A key goal of aesthetic/cosmetic dentistry is the fabrication of maintainable, aesthetic, and functional prostheses that preserve the health of the teeth and soft tissues. Advances in restorative dentistry have significantly improved the clinician’s ability to deliver predictable treatment. When implants are indicated, osseointegration is an added factor that is essential for success. It is universally accepted that implant dentistry is a restorative-driven treatment with a surgical component.

Whether implants and/or natural tooth-supported restorations are to be placed in the aesthetic zone, the following factors must be considered in order to achieve the desired result:

- diagnosis of smile design
- site development, including soft- and hard-tissue grafting to correct unesthetic or functionally compromising anatomic abnormalities
- proper biologic width
- gingival contours
- the removal of excessive alveolar bone and gingival tissue for the correction of a “gummy” smile.

All of these factors need to be considered during treatment planning and addressed prior to placement of dental implants or natural tooth-supported restorations. Crown lengthening, when indicated, is critical to the success of creating a smile that is harmoniously balanced with the surrounding facial features. Patients who clinically display too much gingival tissue and short clinical crowns require a fully developed diagnosis and treatment plan to provide a predictable aesthetic outcome. This is imperative with the utilization of dental implant restorations.

If a patient has altered passive eruption (APE) of the maxillary anterior teeth, but has completed facial growth, then the gingival levels must first be corrected with either a gingivectomy or aesthetic crown-lengthening procedure before the placement of dental implants. This ensures that the gingival margin of the maxillary anterior teeth will be at the correct height after restoration of the implant, and over the long term.

This article discusses the principles and clinical techniques used to achieve correct positioning of gingival margin when restoring implants and/or natural teeth in the maxillary anterior region. The focus is on optimal aesthetics and long-term tissue health.

**BIOLOGICAL PRINCIPLES**

Biological width is the measurement between the crestal bone and the inferior aspect of the periodontal sulcus, which on average is 2.04 mm and comprises the epithelial attachment (~0.97 mm) and connective tissue (~1.07 mm). This translates to at least 3 mm between the most apical extension of the restorative margin and the crest of the alveolar bone. This allows sufficient space for the supracrestal collagen fibers, and allows a gingival crevice of 2 to 3 mm. If this guide is followed, then the restorative margin should be positioned approximately midway between the gingival margin and the depth of the sulcus. Failure to allow sufficient space between the crown margin (natural tooth or implant) and the crest of the alveolus can result in increased inflammation and possible periodontal pocket formation.

In the absence of periodontal disease, the osseous crest roughly follows the scalloped parabolic contour of the cemento-enamel junction (CEJ) and is 2 to 3 mm apical to the CEJ. In addition, the average interproximal bone height is 3 mm coronal to the facial height of bone. Since the soft-tissue topography is usually determined by the underlying bone.
Placing Dental Implants...
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The periodontal probe
and the width-to-
Suturing of the implant sites following extraction of the deciduous
In addition
Four weeks after surgery, demonstrating gingival margins of the
prior to the place-
(Figure
Gingival recontouring in the maxillary anterior region to place the
but also to provide a
37
anterior teeth at their proper position.
Figure 8.
Figure 5.
Figure 6.

Figure 5. Bilateral retained maxillary deciduous cuspids and anterior altered passive eruption (APE).

Figure 6. Gingival recontouring in the maxillary anterior region to place the gingival margin at the CEJ.

Figure 7. Suturing of the implant sites following extraction of the deciduous cuspids, relocation of the crestal and interdental bone so it is 2 mm apical to the CEJ of the adjacent teeth, and then placement of dental implants.

Figure 8. Four weeks after surgery, demonstrating gingival margins of the anterior teeth at their proper position.

are to have dental implants to
replace missing teeth, any
APE should be corrected prior to implant placement. In
addition, the gingiva may be
coronally positioned second-
to the following:
• plaque-induced inflamma-
tion
• incisal attrition
• gingival hyperplasia
• orthodontic tooth move-
ment
• deep decay causing short clinical crowns
• traumatic injury
• tooth eruption after the patient has completed facial growth.

