# Esthetic Crown Lengthening for Maxillary Anterior Teeth

**Abstract:** In the maxillary anterior region, the gingival labial margin position is an important parameter in the achievement of an ideal smile. The relationship between the periodontium and the restoration is critical if gingival health and esthetics are to be achieved. Periodontal therapy is a necessary and useful adjunct when any anterior restoration is undertaken. Anterior surgical crown lengthening may be undertaken to avoid restorative margin impingement on the biologic width. Crown lengthening is also used to alter the gingival labial profiles. This article discusses the esthetic parameters of ideal gingival labial positions and presents a classification of crown-lengthening procedures and the procedure for a two-stage crown-lengthening technique. The two-stage crownlengthening technique is surgically precise because healing is predictable.

entistry has undergone a significant evolution in the last 2 decades. Sophisticated advances in the development of newer restorative materials and techniques have led to an unprecedented improvement in esthetic rehabilitation. It is no longer enough to merely replicate lost tooth structure. Patients demand and expect anterior rehabilitations to be esthetic. There is a tremendous focus on cosmetics today. One has only to gaze through magazine advertisements to see the emphasis that is placed on being attractive.

Dentists are blessed with the unique ability to not only improve patients' health but also enhance their attractiveness. The relationship between a person's physical appearance and his or her self-esteem is well documented<sup>1,2</sup> (*Psychology Today*, November, 119-131, 1973). Studies have shown that a person's face is the prime source of determining physical attractiveness.<sup>1</sup> Patients have stated that their teeth have the greatest impact on improving their physical appearance, and hence self-esteem. Therefore, dentists play a significant role in helping to improve their patients' psychological health.

Dentists are called on to provide restorations that are in harmony with the lips, the face, the adjacent teeth, and a healthy periodontium. Until recently, the scope of esthetic rehabilitation was limited to a close replication of tooth structure on a healthy periodontal foundation. In the past, periodontal therapy was aimed primarily at the elimination of disease, sometimes at the expense of esthetics. However, the scope of periodontal therapy has expanded. The primary goal remains to maintain the dentition with a healthy intact dentogingival unit. However, periodontics has now entered the age of periodontal plastic surgery.<sup>3</sup> Many periodontal therapies lead to esthetic amelioration of the dentition. These techniques allow for the ability to cover denuded roots, correct localized alveolar defects, regenerate bone, increase the amount of keratinized gingiva, enhance papilla reformation, and alter dental gingival levels.

The preservation of a sound periodontium remains the sine qua non of a successful esthetic and functional restoration. A thorough knowledge of the normal anatomy and the interplay between the restoration and the periodontium is essential to achieve a predictable successful esthetic rehabilitation of the smile when prosthetics are planned in the maxillary anterior sextant. Communication between the restorative dentist and periodontist is essential in

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### **Learning Objectives:**

## After reading this article, the reader should be able to:

- describe the indications for crown lengthening in the maxillary anterior sextant.
- discuss the parameters of dental gingival labial relationships to achieve esthetics and harmony.
- determine how to position the restorative margin so the biologic width is not violated.
- explain the indications for the variety of crown-lengthening techniques available.

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these cases. Periodontal therapy plays an important role in the esthetic rehabilitation of the maxillary anterior segment, especially if periodontal disease is present. If the periodontium is healthy, the role of periodontics in smile rehabilitation is limited to crown lengthening and gingival augmentation.

Many indications for clinical crown

**Figure 1**—A clinical illustration of periodontal health and ideal esthetic gingival balance.

Figure 2A—The preoperative view of uneven, dissimilar gingival margins.

Figure 2B—Postoperatively, gingival symmetry and a more esthetic appearance are evident.









lengthening exist. These include caries removal, increasing crown length for restoration retention, restoration of the tooth without violating the biologic width, and esthetics via an alteration of the gingival labial profile. This article introduces a two-stage crownlengthening technique. The focus will be on the maxillary anterior sextant. The esthetic parameters and biologic rationale must first be discussed before the technique is elucidated.

