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Crown Lengthening in the Esthetic Zone

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The maxillary anterior region presents unique esthetic requirements that render both surgical and restorative treatments challenging clinical endeavors. When implants are placed in an esthetic area where natural teeth are present, the need for harmonization of adjacent free gingival margins may arise. This article will address the surgical aspects of elective crown lengthening procedures in the esthetic zone.

The need for surgical elongation of the clinical crown (which includes osseous resection), as compared with simple gingivectomy, stems from studies supporting the existence of an inviolate physiologic parameter between the marginal gingival tissues and the alveolar crest.

In periodontal-prosthodontic interdisciplinary therapy, where subgingival restorative margins are desired, it is prudent to discuss the concept of the so-called biologic width. The dimensions of the tissues occupying the area between the base of the gingival sulcus and alveolar crest were first described by Gargiulo et al.[6] These investigators reported that the average dimension of the junctional epithelium and supraalveolar connective tissue was 2.04 mm (range 1.8–2.4 mm). Subsequent researchers have shown that a definitive dimensional relationship exists among the alveolar crest, the supraalveolar connective tissue attachment, the junctional epithelium, and the base of the gingival sulcus.[1,4,7,8] The total width of these tissues varies among individuals but remains constant within individuals.[19] The results of studies suggest that, to prevent periodontal tissue inflammation, the biologic width must not be violated by restorative procedures.[4,9,10] Ideally, a restoration margin should be placed no more than 0.5 to 1 mm subgingivally to prevent encroachment on the biologic width.[18] Although genetic variations may exist,[14] a minimum distance of 3 mm is recommended between the margin of a restoration and the alveolar crest in most individuals.[7,9,16]

In designing a treatment plan that includes surgical enhancement of clinical crown dimensions, the surgical and restorative team must recognize the boundaries of the esthetic zone. Because the lips form the framework of a smile, the lips define the esthetic zone.[5] It is essential to conduct a smile analysis in order to identify the existing relationship between the upper lip and the maxillary gingival

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margin levels. Based on defined esthetic guidelines,[3] the prosthodontist or restorative dentist is responsible for providing the surgeon with the desired marginal tissue levels. This would lay a foundation for planning the appropriate amount of osseous tissue resection that should reestablish the biologic dimension after final restoration. A presurgical wax-up may aid the surgeon in envisioning the final outcome planned by the restorative dentist.

Indications for esthetic crown lengthening:

1. Short clinical crowns as a result of altered passive eruption.
2. Discrepancy in free gingival margin levels on teeth planned for esthetic restorations.
3. Excessive gingival display (gummy smile).
4. Contralateral asymmetry in marginal tissue levels.
5. Diastema closure with restorations that may appear too wide relative to tooth length.
6. Esthetic improvement of natural teeth lengths when adjacent to implant restorations with more apical marginal tissue levels.

Conditions that allow for optimal control of the marginal fit of a restoration and optimal access for daily plaque control by the patient are also necessities.[2]

Contraindications for esthetic crown lengthening:

1. Teeth with short roots where osseous recontouring may compromise support.
2. Periodontally involved teeth.
3. Inadequate oral hygiene resulting in marginal gingivitis.
4. Systemic conditions that may interfere with ideal healing following surgery.

Interdisciplinary therapy must be planned with the final cosmetic result in mind, and it is imperative to note that the ultimate goal is to recreate a natural appearance of the hard and soft oral tissues in order to meet the expectations of the patient. By following defined esthetic rules for the maxillary anterior restoration,[17] this goal can be achieved with a high degree of predictability.

Because the central incisors are the most dominant teeth in a smile, surgical lengthening should be planned with recognition of a width:length ratio of 75% to 80%.