In such cases the surgeon
should first correct the coro-
nally positioned gingiva
margins with a gingivectomy
procedure, or the gingival
margins and alveolar crest
levels must be altered with
a crown-lengthening proce-
dure prior to the place-
ment of the dental implant.

These procedures can be
accomplished at a separate
surgical visit or at the time of
dental implant placement,
but should be performed prior
to the preparation of the im-
plant osteotomy. This

will ensure that the eventual gin-
gival margin over the dental
implant will be at its correct
level relative to the adjacent
anterior teeth (Figure 4).

Clinical Treatment Guidelines and Procedures

Anatomic considerations serve as
important parameters when performing aesthetic gingival recontouring. The laboratory can fabricate a
useful guide in the form of a
wax-up. The mounted diag-
nostic casts are modified in
wax so that ideal tooth anato-
my as desired in the final

prosthesis is created. Guide-
lines published by Chirde and
Pinault should be followed. These
guidelines suggest that
the average length for aes-
thetically pleasing maxillary
central incisors is 10 to 12
and the width-to-
length ratio is 75% to 80%.
These
guidelines should be kept in mind when recontour-
ing the gingival tissues so as
to not leave the teeth too long
or too short.

After proportions are
achieved on the central inci-
sors, practitioners should
focus on the height of contour of the gingival margin of these
teeth. The proper place-
ment of the peak of the para-
bolic curve of the gingival
margin for the central in-
sors, cuspids, and bicuspids
should be located slightly dis-
tal to the middle of the long
axis of these teeth. This gives
these teeth the subtle distal
root inclination that is im-
portant for an aesthetically
pleasing smile. The zenith
for the lateral incisors is
located at the midline of the
long axis of the tooth. Fur-
thermore, the height of the
gingival crest for these teeth
should be 1 mm shorter than
the gingival margins of the
adjacent teeth. For all teeth
the gingival tissues should ideally
have a "knife-edge" margin.

The presence of short clin-
cical crowns and crestal bone
levels approximating the CEJ
indicates a diagnosis of APE.
The practitioner can then fab-
ricate an aesthetic guide that
can be placed over the pa-
tient’s existing teeth to allow
both the practitioner and
patient to visualize what the
smile would look like with the
gingiva in a modified, more
esthetic position.

The repositioning of the
gingival margin and crestal
alveolar bone requires the ad-
mistration of local anesthe-
sia. A periodontal probe is
placed into the sulcus, at-
tempting to locate the CEJ,
but sometimes the CEJ
cannot be discerned. In a case
where the location of the CEJ
is not clearly identified, a
periodontal probe should be
passed through the periodon-
tal attachment until the crest
of alveolar bone is contacted.
Coupled with current peri-
apical radiographs, locating
the crest should help identify
the CEJ.

Surgical crown lengthen-
ing is then accomplished to
correct the APE. The labora-
tory-fabricated gingival aes-
thetic guide can be used not
only to position the alveolar
crest 3 mm apical to the CEJ
but also to provide a
blueprint for attaining hori-
zontal gingival symmetry and
height. The guide will also
ensure proper interproximal
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scalloping. The newly established gingival margin will be determined by the patient's lip line while smiling, the desired length of anterior teeth relative to the existing level of alveolar bone, and healthy interdental tissue.

Scalloping the gingival tissues is accomplished with a 15c surgical blade. An inverse beveled incision is made, connecting the sulci of the affected maxillary teeth. The surgical incision can transverse the base of the papillary tissue or can follow the topography of the interdental papilla. For aesthetic success at this critical phase of crown lengthening, it is important not to elevate the papilla, which usually will result in loss of proximal tissue height.

A full-thickness mucoperiosteal flap is then elevated with a periosteal elevator (ie, Woodson No. 2 elevator), and osseous resection is performed with a surgical length No. 8 round diamond bur (No. 5801 [Brasseler]) and periodontal hand chisels (Kirkland 15/16 [Hu-Friedy]).

The surgical flap can then be positioned to the prearranged height determined by the aesthetic surgical guide. The flaps are sutured using a 3/8 reverse cutting suture needle (Hu-Friedy) with a 4-0 thread of polyglycolic acid, using a sling suture technique. Suture removal is performed 10 days following surgery, and the patient is instructed in the oral hygiene regimen to be used. This includes brushing with a soft-bristled toothbrush in a circular motion and cleaning interdentally with either dental tape or floss. Additional-ly, Stim-U-Dents (Johnson & Johnson) can be used to maintain the apically positioned gingiva while removing bacterial plaque.

