

Use of an 810-nm Diode Laser in a Combined Gingivoplasty, Frenectomy, and Second-Stage Implant Recovery Procedure

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SYNOPSIS

Multiple procedures using a diode laser are described prior to placement of a fixed bridge.

PRETREATMENT

A. Outline of Case

1. Full Clinical Description

A 78-year-old male patient attended for a routine examination (Figure 1). He had been a regular patient of the practice during a three-year period and had received only examination and hygiene maintenance at six-monthly intervals. At his current visit, he expressed a need to evaluate the possibility of replacing his existing upper and lower cast chrome-cobalt partial dentures with fixed prostheses. He was advised that treatment would involve the provision fixed bridgework in three quadrants, with additional support through implant-retained abutments in the upper left quadrant.

MEDICAL HISTORY

The patient was in general good health. He had been prescribed beta-blockers for hypertension, which was under control. In addition, he was taking statins for hypercholesterolemia.

DENTAL HISTORY

The patient had lost several teeth many years previously and had been provided with earlier upper and lower acrylic resin dentures. These had been replaced by cast chrome-cobalt / acrylic resin dentures which had remained satisfactory through the past 10 years. However, the patient expressed dissat-



Figure 1: Preoperative view at presentation

isfaction with the comfort of these prostheses during function. Despite his earlier treatment, he had sought regular dental treatment during the latter years and had maintained a high level of oral health.

2. Occlusion

During examination of the dental arches in occlusion and the underlying skeletal landmarks, it was noted that the patient had a Class I occlusion, with normal Frankfort and maxillary (FMP) angle.

3. TMJ

Examination of both temporomandibular joints, through palpation and radiograph, revealed normal structure and movements. Opening / closing and excursive movements of the mandible revealed no abnormality. With the dentures in place, there was group function of posterior quadrants on both sides. This was noted for duplication in the new prostheses.

4. Radiographic Examination

Panoramic (Figure 2) and periapical

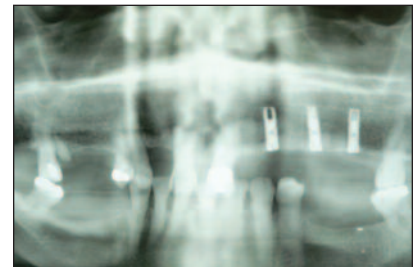


Figure 2: Preoperative panoramic radiograph showing several implant fixtures fully osseointegrated



Figure 3: Preoperative periapical radiograph of tooth #9

(Figure 3) radiographs were taken to establish both dental and alveolar bone status prior to treatment. These views were repeated at stages during the treatment, as required. With the exception of dental findings listed below, there was no sign of hard tissue pathology in either jaw or TMJ regions. It was noted that there was sufficient alveolar bone in the edentulous upper left region, to allow the placement of dental implants (Figure 4). There was visual evidence of retained root fragments associated with extractions in both maxillary molar regions.



Figure 4: Interocclusal view showing adequate space for new prosthesis



Figure 5: Left lateral view showing posterior frenum attachment near the ridge crest

5. Soft Tissue Status

General oral soft tissue:

Examination of all soft tissue structures revealed no abnormality. All tissues appeared normal in appearance, and dorsal and ventral tongue surfaces, together with tongue movements, were within normal expectations. The loss of teeth in the upper left quadrant had resulted in some loss of postextraction keratinized gingival tissue. This was of concern in the bicuspid region, where there was a low frenal attachment, as shown in Figure 5.

Gingival soft tissues: All natural tooth sites were examined with a periodontal probe and findings recorded, as shown in Figure 6. Of specific relevance to the treatment provided, there was some false pocketing at tooth #9, with recorded depths of 3 mm on mesial, distal, and facial aspects. Generally, the attached gingiva appeared thickened, yet healthy in appearance (Figure 7). Such hypertrophic change may have been due to anti-hypertensive medication and did not merit any further intervention. The general level of oral hygiene



Figure 6: Preoperative periodontal probe chart

was considered good with signs of calculus deposits only on teeth #22, 23, and 26.

6. Hard Tissue Status

At the time of initial active-treatment assessment, the following teeth were charted as missing:

- Upper jaw: #1, 3, 4, 7, 10, 11, 12, 13, 14, and 16.
- Lower jaw: #17, 19, 20, 27, 28, 29, 30, and 32.
- Tooth #9 had been restored with a porcelain-fused-to-metal (PFM) crown, and teeth #2, 5, 18, and 31 restored with amalgam. There was evidence of caries distally at tooth #18. The PFM crown at tooth #9 had been re-cemented several times and this may have been due in part to a short clinical crown height.
- *Tooth vitality test:* All teeth tested vital to ethyl chloride.
- *Mobility:* There was no mobility recorded at any natural tooth site.
- *Percussion:* Percussion testing of all tooth sites revealed no hyperesthesia.

