AESTHETIC CROWN LENGTHENING: CLASSIFICATION, BIOLOGIC RATIONALE, AND TREATMENT PLANNING CONSIDERATIONS

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The rationale for crown lengthening procedures has progressively become more aesthetic-driven due to the increasing popularity of smile enhancement therapy. Although the biologic requirements are similar to the functionally oriented exposure of sound tooth structure, aesthetic expectations require an increased emphasis on the appropriate diagnosis of the hard and soft tissue relationships, as well as the definitive restorative parameters to be achieved. The development of a clinically relevant aesthetic blueprint and attendant surgical guide is of paramount importance for the achievement of successful outcomes.

Learning Objectives:
This article provides a classification system that clinicians can use when treatment planning for aesthetic crown lengthening. Upon reading this article, the reader should have:

• A clear understanding of the involved biological structures.
• Didactic instruction on the classification and treatment planning for aesthetic crown lengthening procedures.

Key Words: crown lengthening, biologic width, periodontium

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Crown lengthening has been traditionally utilized as an adjunct to restorative dentistry, typically in situations where subgingival caries or fractures require the exposure of sound tooth structure and reestablishment of the biologic width space. Additionally, chronic gingivitis secondary to the placement of restorations that impinge on the biologic width may also be treated with crown lengthening procedures.

With the increasing popularity of aesthetic-oriented treatment, an understanding of the therapeutic synergies brought about by an interdisciplinary approach has developed. As a result, crown lengthening procedures have become an integral component of the aesthetic armamentarium and are utilized with increasing frequency to enhance the appearance of restorations placed within the aesthetic zone.

Although the literature is replete with examples of aesthetic crown lengthening, in the majority of instances, the information provided is composed of case reports. This article will discuss biological parameters for aesthetic crown lengthening. Based on an analysis of the possible clinical scenarios, a new classification system is introduced in an effort to organize the diagnostic process. Anatomical relationships that allow an innovative treatment sequence approach are discussed as well.

Anatomical Considerations

The periodontium is the basic functional unit that supports the teeth. The tissues that comprise the periodontium are the alveolar bone, periodontal ligament, cementum, junctional epithelium, and gingiva (Figure 1). These tissues exist interdependently in a state of physiologic homeostasis, where normal cellular activity allows the maintenance of health as well as the response to environmental insults.

The tooth is retained within the alveolus by the periodontal ligament. Periodontal ligament fibers attach to the alveolar bone surface on one end, and the cementum layer of the root surface at the other. The gingival tissue is located coronal to the periodontal ligament. It provides little support and its primary function is to isolate the underlying structures from the oral environment. The gingiva comprises primarily connective tissue, which is covered by an epithelial layer that provides...
a protective barrier against bacterial, mechanical, and immunological insults (Figure 1). Collagen fibers within the gingival connective tissue insert into the periosteum of the alveolar process and into the cementum layer. Additional groups of gingival fibers are classified according to their location, origin, and insertion.

The epithelial layer isolates the connective tissue from the oral environment, while providing the interface responsible for the attachment of the supra-alveolar gingiva to the surface of the tooth as well. Gingival epithelium is stratified squamous in nature and includes the oral epithelium, sulcular epithelium, and junctional epithelium.2,3 The oral epithelium covers the extrasulcular mucosal surfaces and may exhibit a keratinized or parakeratinized surface.4 The nonkeratinized sulcular epithelium lines the soft tissue wall of the gingival sulcus, extending from the gingival margin to the junctional epithelium (Figure 1).2,3 The junctional epithelium constitutes the attachment interface of the epithelial layer to the surface of the tooth. It forms an epithelial tissue collar along the cervix of the tooth, and extends in an apical direction from the bottom of the sulcus to the level of the gingival connective tissue attachment. Unlike keratinized cells, the cells of the junctional epithelium are adapted for adherence to the enamel or cementum surfaces through a mechanism termed hemidesmosomal attachment.5–7 Intercellular junctions are less prevalent within the junctional epithelium when compared to the oral and sulcular epithelium. The low cohesive forces between cells in the junctional epithelium result in readily distensible intercellular spaces, which may account for the susceptibility to tearing during periodontal probing and retraction cord placement.8–10 Fortunately, the repair process takes place at a brisk pace, owing to the rapid cell migration rate observed in epithelial tissues.

