The Pankey Series of Online CE on Dentaltown presents

Utilizing Laser Procedures for Restorative Access

by Samuel B. Low, DDS, MS, MEd

Abstract

Today's dental practitioner is being exposed to laser therapy as a procedure for treating soft and hard tissue, including aesthetic crown lengthening. This CE course reviews various laser therapies considering multiple wavelengths with attention to perio-restorative uses and contraindications in closed crown-lengthening procedures.

Educational Objectives

After completing this course, you should:

- Understand indications for using laser in crown-lengthening procedures with attention to aesthetics.
- Appreciate contraindications when tradition "flap" procedures are appropriate.
- Create a surgical management protocol for aesthetic crown length surgery.
- Provide the rationale for biologic width.
- Differentiate laser wave lengths and indications for tissue-type targets.

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The restorative dentist is continually challenged by the need for accessibility during restorative procedures. On most occasions, this need occurs at the time of the restorative procedure creating an immediate dilemma. A decision tree materializes with consideration of the following choices: 1) stop and reappoint either with the respective clinician for the surgery or refer to a periodontist, 2) attempt to perform a crown length procedure now, or 3) proceed on, hope for the best and possibly not have clear access resulting in a substandard restorative margin, or violate the biologic width and the concurring inflammatory reactive response.

Most periodontists would be delighted if all restorative margins were 5mm supragingivally, margins were cast gold, embrasure spaces were large and all pontics were "high water." However, patient aesthetic preferences preclude ideal accessible environments.

As with any decision-making process in perio/restorative treatment planning, the clinician must first determine the overall periodontal prognosis, the gingival health, including pocket depth, the apical extent of existing caries and the level of the alveolar crest. And as with all quality data collection, parameters must include a radiographic exam, probing, tissue characteristics, especially attached gingivae, mobility, and root length and form. With quality data assessment, one can consider the sequence of treatment as:

- Initial oral and radiographic assessment
- Remove defective restoration
- Excavate the decay
- Provisional restoration
- Endodontic therapy
- Periodontal therapy
- Re-evaluation
- Surgery
- Asepsis

Checkpoints for Periodontal Crown Length Procedures

1. Periodontal Considerations

A periodontal exam is essential prior to any anticipated surgical procedure. At minimum, a radiographic exam including vertical bite wings, periodontal charting, assessment of mucogingival dimensions and mobility patterns should be performed.

The radiographic exam provides the clinician with data for periodontal prognosis and also a measurement of the apical restorative margin to the osseous levels and the beginning assessment of biologic width. It can also give a depiction of the overall prognosis as crown root ratios.

Likewise, periodontal charting along with radiographs assist the clinician in determining if the pocket depth is true periodontal pathology or excessive gingivae coronal to the cemento-enamel junction (Fig. 1).

Minimal or no attached gingivae preclude any gingivectomy procedure for restorative access and require either an apically repositioned flap or gingival augmentation prior to any additional dental procedure. Direct measurements can be made as to the width of gingivae and how much are attached. Attached gingivae are determined by the width of the keratinized zone that is actually attached to tooth and bone. Recession, especially that exposing the CEJ, must be taken into consideration, especially if the recession is progressive. Clinical findings include inflamed marginal tissue, marginal tissue inflamed bleeding or exudates, obvious recession and moving tissue by retracting the lip.

Mobility is a key factor in periodontal prognosis and suggests either primary or secondary occlusal trauma and if secondary trauma (mobility with a compromised crown/root ratio) undermines the success of retaining the tooth long term unless stabilization occurs. If one must remove significant bone structure to gain access for the target tooth, then a compromise will occur for either the tooth in question or the adjacent teeth. On occasion, the clinician will expose a concavity as a furca on