7. Other Tests

Pertinent to the presenting oral condition and the proposed treatment plan, it was considered that no further tests were appropriate.

B. Diagnosis and Treatment Plan

1. Provisional Diagnosis

Treatment for this patient to fully restore his dentition in accordance with his preferences would involve several stages, including implant placement and fixed bridgework.



Figure 7: Preoperative view of gingival tissue level around tooth #9

With regard to laser-assisted therapy, it was considered appropriate that some soft tissue manipulation would be required in the upper left quadrant.

2. Final Diagnosis

Laser-assisted treatment could be assigned in accordance with the following clinical needs:

- Gingivoplasty at tooth #9 to remove hyperplastic tissue and achieve some crown-lengthening. The disparity in gingival levels with tooth #8 was acceptable to the patient and the amount of bone and gingival tissue removal required to achieve a balanced appearance was considered prejudicial to the long-term survivability of tooth #9.
- Second-stage recovery of implants placed in the upper left cuspid, bicuspid, and molar regions.
- Lateral frenectomy of low attachment of buccinator fibers to preserve attached gingiva associated with the bicuspid implant.

The final diagnosis reflected the observations and needs outlined above.

3. Treatment Plan Outline

General: Three dental implants would be placed in the upper left quadrant, as part-support for fixed bridgework. In addition, bridge-work would be provided in the other three posterior quadrants.

Specific: In order to facilitate optimal soft tissue profiles for both natural and implant abutments in the upper left quadrant, it was

decided to use an 810-nm diode laser to remove hyperplastic gingival tissue associated with tooth #9, to effect second-stage recovery of the implants, and to carry out a relieving frenectomy at the lateral frenal attachment of superficial buccinators fibers.

4. Indication and Contraindications INDICATIONS

Treatment: In all areas of soft tissue management within this treatment plan there is an ideal in achieving hemostasis, consistent with the need to provide access for hard tissue treatment and early abutment preparation of tooth and implant sites. In addition, an optimal definition of a stable gingival margin at tooth #9 would allow early placement of a permanent coronal restoration. A further indication would include the delivery of soft tissue surgery that provides minimal postoperative discomfort and complication for the patient. The use of a suitable laser wavelength would seek to meet these requirements.

Laser: It is recognized that all laser-tissue interactions in surgical procedures are predominately photothermal in nature. The conversion of incident laser light energy into heat will lead to primary and, through local conduction, secondary heat effects that would allow soft tissue surgery to be carried out through tissue ablation with a supportive hemostasis. As such, the use of laser energy to effect soft tissue surgery is justified.

Wavelength: The predominant chromophores of the keratinized and nonkeratinized gingival tissue in this case are melanin (tissue pigment), hemoglobin, and intracellular water. In addition, the prime needs of treatment would be to achieve tissue ablation with hemostasis, indicating the optimum need for using a near-infrared wavelength, such as the 810-nm diode laser.

CONTRAINDICATIONS

Treatment: The only absolute contraindication to treatment in this case would be to accept the original situation of a well-fitting partial denture. However, in view of the patient's wishes, this alternative was abandoned. Consequently, soft tissue manipulation is mandatory and there can be few if any contraindications for treatment. In addition, further considerations apply:

- a. biologic width (i.e., the sum of the connective tissue attachment, epithelial attachment, and sulcular depth relative to the osseous crest) must be determined and considered when recontouring the periodontium with a subsequent placement of a restoration.
- b. aesthetic considerations – lip line height, etc. in placement of the final gingival contour. Is the patient accepting of the contour, should it match the adjacent teeth, does the lip hide it anyway, and so on.

Laser: Any surgery using laser energy carries some risk of tissue damage and this possibility must be borne in mind.

Wavelength: The choice of a longer wavelength would offer a more superficial level of tissue ablation.

5. Precautions

The benefit of hemostasis offered by near-infrared laser wavelengths is accepted. In comparison to the Nd:YAG laser, the depth of penetration of the 810-nm diode wavelength in oral soft tissue is less, which would reduce the risk of collateral thermal damage. Nonetheless, the use of minimum power parameters, as well as time intervals to allow thermal relaxation and control of carbonization of the tissue and optic fiber, would all reduce the risk of primary and secondary thermal damage.

Gingivoplasty: Whenever periodontal contouring and tissue removal is undertaken in association with natural teeth, attention must

be given to the preservation of the biological width. In addition, preservation of a stable result is dependent on good patient home care.

