The Use of the Erbium Yttrium Aluminum Garnet (2940nm) in a Laser-Assisted Crown Lengthening Procedure

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Abstract

Surgical crown lengthening is a periodontal resection procedure, aimed at removing the supporting periodontal structures to gain sound tooth structure above the alveolar crest level. These techniques can also be applied to the management of aesthetic gingival problems.

Introduction

This article will describe and demonstrate the use of the Erbium:YAG 2940nm laser system (LiteTouch, Syneron Medical Ltd.) as a central tool in the treatment of osseous crown lengthening, and the advantages this wavelength offers versus the use of conventional methods.

Objectives and Methods of Clinical Crown Lengthening

Crown lengthening is a surgical procedure employed for the removal of periodontal tissue, in order to increase the clinical crown height. It is the most frequently used and valuable periodontal surgical procedure related to restorative treatment[1-4].

The objectives of clinical crown lengthening include:

- Removal of subgingival caries
- Preservation and maintenance of restorations
- Cosmetic improvement
- Enabling restorative treatment without impinging on biologic width
- Correction of the occlusal plane
- Facilitation of improved oral hygiene

There are two methods of crown lengthening:

- Orthodontic - coronal extension
- Surgical - apical extension

Clinical Considerations for Crown Lengthening

- Importance of the tooth
- Subgingival caries
- Clinical crown/root ratio
- Root length and morphology
- Residual amount of bone supporting
- Furcation involvement
- Tooth mobility
- Aesthetic demands
- Post-op maintenance and plaque control

The Biologic Width and Aesthetic Dentistry

The clinician must create a symmetrical and harmonious relationship between the lips, gingival architecture and positions of the natural dentate forms. Spear[5] *et al* have referred to this diagnostic methodology as facially generated treatment planning, where the maxillary central incisal edges determine where the soft tissue (i.e., gingiva) and bone should be positioned[6].

For the restorative dentist to utilize crown lengthening, it is important to understand the concept of biologic width, indications technique and other principles[7-9].To maintain healthy periodontal tissue, the attached gingival and biologic width must be considered. Biologic width is measured from the bottom of the gingival sulcus to the alveolar crest and is maintained by homeostasis[10,11]. This width consists of the epithelial attachment which is against the tooth surface and its connective tissue. The average width is 2.04mm. Impinging biologic width may cause periodontal tissue destruction; therefore in crown lengthening, the position of the margin is important.

Methods of Clinical Crown Lengthening

As mentioned above there are two methods to lengthen a crown: coronal extension and apical extension. Apical extension of the crown is achieved by surgery, with or without osseous resection.

In apical extension there are two methods:

- **The open technique** - patients who exhibit asymmetrical gingival levels, those with greater than 3 to 5mm of maxillary gingival display, or both may be candidates for surgical gingival and/or alveolar bone repositioning to improve their aesthetics.
- **The close technique** - for minor localized biologic

width and/or aesthetic gingival zenith corrections. Can be used in lieu of a flap procedure to make the correction and complete the restorative process without the necessary healing time required for open crown lengthening surgeries[12].

CASE STUDY

This clinical report describes a situation in which a crown lengthening procedure was successfully performed with the Er:YAG laser (LiteTouch, Syneron Medical Ltd.) as a principal auxiliary tool, and the advantages of the 2940nm wavelength versus conventional methods.

EXAMINATION

Clinical examination of a 57 year old male revealed missing teeth at the locations of # 17, 36, 44, 45 & 46 with over eruption of teeth # 14 & 15 (Figure 1).

Radiographic examination of the area showed over eruption of teeth 14 & 15 with the alveolar bone.

TREATMENT OPTIONS

The treatment options available in this case were:

- Insertion of implants and metal-ceramic crowns at the locations of teeth # 17, 36, 44, 45 & 46.
- In addition to option 1 above - crown lengthening for teeth # 14 & 15 and covering them with metal-ceramic crowns.