#### **Esthetic Parameters of the Periodontium**

The gingival labial position is but one of a few factors that can contribute to an esthetic smile. The evaluation of a smile should include an analysis of the amount of gingival display when the lips are parted. The smile is dynamic and variable and changes with age. Aging leads to a decrease in the amount of maxillary central incisor display when smiling.<sup>4</sup> Depending on the relationship of the upper lip to the cervical margin of the maxillary central incisors,<sup>5</sup> a smile is one of three types: high lip line, low lip line, and medium lip line. The medium lip line is felt to be the most ideal, harmoniously displaying the dental and gingival elements in proportional symmetry (Figure 5H). A low lip line is rarely a problem for the restorative dentist. In fact, it often serves as a drape for imperfect dental relationships and dentistry. A high lip line, which displays a disproportionate amount of gingival tissue, can sometimes be altered if the clinical crowns can be lengthened. This is possible if there is excess gingival display, as in delayed passive eruption, or if the teeth will be restored and the dental gingival relationships reestablished at the new dental gingival junction. This is dependent on tooth length, incisal edge position, and the functional occlusion.

Healthy, esthetic gingival tissues should be pink in color and firmly bound down to the necks of the teeth. The surface texture of the gingival tissues is stippled, with an orange-peel appearance. The interdental papillae extend from the free gingival margin and should be firm and knife-edged. They should fill the gingival embrasures to the contact point (Figure 1). Care should be taken to avoid loss of gingival papillae in all periodontal and restorative procedures because they are difficult, if not impossible, to re-create after being destroyed.

The gingival zenith is located distal to the long axis of the tooth on the labial surface of

the maxillary central incisors and canines. In contrast, the maxillary lateral incisors have a symmetrical gingival height of contour with the gingival zenith at the midline of the labial tooth surface<sup>5-7</sup> (Figure 1).

As stated earlier, the gingival height of contour ideally follows the contour of the upper lip. Closer inspection reveals that the gingival height of contour of contralateral teeth should be symmetrical. The height of contour of the central incisors should be symmetrical and at a level coincident with the maxillary canines. The lateral incisors should have a gingival level slightly more incisal (about 1.5 mm) than the adjacent centrals and canines.<sup>5,8</sup> Uneven gingival margins create visual tension and violate one of the most important parameters of esthetics—that of symmetry (Figures 2A, 3A, 5A, 5B, and 6A).

The exact amount of attached gingival tissue required for health varies. However, if a restoration is being considered and a minimum of attached tissue is present, preprosthetic augmentation is recommended so that teeth will not be predisposed to recession.<sup>9-11</sup> If a minimal amount of keratinized gingiva exists before crown lengthening, all of it must be preserved during the procedure via sulcular incisions. Gingivectomies and external bevel incisions are contraindicated.

In addition to the above periodontal concepts, some other factors that contribute to the restoration of a pleasing esthetic smile are the lips, the facial profile and structure, the incisal edge position, tooth shade, color and hue, the incisal embrasures, the incisogingival height of the teeth, tooth contour, texture, alignment, and the plane of occlusion.

## Biologic Width—A Concept Under Siege

The dental gingival unit is composed of two parts—the epithelial attachment, or junctional epithelium, and the connective-tissue attachment.<sup>12,13</sup> A gingival sulcus is also present. In the seminal study by Gargulio et al,<sup>14</sup> a proportional relationship was established between the crest of alveolar bone, the connective-tissue attachment, the epithelial attachment, and the gingival sulcus. Their research presented an average sulcus depth of 0.69 mm, an average epithelial attachment of 0.97 mm, and an average connective-tissue attachment of 1.07 mm. The combined dimension of the epithelial and connectivetissue attachment averaged 2.04 mm, and has come to be known as the biologic width.<sup>15</sup>

Numerous articles have discussed the need to maintain a minimum biologic width of 2 mm relative to the margin of the restoration.<sup>16-27</sup> This has become the standard for which numerous crown-lengthening procedures have been performed over the last 3 decades. Clinicians have questioned the need for a minimum of 3 mm (2 mm for biologic







**Figure 3B**—Surgical view of a one-stage crown-lengthening procedure, classification II A 1. Ostectomy is performed to alter the gingival position of the central incisors. A periodontal probe is used to determine the new position of the biologic width and where the crown margin can be placed.

