Laser-Assisted Soft and Hard Tissue Crown Lengthening

"Biologic width" may be defined as the combined width of connective tissue and junctional epithelial attachment formed adjacent to a tooth and superior to the crestal bone of the alveolar process.1,2

Critical to the long-term success of any crown-lengthening procedure – whether accomplished by conventional means or by laser, and whether involving soft tissue modification alone or in conjunction with osseous surgery – is preservation of biologic width, as emphasized by the authors of the three abstracts presented below.

As McGuire and Scheyer note, "Common to all crown-lengthening procedures is the need for meticulous attention to maintaining the anatomical requirements of the biologic width, which, if violated, can lead to chronic inflammation, attachment loss, and recession."3

Kao and colleagues stress the need to consider the width of attached gingiva and the location of the underlying alveolar crest in order to properly define the surgical approach for esthetic crown lengthening: "Measuring the zone of attached gingiva determines the type of attached gingiva-anatomic crown relationship. Transgingival sounding of the alveolar crest determines its relationship to the gingival crest, the cementoenamel junction (CEJ), and the mucogingival junction. The location of these anatomical landmarks will indicate whether there is gingival excess or normal gingival width and the location of alveolar crest in relationship to the CEJ. The surgical treatments to correct these defects are based on this differential diagnosis."4

The ability of lasers to perform soft and hard tissue crown lengthening has been described in several published reports4-7, and a representative sampling of how clinicians use a variety of laser wavelengths for this procedure has appeared in the Journal over the past several years (see page 33). The soft tissue procedures generally involve gingivectomies and gingival recontouring; hard tissue applications use the erbium family of lasers to remove bone, either through an open technique which requires flap reflection, or a closed (flapless) approach. The latter is more controversial and is the main focus of this article.

The challenge in performing closed-flap crown lengthening, of course, is the inability to visualize not only the interaction of the end-cutting laser with the bone beneath the gingival tissue but also the possible unwanted iatrogenic vertical defects. A number of clinicians have set guidelines for when the flapless approach is advisable.

For example, in his discussion of osseous recontouring with an Er:YAG laser, van As6 cautions practitioners to consider closed flap osseous surgery only in cases where localized or minor osseous recontouring is necessary, such as next to a pontic or extraction site as well as the buccal or lingual surface of a tooth. Additionally, caution should be exercised if the patient has pre-existing periodontal disease in other areas of the mouth. Van As states: "For cases involving circumferential bone relief on one tooth, or if there are multiple teeth requiring treatment, the author recommends that use of the laser in a full open-flap surgical procedure be considered. The visibility afforded by full open-flap osseous surgery allows the clinician to visualize the parabolic architecture of the bone, prevent unwanted vertical defects, establish the ideal biologic width through creation of ledges or bone fragments, and maintain crucial amounts of attached keratinized tissue."6

As another guideline, Lowe7 suggests a closed-flap technique with an Er,Cr:YSGG laser may be used for minor, localized biologic width and/or aesthetic gingival zenith corrections. He notes that "patients with normal or thick biotypes (i.e., normal to thick keratinization) are good candidates for this procedure."7

Esham9 used an Er,Cr:YSGG laser to perform a closed-flap crown lengthening procedure, limited to 3 mm of apical gingival tissue removal, 2.5-mm thickness of buccal and lingual bone, and one or two tooth surfaces. He advises employment of an open-flap procedure if more bone is to be removed.

Careful patient and case selection, then, would appear to be one factor in determining the applicability and relative long-term success of flapless laser-assisted crown lengthening procedures.

Such guidelines notwithstanding, few re-entry reports have examined the results of laser-assisted flapless crown lengthening. The Tosun group’s manuscript in this issue (pages 10-15) and the article by McGuire and Scheyer abstracted below are two such re-entry investigations in which flaps were reflected subsequent to the closed laser procedure to enable examination of the topography of the underlying tissues. The former is an in vitro study conducted on sheep mandibles, and findings appear within the article; the latter is a prospective case series involving an unspecified number of human patients, and results are briefly summarized below.

After McGuire and Scheyer used an Er:YAG laser for gingivectomy and flapless osseous resection, flaps were reflected to observe and document immediate intraoperative findings and to clinically modify potentially problematic surgical sequelae. The investigators noted osseous troughs at the apically positioned osseous crests, insufficient and ragged bone removal, and root surface pitting secondary to laser-induced charring. They then performed necessary modifications with either laser or rotary and hand instrumentation: a quartz “chisel” tip was used to eliminate areas of bone t roughing, and roots were planed and scaled as needed to eliminate root surface charring or pitting.
RESEARCH ABSTRACTS

The authors expressed concerns over their intraoperative results: “Would these surgically created defects self-correct through bony remodeling over time? Would these osseous troughs eventually act as intrabony defects and initiate subsequent periodontitis? What would be the attachment apparatus tissue response should these troughs persist over time? Would the postoperative gingival margin and papillae remain stable over time?” These questions would begin to be addressed, at least to the extent of their postoperative follow-up time frames, as described below.

