



# MAINTENANCE OF THE INTERDENTAL PAPILLA FOLLOWING ANTERIOR TOOTH REMOVAL

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**Soft and hard tissue recession following the removal of an anterior tooth presents a unique restorative challenge for the treatment team. The dental literature has examined postextraction tissue loss and proposed multiple solutions for this aesthetic complication. The majority of these techniques have focused on the prevention of buccolingual recession of the residual ridge, while the maintenance of the interdental papilla following extraction has received less attention. The purpose of this article is to present a clinical technique for maintaining papillary height and form following single anterior tooth removal.**

In order to understand the clinical protocol utilized to maintain the morphology of the papilla following anterior tooth removal, it is first necessary to understand the rationale behind the technique. The examination of the ridge of a fully edentulous patient will reveal no papillary form. To understand the role of the dentition in the creation of the papilla, a review of normal anatomy is necessary. Upon evaluation of tooth position in the bony environment of the patient, it is evident that conventional osseous architecture follows the cemento-enamel junctions of the teeth only 2 mm more apical in location.<sup>1</sup> This results in the classic osseous scallop that occurs apically on the facial and lingual aspects and coronally in the interproximal region. While the presence of this osseous scallop alone would establish a degree of papillary form, it would not account for the entire presence of the height

of the papilla. In a typical human, the osseous scallop from facial to interproximal averages 3 mm in height across the maxillary anterior region (Figure 1), with a range of 2.1 mm to 4.1 mm.<sup>2</sup> The height of the gingival scallop from facial to interproximal, however, is commonly determined to be 4.5 mm to 5.5 mm (Figure 2).<sup>3</sup> In order to understand the process used to maintain the papilla following extraction, it is necessary to identify the etiology of the 1.5 mm to 2.5 mm discrepancy in bone height in relation to the gingival scallop.

The concept of biological width and its mean measurements have been well described in the literature.<sup>4,6</sup> These efforts have determined that the connective tissue attachment has a mean height of 1 mm, the epithelial attachment has a mean height of 1 mm, and the average sulcus is approximately 1 mm in depth. This results in 3 mm of gingival tissue above the osseous crest in the average patient, which fails to explain the height of the gingival scallop from the facial to the interproximal aspect. If the height of gingiva to bone was constant facially

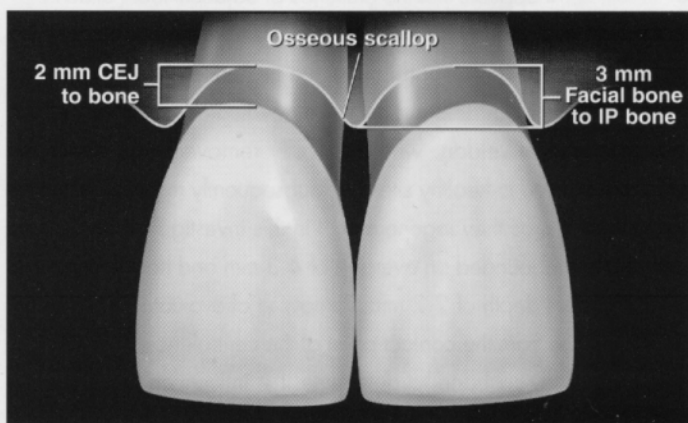
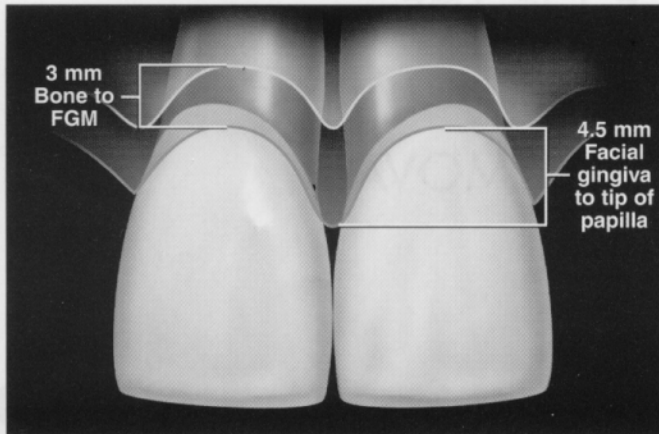


Figure 1. The bony architecture mimics the CEJs of the natural dentition. Note the scalloping, which is an average of 3 mm from the height of the facial to the interproximal aspect of bone.