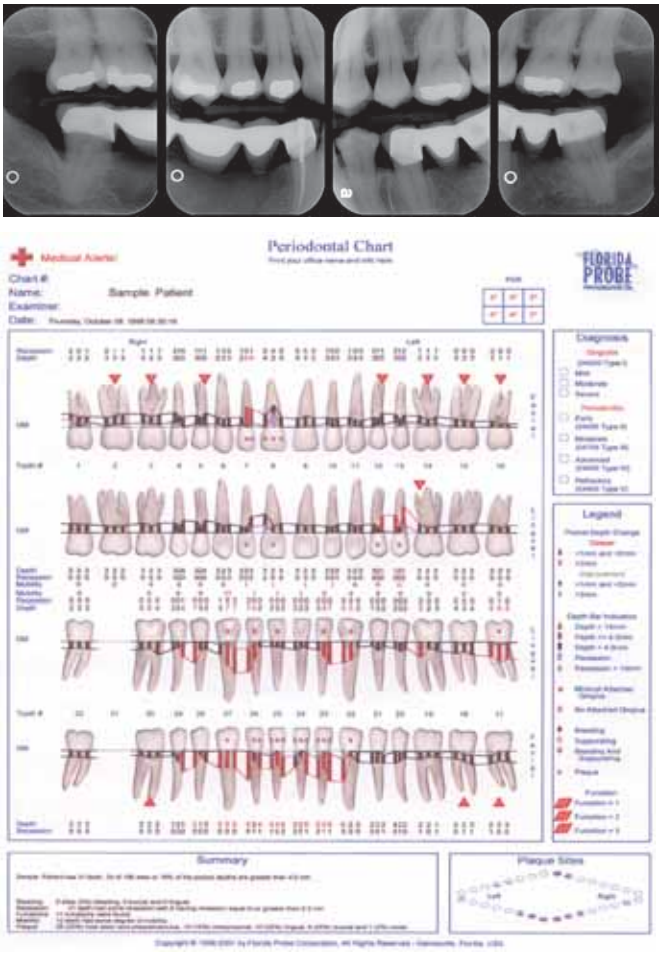

Figure 1: Data collection with vertical bite wings and pocket depth charting

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the tooth in proximity to the procedure in his quest to gain crown length.

2. Aesthetic Considerations

Several resources exist that provide benchmarks for teeth in the aesthetic zone. Most center on a rule of "golden proportion" where the length of the tooth is at a ratio of 1.6 to 1 for the width (Fig. 2). Measurements to determine this positioning include utilizing a periodontal probe to measure, in millimeters, the length and the width. In addition, one can use the Chu aesthetic gauge, which incorporates the ration algorithm into a guide that can be directly placed on the teeth. With this gauge, the corresponding color indicates the appropriate height and width ratio (Fig. 3). On occasion, the patient will desire an enhanced aesthetic appearance with no restorations. If short anatomical crowns exist, the surgical procedure might expose the cemeto-enamel junction (CEJ) permanently and thus lead to an unacceptable result. Therefore, sounding the osseous levels in relation to both the gingival margin and the CEJ is a critical pre-surgical/restorative planning procedure in data collection.

The lip line to the projected gingival margins also has universally accepted consideration and a space larger than 2-3mm might require apical movement of both the gingival and restorative margins to decrease the "gummy smile" appearance.

A checklist of characteristics of gingivae on smiling would be the following:

1. Are the gingivae thick or thin in facial lingual dimensions?
2. Are the gingival contours scalloped or a straight, flat appearance?
3. Do the papillas fill the embrasure space?
4. Where is the CEJ relative to the free gingival margin?
5. Do I have enough attached gingivae?
6. How much exposure of gingivae is acceptable in the respective smile line?

Likewise, for the teeth and bone:

1. What are the overall tooth form characteristics?
2. What is the clinical and the anatomical crown length?
3. What are the ratios of tooth length to width?
4. Are the roots dominant?
5. Is the bone facial lingually thin or thick and where is it related to the CEJ?