Biologic Width

The concept of biologic width is widely utilized as a clinical guideline during the evaluation of periodontal-restorative interrelationships. This concept presupposes the existence of a constant vertical proportion of healthy supra-alveolar soft tissues, with a mean dimension of approximately 2 mm, measured from the bottom of the gingival sulcus to the alveolar crest (Figure 1).
The biologic width encompasses the junctional epithelium and the connective tissue attachment. According to early investigators, the average dimension of the epithelial attachment was 0.97 mm and the average dimension of the connective tissue attachment was measured at 1.07 mm — yielding the combined dimension of 2.04 mm known as the biologic width. The biologic width dimension appears to constitute a constant feature in the human periodontium, and it has therefore been suggested that it be considered an immutable therapeutic parameter. Clinical observation indicates that impingement of the biologic width will result in attempts by the gingival tissue to reestablish its original dimension through bone resorption or, in the presence of thick alveolar bone, chronic gingival inflammation. Furthermore, there is experimental evidence suggesting that the biologic width will reestablish itself during healing of the periodontal tissues following surgical procedures.

**Bone Sounding**

The level of the alveolar crest must be determined prior to any considerations regarding aesthetic crown lengthening. The degree of clinical crown elongation vis-à-vis the position of the alveolar bone will determine the feasibility, surgical aspects, and treatment sequence.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Characteristics</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Type I</td>
<td>Sufficient soft tissue allows gingival exposure of the alveolar crest or violation of the biologic width.</td>
<td>May be performed by the restorative dentist. Provisional restorations of the desired length may be placed immediately.</td>
<td>Requires osseous contouring. May require a surgical referral.</td>
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<tr>
<td>Type II</td>
<td>Sufficient soft tissue allows gingival excision without exposure of the alveolar crest but in violation of the biologic width.</td>
<td>Will tolerate a temporary violation of the biologic width. Allows staging of the gingivectomy and osseous contouring procedures. Provisional restorations of the desired length may be placed immediately.</td>
<td>Requires osseous contouring. May require a surgical referral. Limited flexibility.</td>
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<tr>
<td>Type III</td>
<td>Gingival excision to the desired clinical crown length will expose the alveolar crest.</td>
<td>Staging of the procedures and alternative treatment sequence may minimize display of exposed subgingival structures. Provisional restorations of desired length may be placed at second-stage gingivectomy.</td>
<td>Requires osseous contouring. May require a surgical referral. Limited surgical options. No flexibility. A staged approach is not advantageous. May require a surgical referral.</td>
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<tr>
<td>Type IV</td>
<td>Gingival excision will result in inadequate band of attached gingiva.</td>
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Bone sounding is utilized to determine the thickness of the soft tissue layer and proximity of the alveolar bone during the planning stages of various surgical procedures. Following the administration of a local anesthetic, a measuring instrument is utilized to puncture and penetrate the mucosa until contact is made with the underlying bone. During this periodontal evaluation, bone sounding assists in determining the level of the alveolar crest and thus the need for osseous contouring.\textsuperscript{14,16} 

Specifically applied to aesthetic crown lengthening, bone sounding is performed in an attempt to determine the location of the alveolar crest, primarily on the labial aspect but additionally including the proximal areas. To this effect, a periodontal probe is inserted into the sulcus and forced to penetrate transgingivally until contact is made with the alveolar crest, perforating the junctional epithelium and gingival connective tissue in the process. An even sharper instrument, such as an endodontic or curved explorer, may be utilized in situations where the position of the osseous crest is not readily identifiable. The acuity of digital perception as it relates to the actual position of the alveolar crest will vary depending on the periodontal biotype and site-specific characteristics, including recession, root anatomy, and tooth morphology. Conditions that favor the presence of a thicker plate of bone (e.g., with thick, flat periodontium) will result in a more accurate assessment of the alveolar crest position through bone sounding. Alternatively, scenarios associated with bone dehiscences or a thin labial osseous plate, may make identification of the alveolar crest more difficult. This, in retrospect, may be of less consequence since thin or dehisced labial plates are more likely to resorb postoperatively.
Classification and Treatment Sequence

Following an assessment of the alveolar crest position, four distinct clinical scenarios may be identified. Since the amount of tissue to be removed depends on the clinical objectives defined with the aesthetic blueprint, the use of finite measurements is not applicable. A classification system may be more dependent on the relationship between the alveolar crest position relative to the anticipated postsurgical gingival margin level. Each scenario is characterized by specific clinical procedures and carries treatment sequence implications as well (Table). The aesthetic crown lengthening classification system proposed below may be utilized to assist the diagnostic process and streamline the prescription for a treatment sequence.