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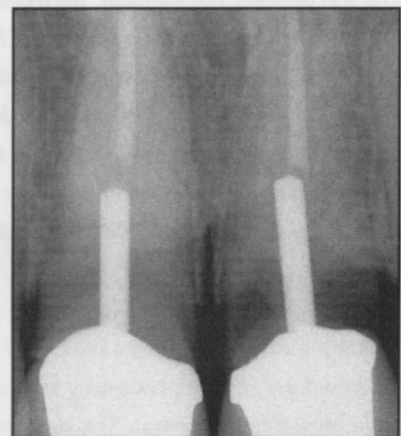
**Figure 2.** On the facial aspect, the free gingival margin averages 3 mm above the bone. Since the tip of the interproximal papilla averages 4.5 mm above the bone, the total gingival scallop is 4.5 mm from facial to interproximal.

and interproximally, the gingival scallop would only be 3 mm and would match the 3 mm osseous scallop, instead of measuring 4.5 mm to 5.5 mm. One option for the increased gingival height above bone interproximally is that the biological width (connective tissue and epithelial attachment) may be greater in height interproximally, although studies have demonstrated this to be false.<sup>5</sup> Rather, the biological width was determined to be constant circumferentially an average of 2 mm. If the biological width remains the same on the facial and interproximal aspect of the tooth, then the only factor that could explain the greater tissue height interproximally would be an increased sulcus depth. Consequently, it is necessary to determine why the sulcus depth would be different, and how this tissue would be maintained following extraction.

It appears that the presence of adjacent tooth attachment and the size of the gingival embrasure formed by these teeth is responsible for the presence and height of the papilla. This concept was evaluated in 1982 by Van der Veldon, who surgically removed interdental papillae in healthy sites and subsequently measured the tissues as they regenerated.<sup>7</sup> In this investigation the tissue rebounded an average of 4.3 mm and had a mean sulcus depth of 2.2 mm. Tarnow et al evaluated the distance from the contact point of the central incisors to the underlying bone to determine if it influenced the presence of the papilla. The researchers discovered that when the contact was within 5 mm of the bone, the papilla always filled the embrasure with a 5 mm height of tissue



**Figure 3.** Preoperative facial view of teeth #8 through #10, which required placement of a fixed partial denture due to root resorption of tooth #9.



**Figure 4.** Preoperative radiograph exhibits root restoration on the left central incisor that necessitated extraction. The bone levels interproximally and facially were normal.



**Figure 5.** Teeth #8 and #10 were prepared for full-coverage crown restorations. Note loss of papilla height due to patient's failure to return for immediate pontic placement following root removal.



Figure 6. At 10 days postextraction, the patient returned and the provisional restoration was altered to provide an ideal shape for the pontic.

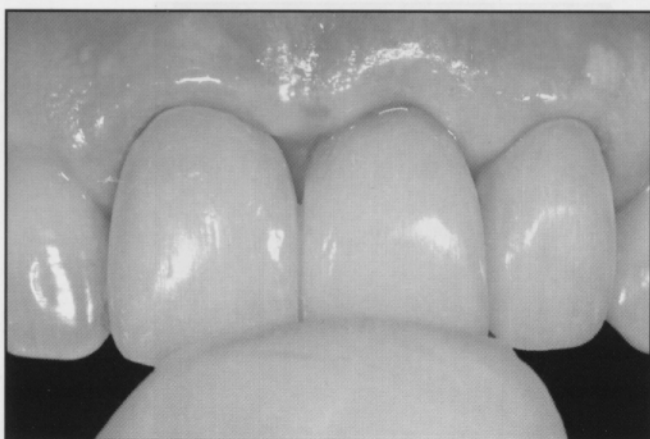


Figure 7. Using manual pressure, the provisional restoration was seated. The interproximal contours and contact heights were designed to reform the papillae to their original height.