Of interest are the variations in control panel settings and tip types and diameters employed by several authors when performing closed-flap osseous crown lengthening:

- The Tosun group (Er:YAG) used 6 Watts average power output, 400 mJ per pulse, 15 Hz repetition rate, and an 80-degree, 600-micron curved laser tip in their in vitro study.
- McGuire and Scheyer (Er:YAG) used 1.5 Watts, 50 mJ, 30 Hz, water, and a 90-degree, 600-micron tip on live patients.
- van As (Er:YAG) used 3 Watts, 100 mJ, 30 Hz, water, and a 400-micron tip on live patients.
- Flax10 (Er,Cr:YSGG) used 2.5 Watts, 125 mJ, 20 Hz, 30% air, 30% water, and a 400-micron T-4 garnet tip on live patients.
- Olivi11 (Er,Cr:YSGG) used 2.5-3.0 Watts, 125-150 mJ, 20 Hz, 55% air, 45% water, and a 400-micron Z4 quartz tip on live patients.

Techniques differed among the clinicians as well. Flax10 describes a “sewing machine stitch” (i.e., very precise, up-and-down movements) of the laser tip, while McGuire and Scheyer specify a lateral movement of the laser tip from mesial to distal and back. Lowe7 specifies holding the tip adjacent to the tooth in contact with the bony crest and “walking” the tip across the area with a “sewing machine” movement; once the crestal level is achieved, the bone is “smoothed” with the laser set at 50 Hz and moving the tip in a horizontal direction over the crestal bone. Lowe further recommends: “For interproximal biologic width corrections, the tip of the laser can be angled away from the tooth, slightly toward the adjacent root to blend adjacent bone and avoid digging a trench around the tooth.”

Similar to the Tosun group’s in vitro smoothing of alveolar bone with Gracey curettes, Flax smoothed the osseous crest with a 7/8 Grace curette “to minimize any need for remodeling during the healing phase.”10 In his flapless approach, once the crestal level was achieved via Er,Cr:YSGG lasing, Lowe smoothed the bone with the laser set at 50 Hz and moved the tip in a horizontal direction over the crestal bone. McGuire and Scheyer make no mention of post-lasing smoothing or surface modification via instrumentation before the flap was reflected; as mentioned previously, they performed surface modifications after reflecting the flap.

To what extent these differences in settings, tips, and technique may be responsible for the observed outcomes (and how they might affect the long-term success of the crown lengthening procedure) is a topic worthy of additional investigation.

At least for the investigations mentioned here, healing was similar for all closed-flap patient studies. McGuire and Scheyer were able to follow all patients postoperatively for 6 months, and more than half of the patients for 3 years. They noted that esthetics and periodontal health characteristics (including positioning of the gingival margin, health of the attachment apparatus, and patient satisfaction) remained stable for the duration of the study. Ten weeks after placement of veneers, Flax10 noted that the tissue at the mesial of tooth No. 7 “should be tightened.” He reported that “this situation was addressed” during the recall visit. In their respective postoperative follow-up visits, van As8 (3 months), Olivi11 (3 months), and Lowe7 (3 years) reported no complications in their treated patients; healing was uneventful and the hoped-for aesthetic results were achieved.

For U.S. readers, certain carbon dioxide, Nd:YAG, argon, Ho:YAG, Er:YAG, Nd:YAP, Er,Cr:YSGG, diode, and frequency-doubled Nd:YAG lasers have been cleared by the U.S. Food and Drug Administration for intraoral soft tissue surgery. Certain Er:YAG and Er,Cr:YSGG lasers have been cleared for osseous crown lengthening.

As always, clinicians are advised to review the specific indications for use of their lasers and to review their operator manuals for guidance on operating parameters before attempting similar techniques on their patients.

REFERENCES

As part of the paradigm shift toward more minimally invasive surgical procedures, increasing numbers of references to laser-mediated flapless crown lengthening are noted in the published literature. The vast majority of these references are noncontrolled case reports or technique-focused articles. Therefore, prospective, randomized controlled studies that objectively examine the safety and efficacy of flapless crown lengthening are lacking. The current case series represents an initial attempt to examine some of the clinical issues posed by this minimally invasive flapless approach. Ultimately, only well-designed controlled clinical trials can yield the type of evidence-based data necessary to categorize this approach to crown lengthening as standard-of-care treatment.

Copyright 2011 Quintessence Publishing Co., Inc.
A gummy smile poses a restorative challenge for dentists attempting to achieve ideal esthetics. Many have advocated the use of a gingivectomy or laser-assisted gingival contouring procedure. However, this simplistic approach can potentially create a mucogingival defect or a biological width violation. To avoid these periodontal-restorative complications, it is important during treatment planning to assess the anatomical relationship that resulted in the gummy smile and choose the appropriate surgical treatment to eliminate this condition.

Esthetic Crown Lengthening: Appropriate Diagnosis for Achieving Gingival Balance

Richard T. Kao, DDS, PhD1,2; Scott Dault1; Kenneth Frangadakis, DDS1; J.J. Salehieh, DDS1

1Cupertino, California
2University of California School of Dentistry, San Francisco, California
3University of the Pacific Arthur A. Dugoni School of Dentistry, San Francisco, California


Surgical Lengthening of the Clinical Tooth Crown by Using Semiconductor Diode Laser: A Case Series

Sanjay B. Lagdive; Sushma S. Lagdive; P.P. Marawar; Aruna J. Bhandari; Abhishek Darekar; Veena Saraf

Rural Dental College, Ahmednagar, Maharashtra, India