**Figure 3C**—The flap is sutured 2 mm from the crest of bone. The free gingival margin will form 1 mm incisal to this position. The papillae have not been violated. Note how far the epithelium must travel to close the surgical wound margin.

Figure 3D—The postoperative healing at 1 week. The gingiva is inflamed, and no sulcus is evident. The maturation of gingival sulcus and the final gingival scallop for this patient took 6 months.

**Figure 3E**—The final restoration 10 months after crown-lengthening surgery. The central incisors are equal in length and in proper relationship with the laterals and canines. (Restoration by Dr. David Wohl, Fairfield, Conn.)

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width and 1 mm for gingival sulcus) of sound tooth structure between the restoration and the crest of alveolar bone in all situations.<sup>28,29</sup> The wisdom of not needing a minimum dimension of space between the restoration and the alveolar bone and applying it to all human situations is based on clinical impression.<sup>28,29</sup> In 1961, Gargulio et al<sup>14</sup> reported ranges in sulcus depth from 0.0 mm to 5.36 mm, in epithelial attachment from 0.08 mm to 3.72 mm, and in connective-tissue

**Figure 4A**—Crown lengthening, classification II A 3, is performed. No restorative dentistry is planned, so the maximum clinical crown exposure is the therapeutic endpoint. A gingivectomy removes a collar of tissue slightly incisal to the CEJ.

Figure 4B—Crownlengthening procedure postgingivectomy. Note the increased exposure of the clinical crown. However, if the bone is not removed, gingival tissues will regenerate incisally 3 mm from the crest of bone.

Figure 4C—The fullthickness mucoperiosteal flap is reflected after gingivectomy. This allows access for ostectomy.

Figure 4D—After ostectomy, the flap is sutured to the intact papillae with interrupted sutures. The tissue will usually maintain itself in this position.







attachment from 0.0 mm to 6.25 mm. In 1981, Ramfjord<sup>30</sup> questioned the surgical need for the creation of a 2-mm to 3-mm biologic width apical to the proposed restoration margin. He theorized that it may be better for the body to create its own biologic width, as long as the patient maintains adequate oral hygiene. Data by others show that this may, in fact, be impossible. The average marginal fit of gold and ceramic crowns has been shown to be 20 µm to 57 µm.<sup>31,32</sup> Because the average size of a microorganism is between 4  $\mu$ m and 10  $\mu$ m, we can assume that even a clinically acceptable fitting crown would be capable of harboring dental plaque. Waerhaug<sup>33</sup> postulated that the inflammatory lesion exerted its influence 2 mm from the plaque front. Therefore, the rationale for placing the crown margin 3 mm from the alveolar bone might be to eliminate the influence of plaque from the 2.7-mm zone of influence described by Waerhaug.

Numerous experimental studies have shown the potential for attachment loss when restorative tooth margins are placed within 2 mm of the alveolar crest.  $^{20,22,23,33}$  It has also shown that the placement of been intracrevicular margins predisposes the tooth to recession<sup>34</sup> (Figure 3A). Other studies have corroborated these observations, noting that subgingival crown margins are associated with more inflammation compared to supragingival margins.<sup>17,24</sup> Therefore, placing a crown margin subgingivally does not guarantee that it will be stable. In the esthetic zone, crown margins must be hidden. Therefore, it is beneficial to err on the side of caution and maintain at least 2 mm between the crown margin and the alveolar bone. Violation of the biologic width can result in recession or inflammation.<sup>35,36</sup>