**Type I aesthetic crown lengthening** is characterized by sufficient gingival tissue coronal to the alveolar crest, allowing the surgical alteration of the gingival margin levels without need for osseous recontouring. A gingivectomy or gingivoplasty procedure will usually suffice to establish the desired gingival margin position while simultaneously avoiding a violation of the biologic width (Figures 2 through 5). Type I aesthetic crown lengthening is frequently managed by the restorative dentist. The delicate strokes required by the gingival sculpting technique are best accomplished with the judicious use of a surgical laser or similar device, which may additionally provide the advantage of intraoperative hemostasis. Sharp dissection with a scalpel blade should be avoided, as it offers less control and creates a bloody field as well. Properly managed, this scenario allows the placement of a provisional restoration that exhibits the desired clinical crown length at the time of surgery.

**Type II aesthetic crown lengthening** is characterized by soft tissue dimensions that allow the surgical repositioning of the gingival margin without exposure of the osseous crest, but nevertheless in violation of the biologic width (Figures 6 through 14). As discussed previously, the soft tissues will attempt to reestablish this dimension upon impingement. In thin periodontal biotypes, this may result in crestal resorption and subsequent recession, while in thick periodontal biotypes, it may manifest itself as chronic gingival inflammation. Either alternative will negatively impact the predictability and ultimate success of restorations placed within the aesthetic zone. Osseous correction is therefore required subsequent to the gingival excision, for the purpose of
recontouring the alveolar crest to a level where the biologic width space is reestablished (Figure 15). Since the reaction of the gingival tissues following violation of the biologic width is not immediate, the osseous recontouring surgery may be staged separately, thus introducing a timing flexibility that may be advantageous from a treatment sequence perspective. Specifically, it may allow the restorative dentist to perform the gingivectomy and immediately place provisional restorations of the desired clinical crown length during the same appointment; even though knowingly violating the biologic width space. Following soft tissue healing, a periodontist may reflect a mucoperiosteal flap to gain access to the alveolar crest. Since the ultimate gingival margin levels have already been determined, sulcular incisions may be utilized in conjunction with a papillae preservation approach to maintain soft tissue volume and prevent postoperative recession or open embrasure spaces. The margins of the optimized provisional restoration may consequently serve as a surgical template and guide the periodontist during the alveolar crest recontouring procedure (Figure 15). The flap should be subsequently repositioned to its preoperative level, and passive primary closure must be verified prior to suturing, to further ensure the survival of the papillae.

In type III aesthetic crown lengthening, bone sounding may reveal a scenario where repositioning the gingival margin will result in exposure of the osseous crest. This is an unacceptable complication that precludes the completion of any gingivectomy procedures prior to surgical bone contouring (Figure 16). Type III aesthetic crown lengthening cases are usually referred to a periodontist and are frequently a source of dissatisfaction resulting from inadequate interdisciplinary communication. This may originate in the failure to identify specific therapeutic objectives for the surgeon, or alternatively from an ignorance of the restorative-driven nature of the aesthetic crown lengthening procedure. It is inappropriate to refer these patients without providing a surgical template derived from a relevant aesthetic blueprint (Figures 17 and 18). This template will serve as a guide during surgery so that following flap reflection, a constant relationship between the anticipated clinical crown and the osseous crest levels, can be established and maintained through the bone-contouring process (Figure 19). The periodontist should also be instructed to reposition the flaps coronally, rather than apically, in order to...
to maximize tissue preservation and allow the anticipated revisions to the gingival margin that will follow once healing from the osseous surgery has been completed (Figures 20 through 22). Efforts should be made to utilize sutures that will approximate the papillae and minimize the risk of increased gingival embrasure spaces postsurgery.