The gingival margin of the central incisor and cuspid should be at the same horizontal level, whereas that of the lateral incisor should be 0.5 to 1 mm coronal to this line. Although the prosthodontist or restorative dentist must decide on the ideal length for each patient, esthetic guidelines indicate that pleasing clinical crown lengths are 10.5 to 11 mm for the central incisor, 9.5 mm for the lateral incisor, and 10 to 10.5 mm for the cuspid. Maxillary bicuspid lengths must be included in the same procedure if an unesthetic discrepancy is anticipated distal to the cuspids.[3]

In an attempt to achieve optimal results in the esthetic zone, various multidisciplinary approaches have been advocated by several researchers. Due to the possible risk of undesirable postsurgical alterations in marginal soft-tissue levels, including loss of interdental papillae, different approaches are currently used based on the practitioner's preference.[1,5,11–13] Only sparse data in the literature discuss the long-term results of these techniques, with inadequate information regarding the critical esthetically demanding areas.[2]

The conventional approach to esthetic crown lengthening, in which gingivectomy is performed and a full-thickness flap including the papillae is elevated to access the alveolar bone, has been described previously.[1,13] Due to concerns about continued postrestorative recession with resultant discrepancy in marginal tissue levels, at this time the period that should be allowed prior to final tooth preparation and impressions has not been definitively established. Ongoing controlled research by the authors should provide more evidence-based data with regard to this matter. Additionally, once the papillae are surgically elevated, reestablishment of ideal height and fullness cannot be guaranteed.

TWO-STAGE PAPILLA INCLUSION TECHNIQUE

In this technique a first-stage osseous resection procedure is performed followed by a second-stage gingivectomy. This method is generally used if the interproximal contact point between the future esthetic restorations will be repositioned at a more apical level (Fig. 1*A*).

