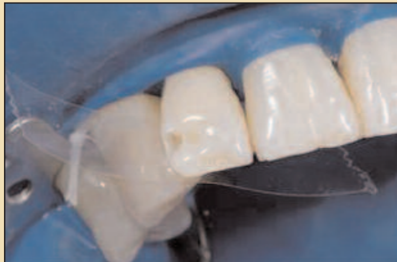

Figure 13: View of preparation after bur use and acid etching

remove unsupported enamel and refine the margins of the preparation. High-volume suction was used continuously. The preparation was then etched with phosphoric acid. Figure 13 shows the completed etched preparation.

Clearfil SE Bond (Kuraray America, Inc., New York, N.Y.) was applied to enamel and dentin surfaces and a nano-composite Adonis (Sweden & Martina S.p.A., Due Carrare-Padova, Italy) was used as the restorative material. Finishing of the restoration was performed with coarse diamond burs, 12-blade finishing burs, and finishing discs (Figure 14).

D. Postoperative Instructions
The patient was told that be could resume normal activities due to the lack of numbness as a result of no injections. The patient was told to call the office if pain or any other unusual symptoms occurred.

E. Complications
No complications occurred during or after the procedure.

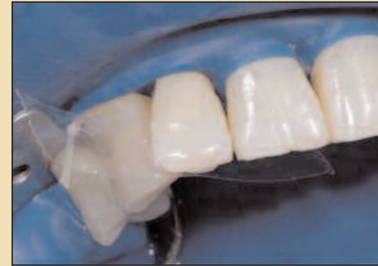

Figure 14: Immediate postoperative view of the restoration

F. Prognosis
The prognosis was good.

G. Treatment Records
Treatment records, including the details outlined above, were included in the patient's chart notations.

FOLLOW-UP CARE

A. Assessment of Treatment Outcome
The objectives originally set were achieved. The entire procedure was performed with success without the use of dental anesthetic. In addiction, satisfactory aesthetic results were obtained.

B. Complications
No complications were encountered during or after the treatment.

C. Long-Term Results
The long-term results are in keeping with the objectives of the original treatment plan. The patient stated that he had experienced no problems with the restoration. The tooth maintained healthy vitality tests.

D. Long-Term Prognosis
Although the restoration of the treated tooth shows good integrity and function, the long-term prognosis is dependent upon proper correct closure maintenance and the patient's oral lifestyle.

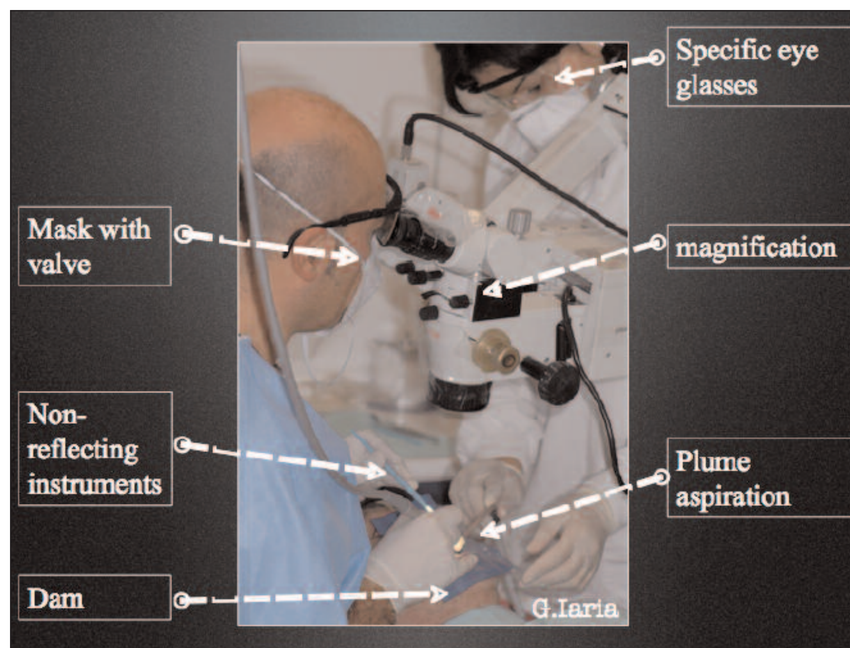

Figure 10: Correct mode of operation using lasers with proper safety measures depicted

must be used in every procedure to maintain the decontamination provided by the laser. As illustrated in Figure 10, safety measures should include the use of:

- wavelength- and device-specific protection glasses for the doctor, the assistant, and patient
- appropriate face masks to avoid plume aspiration
- high-speed evacuation of plume and debris
- nonreflecting instruments
- magnification to better visualize and control the dentist's work.

10. Miracles Don't Happen!
Finally, it should be remembered that lasers are not magic wands — a lot can be done with lasers, but the dentist's knowledge and experience take precedence over the tools. An accurate diagnosis is the only basis to offer the patient the correct therapy which must be carried out with due expertise.

AUTHOR BIOGRAPHIES

Dr. Prof. Giuseppe Iaria qualified in Medicine and Surgery at University of Milan in 1984. His postgraduate dental qualifications — Dentist and Orthodontist – were obtained at the University of Milan in 1987 and 1989 with the highest marks. During the Sixth International Conference of the Academy of Laser Dentistry in Palm Springs, California in February 1999, he achieved his certificate of Master of the Academy of Laser Dentistry. On October 22, 2000 he obtained the certification of Dental Laser Educator at the University of California San Francisco. In 2001, the publishing house UTET published his text entitled *The Lasers in Dentistry and Oral Surgery*. On April 16, 2004 he was certified with the International Society for Lasers in Dentistry.

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Editor's Note: *USA clinicians are advised that no erbium laser has been cleared by the U.S. Food and Drug Administration for the desensitization, pulp capping, and decontamination procedures and bactericidal properties identified in this article.*