Figure 2: Aesthetic ratios of 1:1.6

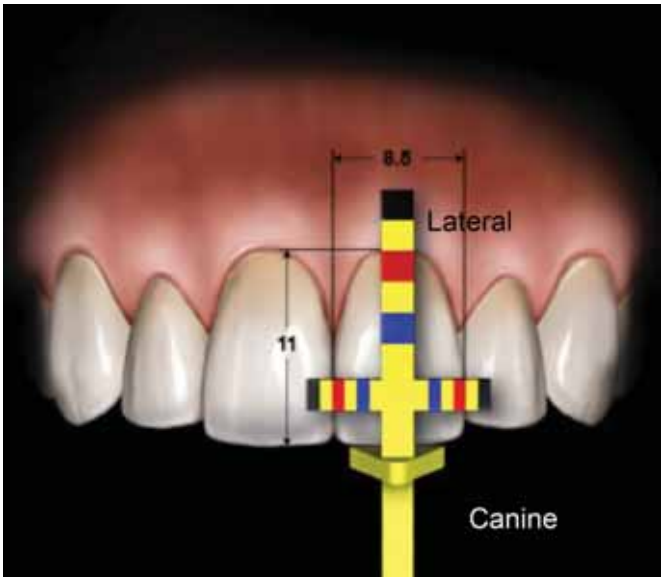

Figure 3: Aesthetic T bar

Rationale for Crown Length

As previously suggested, surgical crown length procedures are indicated from a restorative perspective to be centered on the concept of access. A primary objective of the resulting access is proper form and retention of the restoration. But any soft tissue access must provide sight to subgingival caries and fractures, and to enhance a patient's smile. And when access is not established the negative sequel include problems with invading the biologic width, marginal leakage of restorations, inaccurate impressions, poor finish lines, recurrent decay and irreversible defects on the periodontium with inflammation. Therefore the indications for crown length can also include subgingival caries, subgingival fractures, endodontic perforations and short clinical crowns.

The biologic width is a zone around all teeth and includes the sulcular depth, junctional epithelium and the connective tissue attachment (Fig. 4). The standard measurement for the total of all structures is approximately 3mm. Considering the circumference of the tooth and parabolic architecture, one attempts to have a restorative margin that does not invade the space in a 3mm zone especially in the area of the straight buccal or lingual surface. Due to parabolic architecture, the distance is 4mm mesial and distal interproximally. Gingival margins follow boney architecture and when bone levels are not adequately established with ostectomy, eventual coronal gingival growth

will occur and undermine the aesthetic appearance with short clinical crown appearance.

Crown Lengthening Surgery Principles

Using parameters listed in pre-surgical planning, defining the most apical margins becomes essential for what will determine the restorative and the gingival margins. Thus, all caries must be removed if possible before establishing the biologic width, including breaking the contacts and developing preparations with high quality provisionals that mimic the final restorations.

The basic tenants of periodontal surgery are access, hemostasis and hopefully, "do no harm." Most periodontal surgical procedures in crown length are divided into two categories: 1) excisional surgery consisting of gingivectomy and 2) incisional surgery with flap procedures.

Excisional Surgery

Long considered a dated procedure, the gingivectomy can be very effective when excessive gingival growth is encountered as in the supra-boney, pseudo-pocket environment. When measuring the free gingival margin to the CEJ demonstrates coronal growth, then a gingivectomy with either a blade/scalpel or laser will decrease the gingivae and allow contouring with a champher effect. The angle of the blade or laser tip should always be at a 45-degree angle versus a 90-degree angle when possible (Fig. 5). When accessibility is difficult, one can make initial incisions at less than ideal angles, but then the resulting cut must be redefined by additional recontouring to enhance the gingival architecture.

However, when the clinician encounters minimal to no attached gingivae, any excisional procedure is contraindicated. In these cases, gingivae require augmentation prior to any apical manipulation of the gingival margin. All incisions must be coronal to the muco gingival junction.

Figure 5: External bevel gingivectomy

A second major contraindication to an external bevel incision is when access to the boney margins is necessary to recontour osseous levels and avoid biologic width invasion. This rule is for all devices including lasers, with exception of the closed crown length procedure. Therefore, utilizing radiographs and periodontal probing with the CEJ as a guide is essential before making incisions.