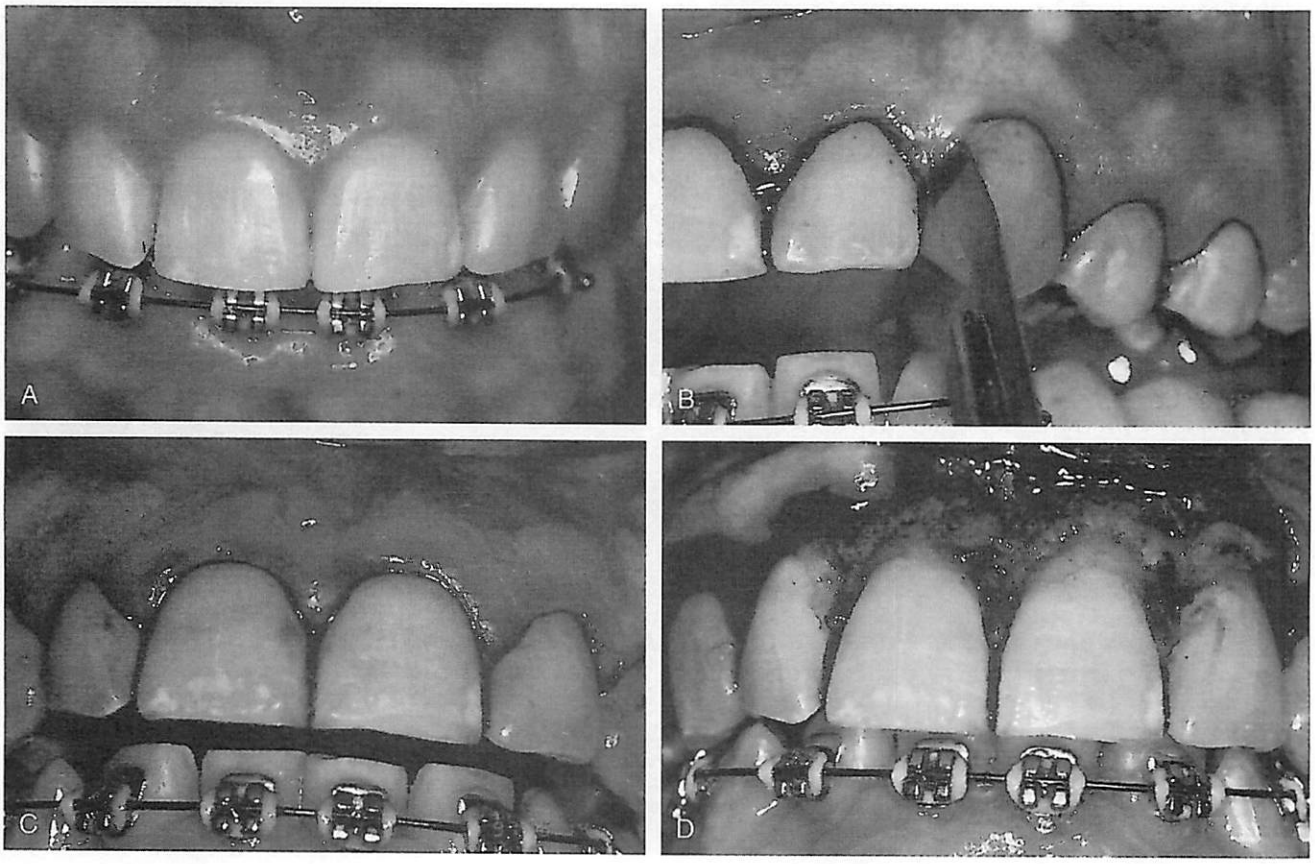

Figure 1. *A,* Short clinical crowns with internal stains. *B,* Sulcular incision including the papillae. *C,* Completed incisions. *D,* Elevated flap.