Depending on the inflammatory state of the gingiva and/or the force of the probe, human variability makes the precise determination of the individual components of the biologic width difficult. The exact histological depth of the gingival sulcus is impossible to determine clinically. The probe might penetrate the epithelium or connective-tissue attachment. This is a constant dilemma for the practitioner. It has been proposed that the complex be renamed the dentogingival complex and that its dimension be 3 mm on the direct labial of the maxillary anterior teeth.<sup>27</sup> Also, the exact dimension of the various components of the dentogingival complex cannot be determined

## Table 1—Classification of Crown-Lengthening Procedures

- I Gingival reduction only—bone removal not required
  - A Gingivectomy
  - B Gingival flap surgery
- II Mucoperiosteal flap with ostectomy—bone removal required

A One-stage procedures, which require one of the following:

- (1) Flaps, ostectomy, apical positioning
- (2) Flaps, ostectomy, gingivectomy, positioning
- (3) Gingivectomy, flaps, ostectomy, positioning
- B Two-stage procedure, which requires:
   Flaps, ostectomy, and repositioning
   4 to 6 weeks later—gingivectomy

Figure 4E—Gingival healing 1 year postoperatively. Tissues have remained stable where they were sutured. No restorative dentistry was performed.



Figure 5A—The preoperative unesthetic smile. The incisal edges do not follow a similar curvature. The centrals are not in harmony with the anterior dentition.

Figure 5B—With "short" central incisor crowns, the centrals are in balance with each other but are not in proper gingival or incisal relationship with the canines and laterals. After periodontal treatment, restorative treatment will improve the incisal and the gingival labial relationship.





clinically. How can the clinician then decide where to place the margin of the restoration if the base of the sulcus cannot be determined? Kois<sup>27</sup> has suggested that the position of the osseous crest be used to determine margin placement. When the patient is under anesthesia, the alveolar crest of bone can be sounded and its position determined. The clinician can then place the crown margin 3 mm from the crest of bone, assuming the previously discussed concepts of biologic width are understood and agreed on.

## **Types of Crown-Lengthening Procedures**

The two indications for maxillary anterior crown-lengthening procedures are: (1) to increase the amount of labial exposure of the clinical crown, and (2) to increase the amount of tooth exposed superior to the bone to prevent impingement of the restoration on the biologic width. Depending on the situation and the therapeutic endpoint required, a number of surgical procedures are available. A classification of these procedures is shown in Table 1.

## Gingival Reduction Only

Rarely are these techniques called for because bone reduction is usually needed to achieve enough exposure of the clinical crown. However, if bone removal is not necessary, it is possible to perform either a gingivectomy or gingival flap surgery without ostectomy. In the case shown here, a gingivectomy alone is done. The preoperative view (Figure 2A) shows uneven, dissimilar margins. The gingiva is inflamed and in need of plaque control. The clinical crowns are not completely exposed because of excess gingival display. The distance from the free gingival margin to the bone is 6 mm.

Oral hygiene instructions are given and root planing is completed. After 6 weeks, gingival healing is complete and a gingivectomy is performed. The postoperative photograph (Figure 2B) shows gingival symmetry, improvement of oral health, and a much more esthetic appearance. This level of improvement is seldom achieved without osseous surgery.

Mucoperiosteal flaps with ostectomy are usually required to achieve enough exposure of the clinical crown. Either one-stage or twostage procedures can be done. The three types of one-stage procedures are: (1) flaps, ostectomy, and apical positioning; (2) flaps, ostectomy, gingivectomy, and positioning; and (3) gingivectomy, flaps, ostectomy, and positioning. Two of the three one-stage techniques and the two-stage technique are reviewed here.