Figure 8. Following 12 months of healing, the papillae had matured but remained 1.5 mm apical to preoperative levels, and were essentially 3 mm above the interproximal bone.

above bone.<sup>8</sup> It would appear that when adjacent teeth are present and the volume of the gingival embrasure is controlled, a deeper sulcus and overall increased height of tissue above bone will exist on the interproximal as compared to the facial aspect. Critical to the preservation of this height of tissue following extraction is control of the gingival embrasure size at the time of extraction. When a tooth is removed and a confined embrasure no longer exists, the interproximal papilla recedes to the same 3 mm level above bone as exists facially (Figures 3 through 5). Consequently, the gingival scallop flattens to match the underlying osseous scallop, which results in compromised gingival aesthetics. One solution to this situation requires the fabrication of a provisional restoration with the same embrasure volume that existed prior to extraction; the papilla is subsequently permitted to reform (Figures 6 and 7). If the height of the papilla was lost following extraction, however, rarely can it be re-created with pressure (Figures 8 through 10). It appears that it is not just embrasure form, but the combination of embrasure form and adjacent gingival attachments that are responsible for papillary formation.

The most effective means of re-creating a papilla is to prevent its loss at the time of extraction, where the replacement of the preexisting gingival embrasure form is critical. In the author's experience, the replacement should occur within hours of the extraction. This article demonstrates a prosthodontic concept utilized to insert



Figure 9. At 12 months, the facial gingival margin had healed well due to the presence of good supporting bone. Since the embrasure form had not been replaced until 10 days postextraction, the papillary height had not returned.

an immediate replacement into the extraction site; this restoration supports the facial gingival margin and the interproximal papillae.<sup>9</sup> The depth of the extension into the socket and the shape of the extension are critical to the maintenance of the soft tissue profile.

### Technical Protocol

The existing gingival form and levels should be initially evaluated (Figure 11). If the tooth to be extracted has poor gingival aesthetics, the patient should be informed that some form of ridge augmentation will be necessary following extraction. If the existing gingival aesthetics are acceptable, then the objective of any restorative procedure must include their preservation. The ability of this technique to maintain gingiva is highly dependent upon the underlying bone levels facially and interproximally on the tooth that is being removed and the remaining adjacent dentition. In order to ensure the facial position of the free gingival margin following extraction, it is essential to maintain a normal level of bone on the facial aspect of the tooth indicated for extraction. If facial bone loss occurs, a degree of facial recession can be expected following extraction unless additional treatment is rendered. This could require the grafting of the socket at the time of extraction,<sup>10</sup> orthodontic extrusion prior to extraction to orient the facial bone coronally,<sup>11,12</sup> or grafting at a subsequent date.

The level of the interproximal bone on the adjacent teeth is also critical to optimal papilla maintenance. Even if the tooth to be removed has interproximal bone loss,



Figure 10. Three years postoperatively, the papillae had not changed, but remained 1.5 mm apical to their original position.

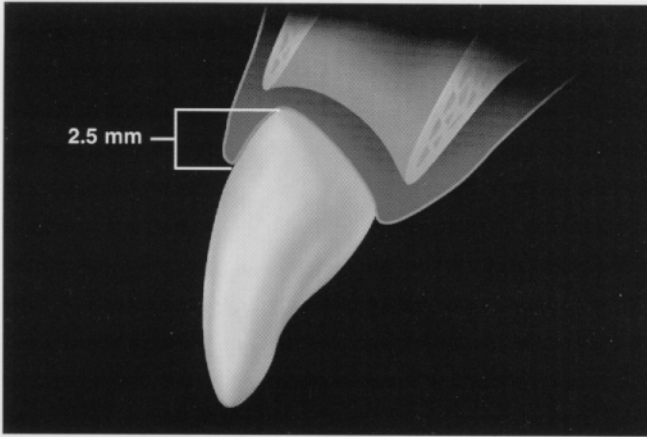


Figure 11. Preoperative view of a patient who required the removal of tooth #8. The facial and interproximal bone levels were normal, although a palatal well with a depth of 10 mm was present.