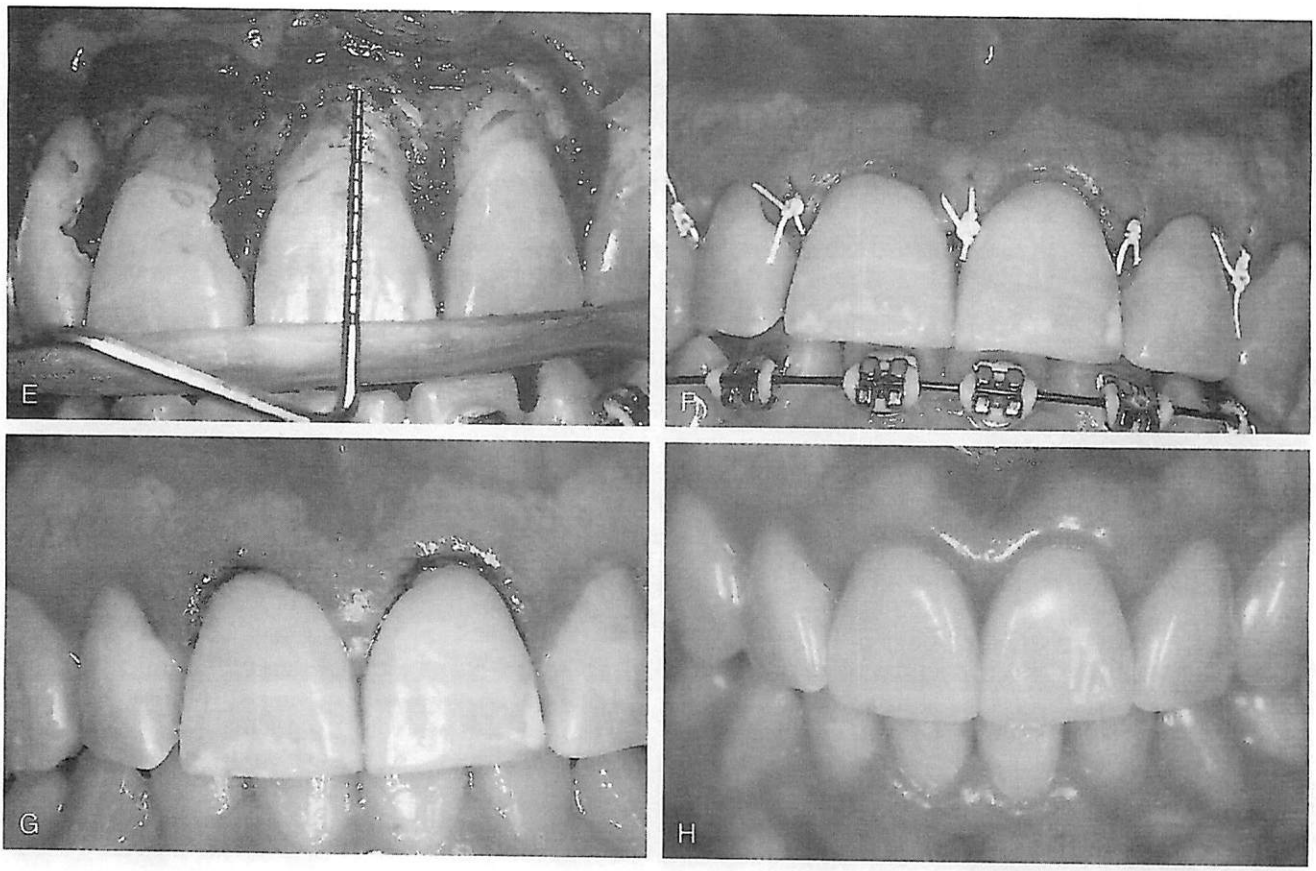

Figure 1 (*Continued*). *E,* Osseous crest levels after resection. *F,* Sutured flap. *G,* Second-stage gingivectomy. *H,* Final result with ceramic veneers.

This would allow access to the interdental septum for osseous recontouring under the papilla as necessary with the knowledge that the average distance between the tip of the papilla and bone is 4.5 mm.[15]

A sulcular incision is made into the gingival crevices of the teeth and interdental papillae (Fig. 1*B, C*), and a full-thickness flap is elevated facially by blunt dissection (Fig. 1*D*). Surgical-length number 4 or 6 round burs are used under copious irrigation to apically relocate the alveolar crest for preservation of the biologic height from the margin of the future restoration. A fixed reference such as the incisal edge or a surgical measurement template is necessary for this step (Fig. 1*E*).

The restorative dentist must inform the surgeon whether the existing incisal edge position will be changed in the final restoration; that is, if the incisal edge is used as a fixed reference and the clinical crown needs to be increased by 1 mm apically and 1 mm incisally, the surgeon must recognize that difference at osseous resection time in order to avoid overremoval of bone.

Osteoplasty is then performed using bone files to eliminate residual sharp margins after verification that newly established alveolar crest levels will allow for the presence of a minimum distance of 3 mm of tooth surface from the cervical margin of the planned restorative tooth preparation.

Interrupted sutures are used to passively replace the flap back to the presurgical position, with special attention directed to maintenance of papillae levels (Fig. 1*E*). These are removed 5 to 7 days postoperatively.

After a tissue stabilization period of 3 months, the free gingival margin levels are reevaluated and a second-stage gingivectomy/gingivoplasty is performed using a number 15c blade or laser incisions as necessary (Fig. 1*G*). This technique is preferred by some practitioners due to the unpredictability of the final position of the marginal tissues if they were to be excised to the desired level at the first surgery.[5] Careful tissue contouring is performed at this stage to simulate the cervical contour of the planned restoration. It must be noted that the crest of curvature of the maxillary central incisor crown is offset to the distal, and any marginal incisions should reproduce the natural anatomic outlines for an ideal esthetic outcome. It is the experience of this author that postsurgical recession after stage I appears to stabilize after 3 months and less tissue sculpting is required than originally anticipated.

Restorative procedures could be initiated approximately 4 to 5 weeks after stage II surgery. The advent of all-ceramic, full-coverage, and veneer restorations (Fig. 1*H*) allows for minimal subgingival margin preparation, thereby maintaining the biologic width.

Although this technique overcomes the drawbacks of tissue recession following osseous recontouring, its main disadvantage is the inevitable loss of papillary height and fullness, which may result in undesirable "black triangles" in the interdental area. This may be minimized by maintaining the lingual papilla height at incision time and further compensation may be attained by apical relocation of the contact point. The latter must be kept to a minimum, however, to avoid esthetic compromise by creating unnatural contours. It is common to have an "unfilled" space beneath the papilla that may take up to 2 or 3 years postoperatively to fill in with papillary tissue.[15]

SINGLE-STAGE PAPILLA PRESERVATION TECHNIQUE

This technique is preferred for veneer restorations in which it is unnecessary to elevate the papilla for access to the interproximal osseous tissue because the biologic width will not be violated by the restoration. It is also indicated for full-coverage, all-ceramic restorations when less than 0.5 mm subgingival extension is anticipated.

In the case presented in Figure 2*A*, veneer restorations will replace old resin restorations on the maxillary centrals and right lateral incisor, while a full-coverage, all-ceramic restoration will replace the short porcelain fused to metal crown on the left lateral incisor. Due to unesthetic discrepancy in marginal tissue levels, the prosthodontist's prescription includes crown lengthening surgery on teeth numbers 7, 8, and 10.