## One-Stage Surgical Crown-Lengthening Techniques

The technique listed in Table 1 as classification II A 1 involves raising a mucoperiosteal flap, followed by ostectomy and then the apical positioning of the tissues at or near the

**Figure 5C**—Crown lengthening, classification II B, is performed. The initial incision and a fullthickness mucoperiosteal flap reflection are shown. Incisions are made at the distal labial line angles of the centrals without violating the papillae.

**Figure 5D**—Ostectomy is performed on both central incisors. The zenith of bone curves slightly to the distal. The new crown margin will be 3 mm from the newly created crest of alveolar bone. The labial ostectomy is blended with the interproximal bone.

Figure 5E—The flap is sutured back in its original position with interrupted sutures.

**Figure 5F**—An internal bevel gingivectomy is performed 5 weeks postoperatively. The distance from the free marginal gingiva to the alveolar crest was 6 mm. Therefore, 3 mm of marginal gingiva could be excised.









crest of bone<sup>7,26,37,38</sup> (Figures 3A through 3E). This technique is useful if the amount of keratinized gingiva is limited. The advantage of this procedure is that all of the keratinized gingiva is preserved and a healthy band of attached and free gingiva remains after the surgery. However, if healing is delayed (Figure 3D), it can take months for the sulcus to reform. A minimum of 3 mm from the alveolar crest to the restoration margin is necessary to avoid violation of the biologic width. The final position of the free gingival margin is unknown because the tissues may shrink or swell, depending on the individual patient. The tissue position at the conclusion of periodontal surgery may be altered by the healing process and may not be stable for months. This delays the final impression and thus delays the completion of the restoration. A second minor gingivectomy may also be needed to place the free gingival margin at the precise position to achieve a harmonious esthetic balance.

The second mucoperiosteal flap with ostectomy technique, classification II A 3, is also a one-stage approach. The indications include an inadequate amount of exposed clinical crown and a requirement for bone removal. The technique begins with an internal bevel gingivectomy, placing the margin of gingival tissues at their final anticipated labial position (Figure 4A), regardless of their relationship to the underlying alveolar bone. An adequate amount of keratinized tissue must remain after the removal of a collar of free marginal gingiva (Figure 4B). Less than adequate postsurgical keratinized gingiva is a contraindication to this technique. After the gingivectomy, an incision is made in the new sulcus and a full-thickness mucoperiosteal flap is reflected, exposing the underlying bone (Figure 4C). When restorative dentistry is not planned, removal of 2 mm of bone from the cementoenamel junction (CEJ) is recommended to expose the maximum amount of clinical crown without causing recession and possible root exposure. Care is taken to leave the interdental papillae intact, because loss would lead to esthetic compromise. Only a thin labial flap of tissue is raised over the papillae to avoid papillary collapse. Labial ostectomy is now performed, positioning the labial bone at least 3 mm from the newly created facial free gingival margin. The flap is then repositioned and sutured to the nonviolated

papillae (Figures 4D and 4E). The advantage of this technique is that it is one-stage. However, healing is not always predictable, despite adherence to biologic principles. Alterations in healing occasionally lead to less-than-ideal esthetics, resulting in reentry surgery or an additional gingivectomy. For this reason, a two-stage crown-lengthening procedure was developed.

## Two-Stage Surgical Crown-Lengthening Technique

A two-stage crown-lengthening procedure is indicated when an increase in clinical crown length is necessary and labial bone removal is required (Figures 5A, 5B, and 6A). The first procedure involves initial reflection of a fullthickness mucoperiosteal flap to achieve access to the facial alveolar bone (Figure 5C). The palatal tissues are not included and the papillae are preserved. In isolated areas, vertical incisions may be useful to minimize flap size and to avoid a labial flap reflection over papillae. The vertical incisions are made at the flap margins on the labial line angle of the teeth being lengthened (Figures 5C, 5D, and 6C). This avoids the possibility of papilla shrinkage. Bone removal is then performed after flap reflection (Figures 5D and 6C). The position of the restorative margin must be anticipated so that the appropriate amount of bone can be removed. There must be at least 3 mm of space between the crown margin and the bone so that the biologic width will not be impinged on or compromised. Esthetic principles should be taken into account during the ostectomy procedure because the gingival tissue follows the bony contour. The zenith of bone over the labial root surface should mimic the anticipated gingival position (Figures 5D and 6C). The height of alveolar contour should be at the midline of the lateral incisors and slightly distal on the centrals and canines.<sup>5-8,38-40</sup> The labial crest of bone is positioned at least 3 mm from the anticipated position of the restoration margin to allow for adequate biologic width (Figures 5D and 6C).