Second-Stage Implant

Recovery: Care should be exercised to accurately locate the position of the implant. Tissue ablation should proceed slowly and with care to remove any char. Wherever possible, direct contact with the cover screw or any surrounding crestal bone should be avoided.

Lateral Frenectomy: Tissue traction during laser incision will assist the ability to resect using minimal power parameters. In addition, the laser fiber tip should be angled as near possible, parallel to the alveolar bone, to avoid damage to the hard tissue and periosteum.

6. Treatment Alternatives

Alternative methods for soft tissue incision would include a scalpel, electrosurgery, and soft tissue punch for implant sites.

7. Informed Consent

The treatment plan was fully explained to the patient and all associated risks outlined. A written consent form was signed by the patient in the presence of a witness. The consent form was retained in the treatment notes.

TREATMENT

A. Treatment Objectives

The objective of this treatment would be to effectively remove or resect soft tissue at each of the treatment sites, with the 810-nm diode laser, with minimal peri- and postoperative complications.

B. Laser Operating Parameters

1. Laser:

- A diode laser (DioLase ST, American Dental Technologies, Corpus Christi, Texas) was used. The operating features are as follows:
- Wavelength: 810 nm
- Co-axial aiming beam: Diode Class I laser 630-680 nm, 3 mW

- Emission mode: Continuous wave (CW) with supplementary gated CW, single or repetitive single pulse
- Maximum power output: 12.0 Watts
- Delivery system: Quartz fiber-optic (320- μ m diameter) with conduit handpiece and disposable cannula tip
- Beam diameter: 320 μ m.

2. Laser settings:

- Gingivoplasty / second-stage implant recovery: 1.4 W CW / contact mode. Time taken per site: 1-2 minutes.
- Lateral frenectomy: 1.7 W CW / contact mode. Time taken: 1-2 minutes.

C. Treatment Delivery Sequence

1. Preliminary to patient treatment

- Secure operating room, define controlled area, and place proper laser warning signs.
- Set up laser and test proper laser operation.
- Test-fire laser, employing all safety measures, using minimum power settings and directing beam onto articulating paper. Objective is to ensure correct laser operation, patency of delivery system, and emission of cutting and aiming beams. In addition, the fiber tip can be inspected to ensure that a proper cleave has been carried out and the spot size is uniform.
- Dispense supplies, and arrange equipment and sterile instruments.
- *Review patient information:* charting, X-rays, etc.
- *Patient seated:* review treatment plan and informed consent.
- *Safety:* place eye protection, patient first followed by operating personnel.

2. Treatment sequence

Individual treatment sites were isolated and infiltration local anaesthetic (2% lignocaine 1:80,000 adrenalin) was administered.



Figure 8: Diode laser beginning the removal of gingiva on tooth #9



Figure 9: Laser procedure finished on tooth #9



Figure 10: Curette used to clean edges of soft tissue

Gingivoplasty tooth #9: Laser power setting: 1.4 Watts CW. The soft tissue pocket was explored with a periodontal probe. The laser fiber was lightly initiated using articulating paper and, perpendicular to the surface, a series of points were developed on the labial gingiva to outline the incision line (Figure 8). With a light contact of the fiber with tissue, the incision line was developed, with minimum depth. Any char on the tissue or fiber tip was removed with damp gauze. Successive sweeps of the fiber allowed precise tissue cleavage to be carried out, as shown in Figure 9. The final excess tissue removal was achieved with a sharp curette, as shown in Figure

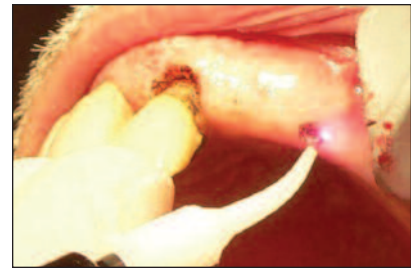


Figure 11: Diode laser beginning the removal of tissue covering implant fixture on tooth #11



Figure 12: Healing cap placed on #11. Diode laser beginning the removal of tissue covering implant fixture on tooth #14



Figure 13: Healing cap placed on #14. Diode laser beginning the removal of tissue covering implant fixture on tooth #13

10. In this way, direct contact with the underlying tooth was avoided.

Second-Stage Implant: Laser power setting: 1.4 Watts CW. At each site, the location of the cover screw was identified with an explorer. With the fiber freshly cleaved and lightly initiated, a circular incision was developed in the overlying keratinized gingiva. This was gradually deepened, with care to avoid the build-up of char, until the cover screw was uncovered. Excess tissue was removed to completely expose the extent of the screw and healing caps were placed (Figures 11-13).