Figure 2. *A*, Asymmetric marginal tissue levels. *B*, Internally bevelled gingival incisions. *C*, Horizontal papilla preservation incision. *D*, Elevated flap showing osseous crest at cemento-enamel junction. *E*, Ostectomy with surgical bur. *F*, Osteoplasty with back-action chisel.

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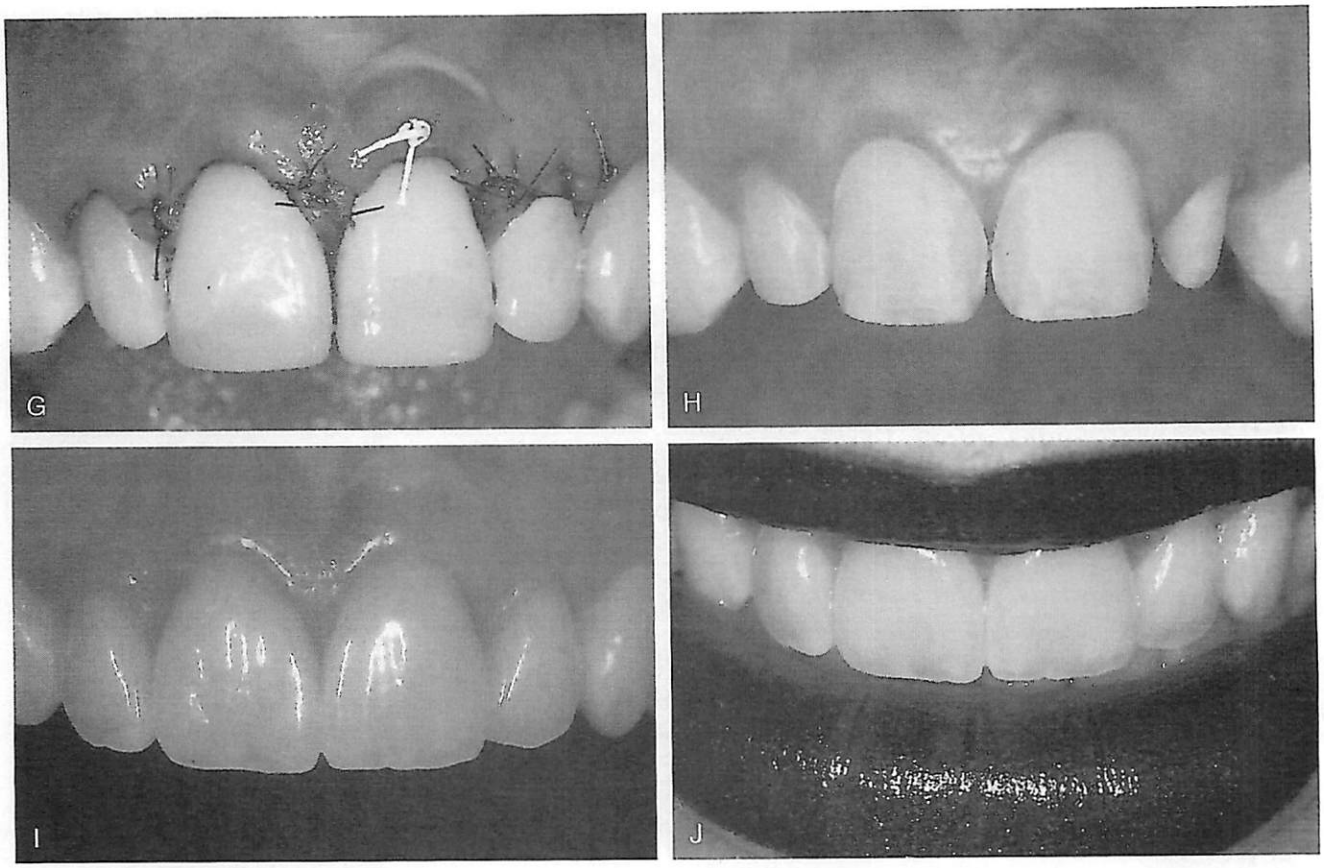

Figure 2 (*Continued*). *G*, Sutured tissues. *H*, Veneer preparation after healing. *I*, Final veneer restorations displaying symmetric tissue levels. *J*, Esthetic harmonious smile.