Figure 12. Preoperative radiographic appearance of the maxillary central incisors. Note the level of the interproximal bone and the palatal well.

it is often possible to maintain the papillae if the adjacent teeth have not experienced bone loss. As greater interproximal bone loss occurs throughout the region, soft tissue maintenance becomes less feasible. Consequently, the region should be carefully evaluated with radiographs, sulcus probing, and sounding to bone prior to tooth removal. This technique is effective when the tooth being removed exhibits adequate facial bone and the adjacent teeth have proper interproximal bone (Figure 12). It can also be combined with grafting of the socket when the extracted tooth has facial bone loss, although the definitive gingival margin will be less predictable on the facial aspect. The predictability of this treatment is also influenced by the thickness of the periodontium, as thicker tissues have a reduced tendency to recede.



**Figure 13.** Diagram of correct pontic shape at the midfacial level. The facial contour extends 2.5 mm apical to the free gingival margin initially, but will be reduced to 1 mm to 1.5 mm at 4 weeks.



**Figure 14.** The adjacent natural dentition were prepared as abutments for the fixed partial denture.

Following evaluation and a prediction of results, it is possible to proceed if the technique is indicated. At the time of extraction, the replacement tooth can be supported in several manners. If the adjacent teeth require restoration, they can be prepared and a conventional provisional fixed partial denture can be placed. If it is not necessary to restore the adjacent dentition, then a tooth can be temporarily bonded to them for support. While a partial denture can also be utilized as a provisional restoration, there is a greater risk of affecting the tissue due to the movement of this prosthesis.

The shape of the extension into the socket is critical for the achievement of optimal results. The tooth should typically extend 2.5 mm apical to the facial free gingival margin upon extraction, which establishes the site of the

pontic within 1 mm of the facial bone to prevent the facial tissue from collapsing during initial healing. The facial-to-interproximal scallop should approximate the underlying bony scallop so that the pontic is within 1 mm of the interproximal bone. In order to support the gingiva and allow the blood clot in the socket to be infiltrated with osteogenic cells this depth will remain for the first 4 weeks following extraction. During these 4 weeks, flossing under the pontic is difficult, and the patient is instructed to brush and floss the adjacent teeth and floss under the pontic, if possible. Vigorous rinsing or irrigation under the pontic is desirable. At the conclusion of the 4-week healing period, the pontic is removed and the depth is adjusted to extend approximately 1.5 mm below the tissue, which enables flossing to be performed more easily.

Along with depth, the shape of the pontic is also critical to papilla maintenance (Figure 13). On the facial surface, the pontic should extend in a straight line from the facial cervical one third of the tooth. The clinician should exercise care not to roll the pontic palatally below the free gingival margin, which will not support the facial free gingival margin as effectively. It is critical that the interproximal contour matches that of the previously extracted tooth, and that the apical extension of the papilla mimics the smooth contour of the corresponding tooth. Any opening of the gingival embrasure below tissue risks an alteration in papillary height. In order to ensure papillary support through the entire buccolingual width of the papilla, the interproximal contours should



**Figure 15.** The tooth was extracted with a rotational motion to protect the facial bone. A fiberotomy was performed prior to extraction to avoid gingival trauma.

also be extended palatally past the contact point. To facilitate hygiene maintenance, the palatal portion of the undersurface of the pontic should bevel coronally to meet the palatal gingival margin. While this eases the patient's ability to floss beneath the pontic, it does not provide a gap for debris.