Figure 14: Healing cap placed on #13. Diode laser beginning frenectomy



Figure 15: Immediate postoperative view of completed diode laser procedures



Figure 16: One-week postoperative view of gingival tissue around tooth #9

Lateral Frenectomy: Laser power setting: 1.7 Watts CW. The buccal tissue was placed under tension to identify the profile of the muscle fiber insertion. The optic fiber was freshly cleaved and lightly initiated. With the fiber held perpendicular to the tissue surface and parallel to the alveolus at 2-3 mm away from fixed gingival tissue, an initial incision was performed. With the tissue under tension, the incision was developed to a depth where superficial muscle fibers were parted, as shown in Figure 14, and no blanching or movement of gingival tissue was observed. Care was taken to avoid char build-up in the tissue or on the fiber tip and the incision was restricted to achieve the surgical objective (Figure 15).



Figure 17: One-week postoperative view of soft tissue healing around the implants and the frenum

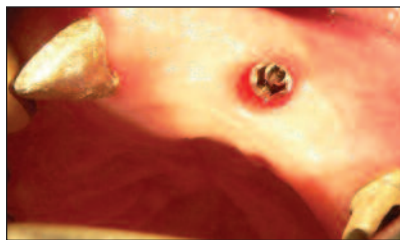


Figure 18: Two-week postoperative view of soft tissue around implant #11



Figure 19: Two-week postoperative view of soft tissue around implant #14

At this time, adjunctive treatment including implant healing cap placement was carried out and the denture adjusted to allow correct seating.

D. Postoperative Instructions

The surgical sites were shown to the patient and their appearance was explained. A chlorhexidine mouthwash was prescribed and the patient instructed to carefully apply this with cotton wool, avoiding disturbance of the coagulum; this should be carried out three times daily during the five-day postoperative period. The patient was advised that the appearance of the treatment sites



Figure 20: Two-week postoperative view of soft tissue around implant #13



Figure 21: Abutments fitted on implants



Figure 22: Telescoping thimble restoration on tooth #9

would change, with detachment of the coagulum at fixed gingival sites and softening and hydration of loose tissue at the frenectomy site at 3-5 days post-operation. The patient would be reviewed at one week and light toothbrushing commenced at the tooth site. Postoperative analgesia was prescribed for use as required. There were considered no limitations on eating or drinking. The patient was instructed to call should any problem occur and was called by phone after 24 hours.

E. Complications

Complications that can be expected following laser soft tissue surgery can include pain, tissue swelling and deformation, bleeding, and



Figure 23: Immediate postoperative view of prosthesis in place



Figure 24: Three-month postoperative probing of tooth #9



Figure 25: Three-month postoperative probing of implant #11

infection. In this case, no such complications were encountered.

F. Prognosis

Laser-assisted soft tissue procedures, employing correct power parameters and technique, generally have a very good prognosis. It was felt that in this case a similar outcome could be expected.

G. Treatment Records

All procedural details, both generally and specifically with reference to the laser use, were entered in the patient's treatment notes, along with the consent details, radiographs, and chartings. As such, the treatment records would reflect the treatment outlined above.



Figure 26: Three-month postoperative probing of implant #13



Figure 27: Three-month postoperative probing of implant #14



Figure 28: Six-month postoperative view of prosthesis

FOLLOW-UP CARE

A. Assessment of Treatment Outcome

The patient was reviewed at one week. The healing was progressing well, as shown in Figures 16 and 17. At two weeks, the healing caps were removed to inspect the tissue contour around the implants, and the contours were excellent (Figures 18-20). The gingivoplasty site resolved rapidly at two weeks and the frenectomy site gradually healed during four weeks after surgery. The implant abutments (Figure 21) and the telescoping thimble on tooth #9 (Figure 22) were fitted during this time. Shortly thereafter, the final prosthesis was delivered, as shown in Figure 23.