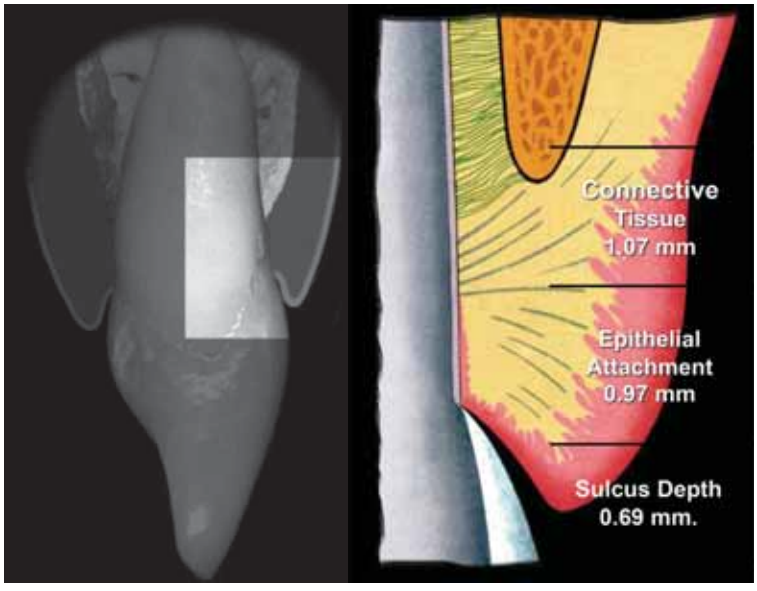

Figure 4: Biologic width

Inverse Bevel Flap Surgery

An axiom in crown length surgery is "whenever in doubt, perform a flap." The inverse bevel flap can preserve the existing attached gingivae by the nature of the apical positioning that occurs with placement of the flap and suturing. Moreover, the flap provides ideal access to all structures, including tooth surfaces and bone. The initial incision is performed according to the attached gingivae principles, tooth width/length rations and lip-line dimensions. Surgical stents/guides fabricated on diagnostic models allow the clinician to take all of the data collection areas into consideration especially when restorations are to be placed as anterior

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veneers (Fig. 6). One can also visualize the parameters using the Chu aesthetic gauges and/or periodontal probes. The clinician can find an ideal length and width to a standard, as a central incisor, and then use that vertical dimension to determine the gingival margin on the remaining maxillary anterior teeth. Most clinicians consider the maxillary incisors to be the same clinical crown length to the canines with the laterals 2mm shorter in distance. Also, one cannot forget the maxillary premolar length for many patients shows the medial aspect of the maxillary molars in smiling.

Figure 6: Fabrication of surgical guides/stents

Figure 7: Carbonization leading to poor wound healing and thermal necrosis

Laser Versus Blade Versus Electrosurgery

The advent of lasers has created a need to compare their effectiveness with other surgical devices. The scalpel/blade is definitely more time effective with less inflammation, more collagen production, and a higher rate of epithelization in the very early stages of wound healing. However, the laser compensates in time for epithelization and collagen production with less scar contraction. In addition, the laser is reported to have enhanced angiogenesis and promotes increased osteoblastic and fibroblastic activity.

When compared to a mono-polar electrosurgery unit, there is less pain and edema, and overall decrease in inflammation. Due to the thermal trauma of electrosurgery, large areas of thermal necrosis are noted without ablation (vaporization) and creation of damaged areas not replaced with new bone (Fig. 7).

Laser Crown Length Surgery

There are several commercially available lasers in the dental market with wavelengths that range from 635 to 10,600nm. The primary wavelengths used in today's dental practice are diodes, Nd:YAG, carbon dioxide and erbium lasers. Each has a unique wavelength that penetrates tissue or has an affinity for tissue considered target areas with absorption. As an example, the diode laser is attracted to melanin, blood and some water absorption. It would be effective for soft-tissue procedures as the excisional gingivectomy including creating access by hemostasis. The Nd:YAG has a similar activity since its wavelength is similar to the diode. However, if these laser wavelengths are placed on teeth or bone for any period of time with even a normal wattage, carbonization will occur with thermal necrosis.

By contrast, the erbium lasers have an affinity with respective wavelengths corresponding to absorption curves for water and hydroxyl apetite. They can be used for osseous surgery and soft-tissue incisions but lack the ideal hemostatic properties of the diodes and the Nd:YAG. Some clinicians utilize both lasers in crown length procedures by managing tissue according to specific protocols (Fig. 8).

Closed Crown Length Aesthetic Procedures

When the clinician is faced with creating an aesthetic result and osseous recontouring is required, the erbium laser can be considered with minimal to no reflection of the flap. However, if the buccal bone is thick, there is a tendency to trough the boney ledge and not be aware of such since the site cannot be directly visualized since the tissue is still attached. If this were to occur, eventually the boney trough would repair and the gingival tissue would grow coronally, and thus be a reoccurring short clinical crown. And if restorations had been placed, the bone growth would invade the biologic width creating significant inflammation.

Figure 8: Utilizing erbium lasers for closed crown-lengthening procedures

Closed crown length is best performed in a normal thickness ridge with the clinician utilizing an experienced tactile since he can perform ostectomy under the gingiva to create the ideal biologic width zone. It is highly recommended that even after laser boney surgery in the area, a manual, small boney chisel be utilized to smooth boney edges and ensure that biologic width has been established.