The actual creation of the pontic can be easily managed, either indirectly on a model or directly in the mouth. In order to fabricate the pontic indirectly, an impression is made prior to the extraction of the tooth. If the adjacent teeth are being prepared, this procedure should be completed prior to the taking of impressions. In the laboratory, the model is poured in fast-setting stone. The gingival outline is subsequently marked with a pencil on the tooth to be extracted from the facial to the interproximal aspect. The tooth indicated for removal is ground down on the model, leaving the appearance of an edentulous ridge. Without disrupting the pencil line, the model is carved with an acrylic bur to the ideal pontic profile and depth, as previously described. Utilizing a vacuum-formed matrix fabricated from a diagnostic waxup, the provisional restoration or pontic of ideal shape is developed. Once a layer of petroleum jelly is applied to the model, the matrix is filled with a provisional material and seated on the modified model. An alternative that initially seats the matrix on the model may also be utilized. Holes are fashioned in the matrix with a bur, and a monoject syringe is used to inject the provisional material into place. To produce a pontic with optimal contour, the material is subsequently photopolymerized, removed, and trimmed.

The intraoral fabrication of the provisional restoration presents a greater technical challenge than does an indirect process. Impressions are utilized to fabricate a diagnostic waxup and fashion a clear vacuum-formed stent. If the adjacent teeth are to be used as abutments they are prepared accordingly (Figure 14). The hopeless tooth is subsequently removed and a resorbable hemostatic material (Surgicel, Ethicon, Inc., Somerville, NJ) is placed in the site to prevent the acrylic material from flowing into the extraction site during the fabrication of the provisional restoration (Figure 15). The clear stent is then seated intraorally; following the appropriate setting period, it is removed and trimmed to optimal contour



Figure 16. Following direct fabrication intraorally, the provisional restoration was trimmed. Note that the pontic was inadequate in shape to support the papillae.



Figure 17. Acrylic resin was added to the pontic to correct the shape and depth of the provisional restoration, which was subsequently trimmed and polished.

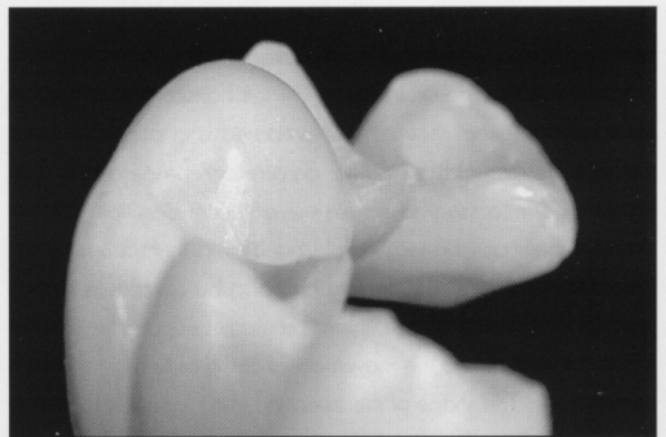


Figure 18. Cross-section of the corrected pontic shape. Compare to Figure 13.



Figure 19. Facial view of the provisional restoration placement. The red line represents the free gingival margin height. Note the 2.5 mm apical extension.



Figure 20. Facial view of the seated provisional restoration at extraction. The blanching of the papilla from the extraction site is caused by the pontic contour.



Figure 21. Provisional restoration 12 months postextraction. The pontic was shortened to 1 mm to 1.5 mm below tissue at 4 weeks following extraction.

(Figure 16). Immediately following the extraction, however, the papillae will collapse into the site, as will the facial tissues, unless they receive adequate support from the restoration itself. In the laboratory, acrylic resin is added to the base of the pontic in order to develop optimal shape and depth as previously described (Figures 17 and 18). Once the pontic has been modified, it is trimmed and polished, and returned to the clinician for try-in and provisional cementation.