Subsequent appointments at weekly intervals allowed regular

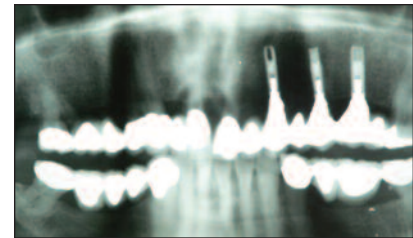


Figure 29: Six-month postoperative panoramic radiograph

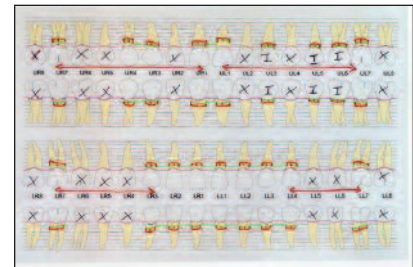


Figure 30: Ten-month postoperative periodontal chart

review of the tissue. The soft tissue sites were therefore regularly reviewed initially and at three months, six months, and one year. Figure 24 shows excellent gingival health and minimal pocket depth around tooth #9 and identical findings existed around the three implants, as shown in Figures 25-27. In all cases, the healing was as expected and normal oral function was maintained. Tooth #9 was vitality-tested and a positive response recorded. Figure 28 shows the six-month post operative view, and Figure 29 depicts a panoramic radiograph at that same interval. The 10-month probing chart, shown in Figure 30, exhibits good periodontal health.

The one-year postoperative view of the prosthesis is shown in Figure 31. At one year, the tissue tone is excellent and the physiologic contour shows very good adaptation to the abutments. Periodontal probings of the implant abutments, shown in Figures 32-34, demonstrate excellent tissue attachment. Radiographs at one year also confirm the health and fit of the restorations (Figures 35-37).



Figure 31: One-year postoperative view of prosthesis



Figure 34: One-year postoperative probing of implant #14

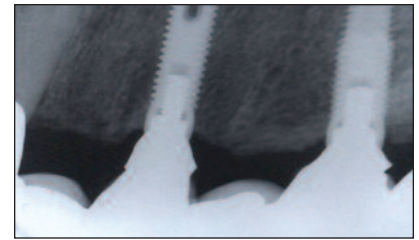


Figure 36: One-year postoperative radiograph of implants #11 and 13.



Figure 32: One-year postoperative probing of implant #11

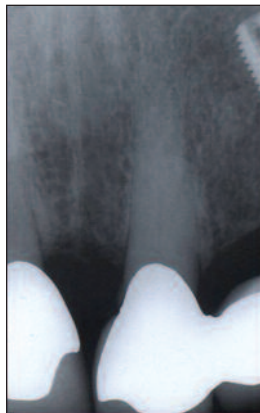


Figure 35: One-year postoperative radiograph of tooth #9

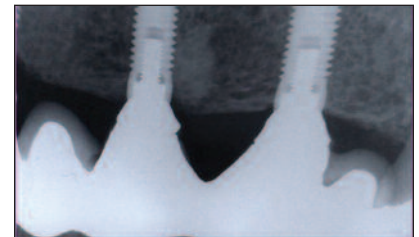


Figure 37: One-year postoperative radiograph of implants #13 and 14.



Figure 33: One-year postoperative probing of implant #13

treatment provided should be considered as good. The patient continues to maintain good oral hygiene and attends for assessment as required. He is pleased with the aesthetic and functional result obtained.

AUTHOR BIOGRAPHY

Dr. Steven Parker studied dentistry at University College Hospital Medical School, University of London, UK and graduated in 1974. He is in Private Practice in Harrogate, UK. He holds Fellowship and Diplomate status with the International Congress of Oral Implantologists. Dr. Parker has been involved in the use of lasers in dentistry since 1990. Prior to joining the Academy of Laser Dentistry in 1993, he was President of the British Dental Laser Association. He joined the Board of Directors of the Academy in 1996 and became chair of the International Relations Committee. From 1999 through

2004, he was chair of the Committee for Proficiency Recognition and co-editor of *Wavelengths*, the former journal of the Academy of Laser Dentistry. He was awarded the Leon Goldman award for Excellence in Clinical Laser Dentistry by the Academy in 1998. In addition, Dr. Parker holds Advanced Proficiency status in multiple laser wavelengths and completed the Academy Educator Course at the University of California – San Francisco in 2000. He is an ALD-Recognized Standard Proficiency Course Provider. He has held consultancies with multiple laser companies and has presented courses, lectures, and workshops worldwide. He has authored numerous articles on the use of lasers in dentistry, including a chapter “The Use of Lasers in Fixed Prosthodontics” in the October 2004 *Dental Clinics of North America*. Dr. Parker was the 2005 President of the Academy of Laser Dentistry. Dr. Parker may be contacted by e-mail at thewholetooth@easynet.co.uk.

Disclosure: Dr. Parker has no current affiliations with any company. ■

B. Complications

No long-term complications were observed. Some concern was expressed that the amount of attached gingiva adjacent to the frenectomy site might compromise the health and function of the implant cuff, but this tissue has remained stable and normal in appearance.

C. Long-Term Results

The long-term results are in keeping with the objectives of the original treatment plan. The restorative phases of treatment were satisfactorily completed and the patient was very satisfied with the outcome.

D. Long-Term Prognosis

The long-term prognosis of the