Ten weeks should be allowed for postoperative healing before beginning either implant placement (if required) or preparation of natural teeth for restorations. By using a gingivectomy or crown-lengthening procedure to properly establish the gingival smile line prior to implant placement or natural tooth preparation, a proper prosthetic emergence profile can be established with a well-constructed provisional restoration. This is true if the abutments are supported by implants or natural teeth.

When the restorative phase of treatment begins, the teeth can be prepared with burs such as the KS burs (Brasseler), using the aesthetic guide as a blueprint for tooth reduction. For full-coverage restorations, ceramic crowns provide excellent aesthetics. Preparations for these crowns are either placed at the free gingival margin or slightly subgingival on the facial aspect. Care should be taken not to violate the biologic width during tooth preparation.

Provisional restorations can be made by placing Luxatemp (Zenith/DMG) in a vacuum-formed matrix that was fabricated on the modified model from which the aesthetic surgical guide was fabricated. After approximately 60 to 90 seconds, the provisionals are removed and trimmed. The provisionals are bonded in place by spot etching the preparations and using Tetric Flow (Ivoclar Vivadent) as the luting material.

The occlusion should then be checked in centric, protrusive, and lateral excursive positions and adjusted as needed. The patient returns to the office 10 days after insertion of the provisional restorations and provides input about the aesthetics. Subsequent to recontouring the provisional restorations to meet the patient's expectations, impressions are taken and a putty matrix of the anterior segment is made to ensure that the laboratory has correctly placed the incisal edges.

Impressions are obtained 6 to 8 weeks later using a 2-cord method with a woven retraction cord such as Ultrapak (Ultradent Products). Care is taken so the gingival tissues are not injured. Full-mouth impressions are taken with vinyl polysiloxane (Take 1 [Kerr]) and face-bow transfer and open bite centric relation records are obtained using LuxaBite registration material (Zenith/DMG). The models are mounted in a semiajustable articulator such as the Stratos 200 articulator (Ivoclar Vivadent). The case can be completed using full feldspathic porcelain crowns (Colorlogic [DENTSPLY Ceramco]), which are bonded with both OptiBond Solo Plus (Kerr) and Variolink II (Ivoclar Vivadent). Excess cement is removed with an explorer and periodontal scaler. The previously fabricated putty facial index should be placed to see if there are any discrepancies. Such discrepancies are modified.

**CLINICAL EXAMPLE**

A clinical case is described in Figures 5 to 10. In this case, 2 implants replaced 2 retained deciduous cuspids that were extracted after gingival recontouring was accomplished. As shown, the result of these procedures is a healthy periodontium, and the symmetry of the smile illustrates a completed healthy, aesthetic, and functional restorative result. The

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*Figure 9. Uncovering implants and placement of healing abutments (4 mm).*

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*FREEinfo, circle 78 on card*
The gingival margin should be assessed relative to the projected incisal edge position. A predictable method for determining the proper gingival position is to determine the desired tooth size relative to the projected incisal edge position.

central incisors demonstrate midline symmetry as well as the correct 75% to 80% width-to-length ratio. In addition, the incisal smile line follows the curvature of the lower lip.52 The newly established smile line is more aesthetically appealing and harmonious with surrounding facial features.53

DISCUSSION

The gingival margin should be assessed relative to the projected incisal edge position. A predictable method for determining the proper gingival position is to determine the desired tooth size relative to the projected incisal edge position. The practitioner should remember that the incisal edge should not be positioned using the location of the gingival margin to create the proper tooth size. This is because the gingival margin can move with eruption or recession.54 Therefore, the proper position of the gingival margin should be determined by establishing the correct width-to-length ratio of the maxillary anterior teeth,55 using the width-to-length ratio as previously published by Sterrett et al.39 In general, the amount of gingival display must create symmetry among the teeth throughout the maxillary arch.56

If the existing position of the gingival margin creates a short clinical crown relative to the incisal edge, then the gingival margins should be moved apically. This can be accomplished by performing crown lengthening, gingivectomy, orthodontic intrusion, and/or prosthetic rehabilitation.57 The procedure that is chosen depends upon several clinical factors, such as the location of the CEJ relative to the COB, the crown-to-root ratio and the shape of the root(s), the amount of existing tooth structure, and the sulcus/pocket depth.