The existing incisal edge is used as a fixed reference point for the required tissue resection levels using a 15-mm graded periodontal probe. An internally bevelled gingivectomy is performed to the desired tissue levels and contours on each tooth, completely avoiding the interdental papillae (Fig. 2*B*). A second internally bevelled horizontal papilla preservation incision is performed interproximally about 3 mm from the papillary peak (Fig. 2*C*). This bevelled design maximizes blood supply from the fixed connective tissue layer at flap suturing, thereby minimizing soft-tissue scarring after healing at the incision site.

A full-thickness mucoperiosteal flap is carefully elevated facially as necessary for surgical access, remaining coronal to the mucogingival junction (Fig. 2*D*). Avoiding the mucosal layer is a key factor in preventing postsurgical recession that would unnecessarily prolong the waiting period for restorative work to begin. Osseous crest relocation is then performed with rotary and hand instruments to recreate the biologic distance (Figs. 2*E* and *F*). After verification of final tissue levels, the flap is carefully sutured interdentally, where more than one suture may be required on either side of each papilla for accurate tissue adaptation (Fig. 2*G*). The sutures are removed 5 to 7 days postoperatively to avoid interference with healing.

After a healing and tissue stabilization period of 3 to 4 months, the gingival sulcus should be reestablished, and restorative procedures may be initiated (Fig. 2*H*). Figure 2*J* demonstrates how periodontal-prosthodontic interdisciplinary planning may provide the patient with esthetically pleasing restorations that offer ideal tissue health and appearance, resulting in a harmonious smile.

The advantages of this technique are elimination of second-stage surgery and, more importantly, avoiding the risk of losing papillary height or fullness, thereby omitting the possibility of creating "black spaces." A recent study has demonstrated

stabilization of marginal tissue levels 3 months postoperatively using the single-stage technique.[11] A possible drawback to the papilla preservation incision is persistance of a minor residual scar at the incision line, which may take a longer time to disappear, or may otherwise require gingivoplasty. However, it is the experience of this author that carefully bevelled incisions and careful suturing result in a low incidence of this occurence with significantly fewer patient complaints as compared with loss of papillae.

TWO-STAGE PAPILLA PRESERVATION TECHNIQUE

This technique combines the advantages of the previous two approaches by avoiding the risk of papillary tissue loss using the papilla preservation method while assuring marginal tissue control and stabilization in a two-stage approach. It is the recommended technique for patients with very thin periodontium where increased risk of postoperative recession may be expected. It also may be used when an experienced restorative dentist or prosthodontist prefers to perform the second-stage gingivectomy/gingivoplasty using a carbon dioxide laser incision, which allows precise microadjustments of the marginal tissues as per restorative requirements.

The patient in Figure 3 presented with short clinical crowns and an incomplete mesiodistal oblique fracture of tooth number 9 crown that extended slightly under the facial free gingival margin while remaining supragingivally on the palatal aspect.