If restorations are not contemplated and the procedure is performed solely to expose additional natural clinical crown, the labial alveolar bone margin should be positioned 2 mm from the CEJ. The body will re-form a 2-mm biologic width and a 1-mm sulcus, leading to a free margin of gingival tissue 3 mm from the alveolar bone. However, this does not take into consideration alveolar bone resorption, which is possible whenever thin alveolar labial bone is surgically exposed. If this occurs, the gingival tissues will re-form in relation to the alveolar bone and not the CEJ. This can result in root exposure of a natural tooth. The





Figure 5H—The final, well-balanced smile 2 weeks after insertion of veneers on teeth Nos. 6 through 11. (Restoration by Dr. Stephen Guss, Fairfield, Conn.)

**Figure 6A**—A singletooth implant was placed in the position of the right central incisor with the anticipation of crown-lengthening the adjacent central incisor and placing a labial veneer after implant integration.

Figure 6B—Radiograph of the temporized dental implant. Note the depth of the implant placement to move the "dental" gingival junction apically.

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outcome is esthetic compromise in an area being treated for esthetic improvement. After the ostectomy procedure, the flap is repositioned at its original position with interrupted sutures (Figure 5E). Two weeks postoperatively, gingival healing appears complete (Figure 6D). Visually, it appears as if no surgery was performed because the gingival levels have remained unaltered. At 4 to 6 weeks postoperatively, gingival tissues are stable and the

Figure 6C—Crownlengthening surgery, classification II B, is performed on a central incisor. Incisions are made at the mesial and distal line angles of the central incisor. Bone is removed 3 mm apical to the gingival height of contour of the adjacent central incisor implant.

Figure 6D—Six weeks after crown lengthening, calipers are used to measure the implant crown length. This measurement will be transferred to the adjacent central incisor so an accurate gingivectomy can be performed.

Figure 6E—The central incisor immediately after completion of caliper-measured gingivectomy. Note the symmetry of the gingival margins.

**Figure 6F**—The final restoration 2 years postoperatively. A ceramic crown is on the implant on the right central incisor. A labial veneer is on the left central incisor. (Restoration by Dr. Keith Rudolph, Westport, Conn.)









patient is seen for the second procedure, an internal bevel gingivectomy (Figures 5F, 6D, and 6E). The alveolar crest is sounded and the millimeters of supra-alveolar gingiva determined. This number minus 3 mm is the amount of gingiva that can be removed with no change in the free gingival margin. A collar of gingival tissue is excised, leaving additional root exposed. To achieve esthetic accuracy, calipers or periodontal probes can be used. Complete gingival healing is achieved at 2 weeks (Figure 5G).

This technique can be combined with other procedures. Occasionally, a situation will arise where gingivectomy is required on some teeth and ostectomy as well as gingivectomy on others. As demonstrated, these techniques have many indications, independent of the types of dentistry that are being performed. Often they are useful when performing anterior reconstruction with dental implants and natural teeth. The esthetic principles remain the same—the achievement of an esthetic, harmonious, symmetrical smile.