Type IV aesthetic crown lengthening is reserved for scenarios where the degree of gingival excision is compromised by an insufficient amount of attached gingiva. Ideal margin position, therefore, can only be achieved through the use of an apically positioned mucoperiosteal flap, regardless of the need for osseous contouring. Attempting to establish the desired clinical crown length solely with tissue excision will result in an inadequate residual band of attached gingiva under these circumstances. Consequently, type IV cases do not benefit from a staged approach or any other treatment sequence that deviates from the conventional protocol. As a result, definitive gingival margin placement and provisional fabrication may not be feasible during the same appointment.

**Treatment Planning Considerations**

The preservation of biologic width space following aesthetic procedures demands the existence of clearly defined therapeutic objectives. Unlike scenarios where the exposure of sound tooth structure is the main goal, the success of aesthetic crown lengthening is determined by the ultimate restorative margin position and the postoperative appearance of the gingival tissues (Figures 5 and 14). Despite the rationale, the biologic principles governing all crown lengthening procedures remain the same.

Conventional protocols require a waiting period of 4 to 6 weeks for sufficient healing of the attachment apparatus prior to initiating restorative endeavors. The surfaces exposed due to crown lengthening will be displayed through the said healing period until the provisional prosthesis can be fabricated or relined. The exposed areas may be limited to cemento-enamel junctions and varying amounts of root surface, but may also include the margins of previous restorations (Figure 13).

Patients that require aesthetic crown lengthening, however, frequently exhibit a high smile line. As a result, pressure is often placed on the restorative dentist to correct aesthetic deficiencies as early as possible, and maintain certain aesthetic standards throughout treatment.
Therefore, the 4- to 6-week postoperative period currently recommended in conventional protocols may be unacceptable for these patients.

A preferable alternative may be to design a treatment sequence that allows immediate placement of a provisional restoration so that any potential aesthetic issues brought about by the exposure of subgingival structures can be addressed during the same appointment. Only type I cases are currently treated in this fashion. Since sufficient supra-alveolar soft tissue is present in these situations, the desired gingival margin position can be surgically established without impingement of the biologic width, making osseous contouring unnecessary (Figure 4). If hemostasis is achieved, the provisional restoration may be placed immediately following gingivectomy.

Conversely, type II and III cases require osseous contouring. It may be beneficial in these scenarios to compartmentalize the soft and hard tissue components of the crown-lengthening procedure and stage them individually for treatment. Specifically applied to type II cases, this approach advocates performing the gingivectomy to the desired margin levels, followed by the immediate placement of the provisional restoration in violation of the biologic width (Figures 12 through 14). Upon soft tissue healing, a mucoperiosteal flap may be subsequently reflected to access the alveolar crest and perform the bone contouring necessary to restore the biologic width space, using the previously established margins of the provisional restoration as a guide (Figure 15). This staged approach is possible due to the ability of the periodontal attachment apparatus to tolerate a temporary violation of the biologic width dimensions with no apparent morbidity. The maximum length of time that may elapse prior to the onset of a chronic inflammatory reaction or bone resorption is unknown.

In type III cases, osseous contouring is required in order to avoid exposure of the alveolar crest. The 4- to 6-week healing period that is traditionally advocated prior to provisional fabrication may be objectionable to many patients. A prolonged unaesthetic appearance following crown lengthening may be avoided through variations in surgical design and sequence of procedures. By utilizing sulcular incisions and a coronally positioned flap approach, osseous contouring may be completed with minimum exposure of the subgingival structures (Figures 19 and 20). A gingivectomy may be performed at a subsequent stage to establish the definitive gingival margin position while allowing placement of a
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provisional restoration of the desired clinical crown length during the same appointment (Figures 21 and 22). The success of this staged approach will depend on the ability to predict the ultimate alveolar crest position through the utilization of an adequate blueprint technique and concomitant surgical guide (Figures 17 through 19).

Aesthetic Blueprint: Development and Transfer

It is imperative to develop an aesthetic blueprint that effectively defines the morphological parameters to be achieved with the definitive restoration. This can only be accomplished with techniques that allow in vivo testing so that all the aesthetic and functional objectives desired in the definitive restoration can be defined in the intraoral environment. It is a mistake to rely exclusively on a diagnostic waxup for the development of the aesthetic blueprint. Provisional restorations or equivalent appliances are better utilized for this purpose, either of which may be preceded by a diagnostic waxup (Figures 17 through 19).