Following discussion with the patient and evaluation of the possibilities for success, it was decided to perform crown lengthening.

Treatment would involve use of the Er:YAG laser to perform the following, based upon accepted research:

- Flap incision[13-15]
- Ablation of soft tissue around the teeth after raising a flap[16-18]
- Remodeling, shaping and ablating of the bone[13,15,19,20]

TREATMENT

The five implants were placed in one sitting (figure 2). The crown lengthening was performed three weeks post-op (Figure 3).

The laser operating parameters employed for the various surgical stages were as follows:

• ***Flap Access:***

Wavelength: 2940nm (Er:YAG), 600-micron sapphire tip, in contact mode; 200mJ per pulse at 35 Hz. Total power: 7 Watts.

• ***Soft Tissue Removal:***

Wavelength: 2940nm (Er:YAG), 1300-micron sapphire tip, in non-contact mode; 400mJ per pulse at 20Hz. Total power: 8 Watts.

• ***Bone Surgery:***

Wavelength: 2940nm (Er:YAG), 1300-micron sapphire tip, in non-contact mode; 300mJ per pulse at 20 Hz. Total power: 6 Watts.

With the assistance of a diode laser operating at a power setting of 2.4W in contact mode, the location of the incision was marked (Figures 4 & 5). An incision was made with the laser (after anesthesia) at the buccal and palatal side of teeth # 14 & 15 (Figure 6) and a vertical incision was not required. The buccal and palatal flaps were lifted and the area explored (Figure 7); there was soft tissue around the neck of the teeth. The soft tissue was ablated using the laser. Vaporization of soft/granulation tissue (if any exists) after raising a flap is efficient with the Er:YAG laser, offering a lower risk of overheating the bone than that posed by the diode or CO_2 lasers[23] and often obviates the need for hand instruments. Results from both controlled clinical and basic studies have pointed to the high potential of the Er:YAG laser and its excellent ability to effectively ablate soft tissue without producing major thermal side-effects to adjacent tissue have been demonstrated in numerous studies[16-18].

The Er:YAG laser was aimed at the surface of the exposed bone which was ablated in non contact mode (Figure 8). Studies have shown that Er:YAG laser energy effects on bone include bacterial reduction[22]. Following this all accessible bone surfaces were exposed to laser energy to ablate necrotic bone and to shape and remodel the surface, in accordance with established clinical protocols[13,15,20]. The bone level around teeth # 14 & 15 fit to the bone level of teeth # 13 & 16 (Figure 9). The mucoperiosteal flap was re-positioned and sutured with silk 3-0, paying particular attention to primary closure of the flap (Figure 10) .

POST-OPERATIVE INSTRUCTIONS

The patient was prescribed antibiotics to avoid infection and painkillers for pain. Instructions were given to rinse with Chlorhexidine 0.2%, starting the next day for two weeks, three times per day.

MANAGEMENT OF COMPLICATIONS AND FOLLOW-UP CARE

The following day the patient reported moderate pain and moderate swelling. There was no tissue bleeding and the site was closed. The flap was showing signs of attachment and was healing nicely. At seven days post-op the patient returned for inspection and removal of sutures. The swelling had resolved and healing was progressing well (Figure 11). After five months the soft tissue was completely healed without complications (Figure 12). The soft issue had healed over the bone and there were no no bony projections observed under the soft tissue. The prognosis is excellent. An impression was taken five months post-op for two metal-ceramic crowns (Figure 10).

An aesthetic result has been achieved (Figures 13 & 14).

Conclusions

The Er:YAG laser system (LiteTouch, Syneron Medical, 2940nm) can be employed as an auxiliary tool for the purpose of crown lengthening and has been shown to be effective and safe. The use of the LiteTouch wavelength for these procedures presents many advantages vs. conventional methods, including enhancement of the surgical site and less bleeding during the operation, providing the surgeon with a better field of visibility and reducing patient discomfort during use. In addition, anecdotal claims have been made that post-operative effects such as pain and swelling are less pronounced.