A checklist/protocol for closed crown length with a laser is as follows:

1. Develop a surgical guide/stent that has been fabricated to determine the apical extent of the gingival margin utilizing the principles of ideal width and height of respective tooth types.
2. With the surgical guide in place, an outline of the initial incision can be made with the laser in a slightly defocused mode. As with a conventional blade-initiated gingivectomy, the laser incision is started slightly apical to the stent and at a 45-degree angle to create a gingival champher.
3. The stent can be removed after the outline and with the laser tip moving slowly in a back and forth manner, the tip is increasingly moved inward toward the tooth. Caution is necessary for preserving the papillae due to aesthetics.
4. The now-free excised collar can be removed with a curette and the stent replaced to check the accuracy of margin placement.
5. With a relatively lower wattage, the laser tip can now be moved in a side-to-side sweeping motion to sculpt the margin to enhance the chamber and to decrease the thickness of the gingivae to a more "knife-like" architecture.
6. Placement of the erbium laser subgingivally is now necessary and osseous surgery is needed to establish the biologic width. A black mark is placed on the laser tip 3mm from the end of the tip as a biologic width depth gauge.
7. The tip is moved back and forth under the tissue to create an osectomy effect. When adequate bone has been removed, a chisel is used to smooth the boney margins and ensure that a trough has not been created in bone.
8. There is minimal post-operative care and no surgical dressing is placed. Antioxidant gels are used by both the clinician and patient for an anti-inflammatory wound healing effect (Fig. 8).

Conclusion

When the clinician appreciates the concepts of perio/restorative crown length procedures, the devices/tools to implement the actual procedures become secondary to the success of the procedure. However, the lasers possess characteristics which enhance access via hemostasis and accelerated wound healing and are advantageous for the overall result. ■

Author's Bio

Dr. Samuel B. Low is a professor emeritus at University of Florida, College of Dentistry; associate faculty member of the Pankey Institute with 30 years of private practice experience in periodontics, lasers and implant placement. He is also a diplomate of the American Board of Periodontology and past president of the American Academy of Periodontology. Dr. Low provides dentists and dental hygienists with the tools for successfully managing the periodontal patient in general and periodontal practices and is affiliated with the Florida Probe Corporation. He was selected "Dentist of the Year" by the Florida Dental Association, Distinguished Alumnus by the University of Texas Dental School and the Gordon Christensen Lecturer Recognition Award. He is a past president of the Florida Dental Association and past ADA Trustee.

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1. In determining the periodontal prognosis of a tooth treatment plan for a crown length procedure, the following data collection parameters are essential:
   a. mobility
   b. muco-gingival measurements
   c. probing/healing
   d. All of the above

2. Surgical crown-lengthening procedures are indicated for teeth with:
   a. compromised crown root ratios.
   b. no attached gingivae.
   c. mobility and secondary occlusal.
   d. conditions requiring visual access.

3. The following are included in biologic width measurements: the sulcular depth, junctional epithelium and the connective tissue attachment.
   a. True
   b. False

4. An indication for a surgical flap in crown lengthening versus a gingivectomy is when:
   a. ostectomy is not necessary.
   b. oral hygiene compliance is marginal.
   c. ostectomy may expose and anatomical furcation.
   d. None of the above

5. When determining the incision placement for an aesthetic crown-lengthening procedure, the following are not necessary in data collection:
   a. determination of the CEJ to the free gingival margin
   b. prominence of the root morphology
   c. lip-line measurement to the gingival margin
   d. muco-gingival junction to the free gingival margin

6. A significant limitation to the "closed" crown lengthening procedure is:
   a. inadequate gingival removal.
   b. inadequate bone removal.
   c. Post-operative discomfort.
   d. loss of papillary height.

7. A diode or erbium laser can be used without additional instrumentation in closed crown length procedures.
   a. True
   b. False

8. The laser gingivectomy is advantageous over the scalpel or blade procedure because:
   a. the laser procedure creates attached gingivae.
   b. wound healing is accelerated.
   c. higher oral hygiene compliance exists.
   d. blood supply to the site is increased at the time of the procedure.

9. Lasers are effective over electrosurgery instrumentation for what rationale?
   a. Lasers cut via carbonization of the tissue.
   b. Electrosurgery devices increase thermal tissue temperature up to 500 cell layers.
   c. Lasers cut via vaporization of the tissue.
   d. Electrosurgery devices can be used around endosseous root form implants.

10. Which aesthetic surgical procedure is preferred when a patient presents with thick dense gingiva and an apparent buccal exostosis?
    a. Diode laser gingivectomy
    b. Erbium laser ostectomy
    c. Inverse bevel flap with ostectomy
    d. External bevel gingivectomy with a blade

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