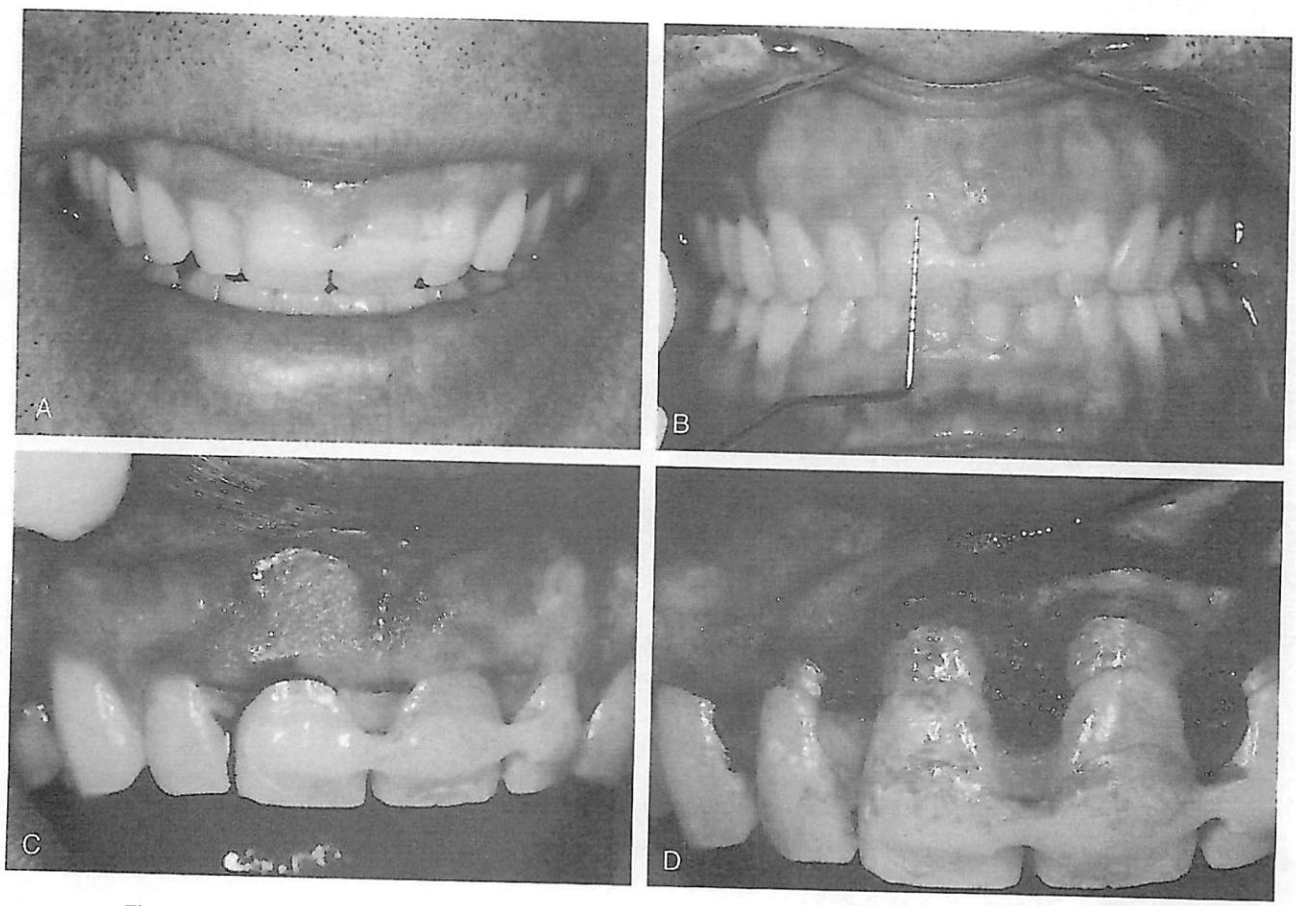

Figure 3. *A* and *B*, Excessive gingival display. *C*, Papilla preservation incisions. *D*, New osseous crest levels.