It is also paramount when establishing the proper position of the maxillary anterior teeth for an optimal cosmetic outcome to assess the level of the interdental papillae and their position relative to the crown length of the maxillary incisors. It has been demonstrated58 that if the height between the interdental papilla base and the contact point is greater than the distance between the contact point and the incisal edge, then there is an indication that there has been significant bone loss.

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Figure 10. Completed smile 2 years after restoration of the maxillary implants.

For patients who display too much gingiva and short teeth, either intrusion or extrusion of the affected teeth.

**CONCLUSION**

For proper implant placement, that allows for a proper aesthetic outcome. This is especially important when utilizing dental implant restorations. If a patient has altered passive eruption of the maxillary anterior teeth either secondary to orthodontic treatment or in the absence of orthodontic therapy, and the patient has completed facial growth, then the surgeon must first correct the gingival level with either a gingivectomy or crown-lengthening procedure before the placement of dental implants. This will ensure that the gingival margin of the maxillary anterior teeth will be at its correct level relative to the adjacent anterior teeth, not only after restoration of the implant, but for the long term. It is essential that there be at least 3 mm between the most apical extension of the restorative margin and the alveolar bone crest. This allows sufficient room for insertion of the supracrestal collagen fibers, as well as provides a gingival crevice of 2 to 3 mm.

For proper implant placement, that allows for a proper restorative result, the guideline of 3 mm on the facial aspect from the osseous crest to the gingival margin, and 4 to 5 mm from the interproximal CBG to the tip of the papilla, is appropriate when there is no bone and/or attachment loss. Further, if the gingival margin is not located at the CEJ and the underlying bone is not 2 to 3 mm apical to the CEJ with its parabolic contours, then the distances of 3 mm on the facial and 4 to 5 mm on the interproximal area should not be used.

**References**


Acknowledgment

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Learning Objectives

After reading this article, the individual will learn:

- aesthetic concerns prior to placing implants or natural tooth-supported restorations, and
- treatment guidelines and procedures for achieving aesthetic and biologically healthy gingival contours when placing implants or natural tooth-supported restorations.

1. Biological width dictates that at least ____ mm be present between the restoration margin and the crestal bone.
   
   a. 2
   
   b. 3
   
   c. 4
   
   d. 5

2. The interproximal papillae between teeth and no bone loss are approximately ____ mm coronal to the interproximal crest of bone.
   
   a. 4
   
   b. 4.5
   
   c. 5
   
   d. 5.5

3. Altered passive eruption when present on teeth adjacent to an implant site should be corrected ____.  
   
   a. before implant placement
   
   b. after implant placement
   
   c. at implant uncovering
   
   d. following restoration of the implant

4. The recommended width-to-length ratio of maxillary central incisors is ____.  
   
   a. 60%
   
   b. 70%
   
   c. 75%
   
   d. 90%

5. When evaluating altered passive eruption during the clinical examination, determination of where the gingival margin should be located is made by ____.  
   
   a. probing into the sulcus to determine where the crestal bone is located
   
   b. identification on periapical radiographs
   
   c. an arbitrary determination based on periodontal aesthetics
   
   d. both a and b

6. A stent based upon a diagnostic wax-up does which of the following?  
   
   a. assists in guiding the periodontal surgery
   
   b. assists in temporization fabrication of the case
   
   c. acts as a blueprint in treatment planning
   
   d. all of the above

7. To avoid the creation of “black triangles” during periodontal surgery, ____.  
   
   a. flap design should split the papilla
   
   b. flap design should include the papilla
   
   c. flap design should not include the papilla
   
   d. both a and b

8. A predictable method of determining the proper gingival position is to determine the desired tooth size relative to ____.  
   
   a. the projected incisal edge position
   
   b. width-to-length ratio of the teeth on a mock-up model
   
   c. width-to-length ratio of the teeth on a study model
   
   d. both a and b