#### Conclusion

Many of today's dental patients are cosmetically oriented. Many others come into dental offices unaware of the benefits and existence of cosmetic dental rehabilitation. An important role for dentists is to teach patients what is possible and available to them. Dentists are fortunate today to be able to completely reconstruct what has been lost. Few disciplines of medicine can make this claim. Periodontal therapy has seen a tremendous growth in technology, which allows dentists to re-create almost all lost periodontium with predictability. The focus of periodontics has changed from resective to regenerative and esthetic. Likewise, restorative dentistry has seen a tremendous evolution in the quality of dental materials. Natural-looking restorations are now possible. Dental implants have made a third set of teeth possible for patients. The knowledge and technology for complete dental rehabilitation exists.

For all of this to be well orchestrated, however, communication must exist between the patient and the dentist. The dentist must be aware of what patients want and need. The patient must be knowledgeable as to what is possible, and must understand the costs, risks, and benefits of treatment. Communication also must exist among dentists. The various dental disciplines must maintain a dialogue about what is possible in each field. The impact of each dentist's treatment on the final result must be known by all participating clinicians. Lastly, excellent communication between the dentist and dental technician should exist. Total esthetic rehabilitation is a team approach.

It is hoped that the crown-lengthening techniques presented will make anterior cosmetic restorations more predictable. With proper treatment planning and communication, a predictable, controlled, esthetic, harmonious result can be achieved for many patients. The beneficiaries will be all who participate in the process.

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This article provides 1 hour of **CE** credit from Dental Learning Systems, Co., Inc., in association with the University of Southern California School of Dentistry and the University of Pennsylvania School of Dental Medicine. Record your answers on the enclosed answer sheet or submit them on a separate sheet of paper.

- 1. Possible indications for crownlengthening include:
  - a. increasing crown length for restoration retention.
  - restoring the tooth without b. violating the biologic width.
  - esthetics via an alteration of c. the gingival labial profile.
  - d. all of the above

#### Placing the margin of the 2. restoration within the biologic width can result in:

- a. recession.
- chronic inflammation. b.
- the re-creation of a newly c. positioned dental gingival complex.
- all of the above d.
- 3. In an ideal esthetic situation, the marginal gingival height of the maxillary central incisors relative to the maxillary lateral incisors is located:
  - approximately 1.5 mm more a. incisally.
  - coincident with the central b. incisors.
  - c. approximately 1.0 mm more apically.
  - d. approximately 4.0 mm more incisally.
- In the maxilla, the gingival 4.

## zenith is located along the midline of the labial surface of the:

- central incisors. a.
- b. lateral incisors.
- canines. c.

uizs

lateral and central incisors. c.

### 5. A mucoperiosteal flap can be performed when:

- ostectomy is required. a.
- excess gingiva covers the clinb. ical crown.
- a minimal band of keratinized с. gingiva exists.
- all of the above d.

### 6. A gingivectomy for crown lengthening is contraindicated when:

- excess keratinized gingiva exists. a.
- b. access to bone is not required. the margin of the provisional c. restoration lies within the biologic width.
- the gingiva is extremely d. fibrotic.

#### The two-stage crown-lengthening 7. procedure requires:

- a. a gingivectomy.
- b. increased clinical skill.
- c. crowning of all teeth.
- reflection of a palatal flap. d.

## Reflection of the papillae is

#### avoided because:

- it adds time to the procedure. a.
- it eliminates papillary recesb. sion.
- there is never a need to c. lengthen teeth interproximally.
- d. none of the above
- 9. The restorative tooth-margin position should be determined before the first stage of the twostage crown-lengthening procedure so that:
  - the appropriate amount of a. bone can be removed.
  - the biologic width will not be b. compromised later.
  - neither a nor b c.
  - d. both a and b
- 10. At stage 2 surgery, the total millimeter (mm) amount of gingiva that can be excised without violating the dental gingival complex is:
  - the distance from the free a. gingival margin to the alveolar crest minus 3 mm.
  - the clinical sulcus depth. b.
  - not able to be determined c. without performing a mucoperiosteal flap.
  - d. the distance from the mucogingival junction to the alveolar crest.

8.