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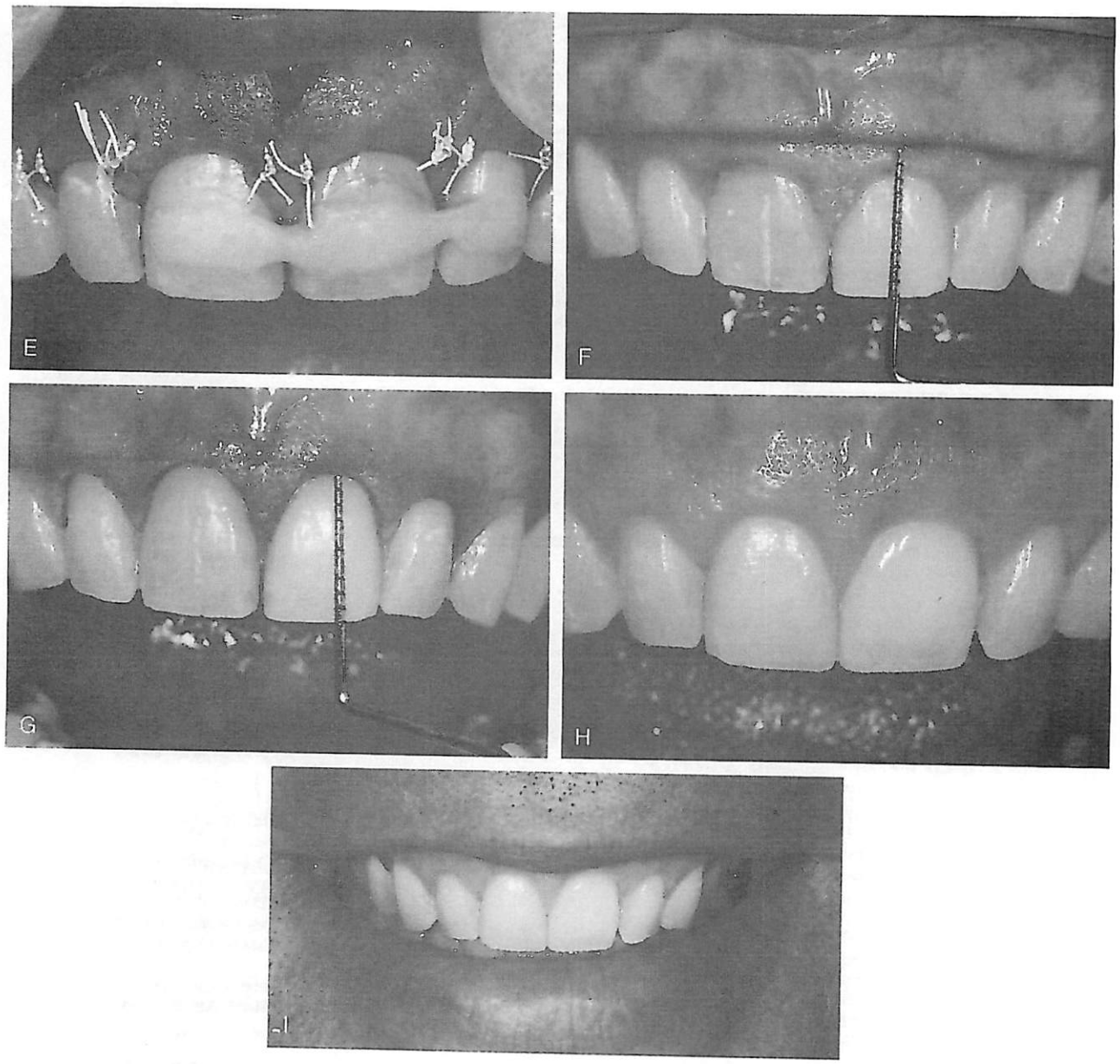

Figure 3 (*Continued*). *E*, Double sutures in the papillae. *F*, Desired tissue level marked on the gingiva. *G*, Gingivoplasty performed to the esthetic level. *H*, Final full-coverage ceramic restoration. *I*, Final esthetic outcome.

The restorative dentist requested esthetic crown lengthening of all maxillary incisors during the same surgical procedure for correction of the crestal-marginal dimension on tooth number 9. A papilla preservation incision was performed as described above (Fig. 3*C*), and osseous resection was performed to recreate the natural biologic dimensions on all incisors planned for crown lengthening (Fig. 3*D*). Interrupted sutures were used for flap adaptation to the fixed papillary areas at the same presurgical level (Fig. 3*E*).

After a healing and tissue stabilization period, the desired level of the free gingival margins is marked on the facial tissues (Fig. 3*F*). A carbon dioxide laser was used in this case by the restorative dentist for establishing the ideal shapes and positions of the marginal tissues (Fig. 3*G*).

Figures 3*H* and *I* show the final restoration on tooth number 9 and the reduction of excessive gingival display as compared with the preoperative smile analysis.

SUMMARY

Crown lengthening in the esthetic zone is a prosthodontically designed and surgically executed procedure that must only be considered after careful restorative and surgical treatment planning, including a detailed smile analysis, clinical and radiographic evaluation of the quality of soft and hard tissues, and selection of the appropriate approach for each individual case.

The presented techniques are modifications of the original conventional surgical approach, where longer healing periods may have been required and loss of papilla height or fullness is of concern. Recognition of the advantages and disadvantages of each technique should increase predictability and success in interdisciplinary smile enhancement therapy.

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