Once the aesthetic blueprint has been developed, it is incumbent on the clinician to ensure its accurate transfer through all therapeutic phases. While there are advantages to having the aesthetic crown lengthening procedure performed by the restorative dentist, a team approach with a periodontist may be required depending on the clinical scenario. It is at this point where most problems surface, usually due to deficient interdisciplinary communication. Due to inadequately controlled surgical variables, the restorative dentist may be faced with the burden of deviating from the aesthetic blueprint and compromising the morphology of the definitive restorations to compensate for excessive or insufficient clinical crown length or increased gingival embrasure spaces. It is thus essential to provide the surgeon with concrete therapeutic parameters so that the aesthetic blueprint may survive the referral process. This may be accomplished with the use of surgical guides derived from the aesthetic blueprint and provided by the restorative dentist.

Conclusion

Aesthetic crown lengthening should be considered as a surgical component of restorative therapy. The aesthetic crown lengthening classification system presented herein is based on the dynamic relationship between the alveolar crest position and the anticipated gingival margin levels postoperatively. Categorizing the possible scenarios may expedite the diagnostic process and assist in streamlining the treatment sequence. A thorough understanding of the anatomical structures involved, and the biologic width concept, is essential for the appropriate assignment within the described treatment classes. The utilization of a staged approach, as well as alternative treatment sequences, may also facilitate the management of aesthetic demands in type II and type III cases. Further studies may be necessary to determine the long-term stability of the gingival margin position following aesthetic crown lengthening procedures, as well as the potential variables introduced by different periodontal biotypes.

Acknowledgment

The author declares no financial interest in any product cited herein.

References

1. According to Gargiulo et al, what is the combined average dimension of the junctional epithelium and the connective tissue attachment?
   a. 3.25 mm.
   b. 2.04 mm.
   c. 4.00 mm.
   d. None of the above.

2. Evidence suggests that when the biologic width is impinged upon, its tendency over the long term will be:
   a. To respond with proliferation of granulomatous tissue.
   b. Necrosis and reduction of its original dimensions.
   c. Abscess formation.
   d. To reestablish itself.

3. The main factor determining the response of the gingival margin to a biologic width violation is:
   a. Periodontal biotype.
   b. The type of restorative material utilized.
   c. An allergic reaction.
   d. All of the above.

4. What are the differences and similarities between traditional crown lengthening and aesthetic crown lengthening?
   a. They are applied to different areas of the mouth.
   b. Flap design is different, suturing techniques are similar.
   c. Surgery is the same, but healing times differ.
   d. The rationale is different, but biological principles are the same.

5. The main reason for utilizing a staged approach in type II and type III aesthetic crown lengthening cases is the ability to:
   a. Maximize insurance coverage.
   b. Establish the gingival margin level and place provisional crowns with desired clinical crown length simultaneously.
   c. Schedule patients with more flexibility and manage time efficiently.
   d. Ensure an optimal healing response during each procedure.

6. According to the aesthetic crown lengthening classification proposed, type II cases will allow:
   a. Performing the gingivectomy without exposure of the osseous crest.
   b. A temporary violation of the biologic width space.
   c. Sequencing therapy through a staged approach.
   d. All of the above.

7. Type II cases will tolerate a temporary violation of the biologic width space without apparent morbidity for a maximum time period of:
   a. 4 to 6 weeks.
   b. 3 months.
   c. One year.
   d. The maximum time period is not known.

8. When bone sounding, the ability to accurately locate the alveolar crest will be influenced by:
   a. Periodontal biotype and site specific characteristics.
   b. Availability of the recommended instrument kit.
   c. Degree of plaque accumulation.
   d. Thickness of the biologic width.

9. According to the proposed classification system, the following are characteristics of type III cases, except for:
   a. Insufficient amount of soft tissue to perform the gingivectomy.
   b. Risk of exposure of the alveolar crest.
   c. A staged approach cannot be utilized.
   d. None of the above.

10. The degree of aesthetic crown lengthening to be performed should be determined as follows:
    a. Close consultation with an experienced periodontist.
    b. The surgeon will identify the anatomic limitations of the procedure.
    c. Development of a relevant aesthetic blueprint and surgical guides.
    d. Bone sounding measurements.