Figure 1: At presentation

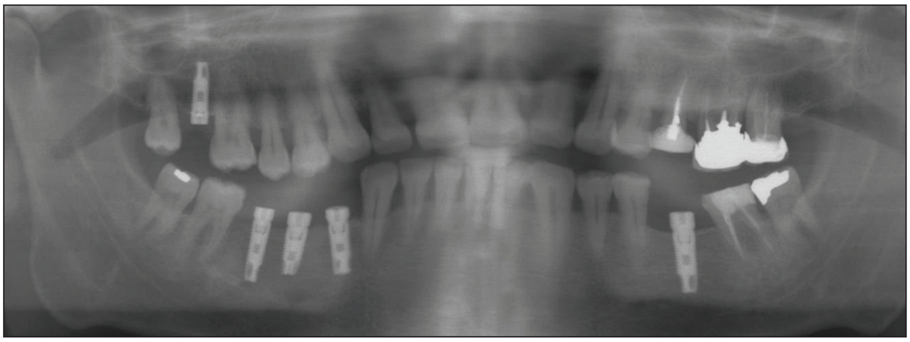

Figure 2: Insertion of five implants

Figure 3: Teeth # 14 & 15 in occlusion

Figure 4: Using the diode laser to mark the border for incision of the soft tissue

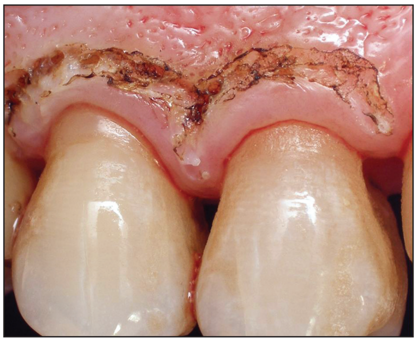

Figure 5: Incision border

Figure 6: Using the LiteTouch laser to perform the incision

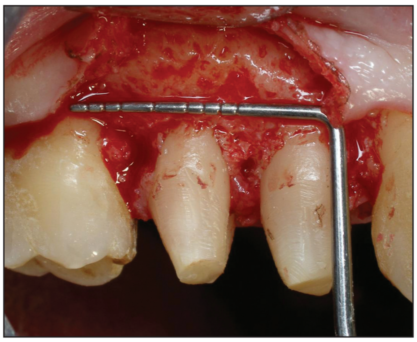

Figure 7: Lifting the mucoperiosteal flap

Figure 8: Using the LiteTouch laser to perform bone ablation

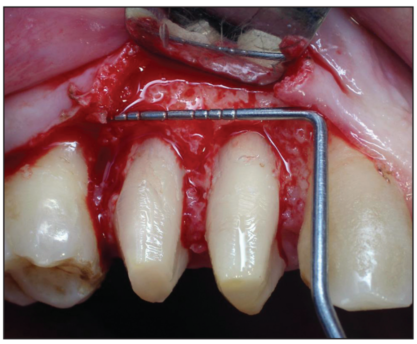

Figure 9: Bone level after ablation with the LiteTouch laser

Figure 10: Immediate post-op

Figure 11: One week post-op

Figure 12: Four months post-op

Figure 13: Nine months post-op

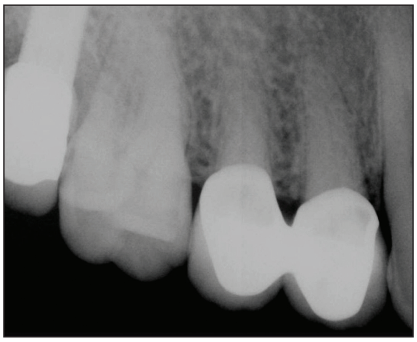

Figure 14: Nine months post-op X-ray image

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