Regardless of which technique is used to fabricate the pontic, the tissue will have already begun to collapse into the extraction site prior to the seating of the provisional restoration. As a result, blanching of the tissue under pressure will always occur when the provisional restoration is seated (Figures 19 and 20). Since this tissue reaction is normal, the pontic is seated, and the patient is released. Four weeks postoperatively, the pontic is removed and shortened from 2.5 mm to 1 mm to 1.5 mm below tissue, which facilitates the patient's ability to floss.

It is difficult to precisely define the length of the healing period that must occur between tooth extraction and the final impressions and finishing of the restoration. The amount of tissue change that will occur is highly variable, dependent upon several factors. If the existing periodontium has a flat nature (ie, characterized by thick, fibrotic gingiva and relatively square tooth form), then the amount of tissue change expected following extraction would be minimal. If the periodontium is highly scalloped with very thin gingiva, however, significant tissue changes may be evident following the extraction. The technique described would be the same for the thick, flat, or thin scalloped periodontium — only the potential for change following the extraction would be different. In order to minimize subsequent ridge changes, the author delays a minimum of 6 months and ideally 12 months following extraction prior to completing the definitive restoration for any anterior tooth (Figures 21 through 24).

### Conclusion

The purpose of this article has been to describe a technique for the maintenance of the height of the interproximal papillae following anterior tooth removal. It has proven to be highly reliable clinically, as long as the underlying bone on the adjacent teeth is adequate.

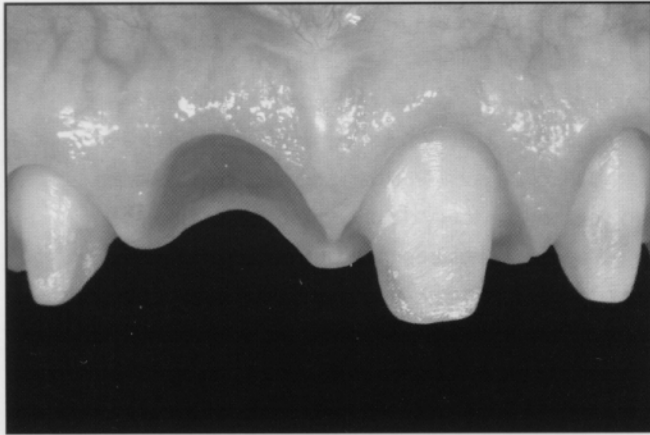


Figure 22. Ridge at 12 months postextraction, prior to final impression. Note the maintenance of the papillary form.



Figure 23. Lateral view of the harmonious pontic adaptation 2 years postoperatively.

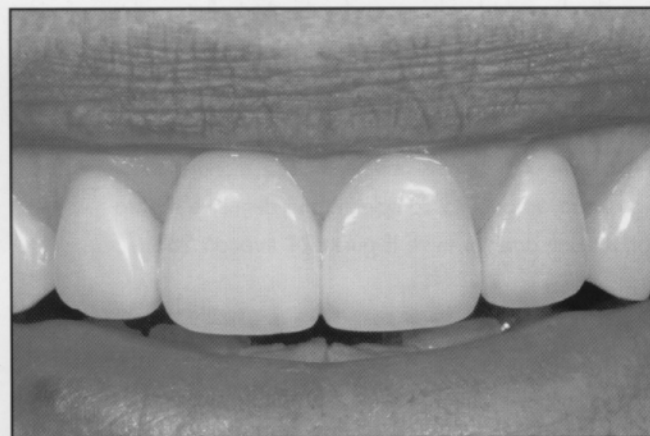


Figure 24. Facial view of the definitive restoration 2 years postoperatively. Due to control of the gingival embrasure form throughout the procedure, the papillary height is virtually unchanged.

Whenever an immediate implant is performed or during ridge healing prior to implant placement, it can also be used as a method for maintaining the papilla during single-tooth implant treatment by bonding a pontic of the described shape over the implant at time of placement.<sup>13</sup> In addition, the use of the extracted tooth as a pontic can be incorporated by bonding it to the adjacent natural teeth after first altering it to the correct shape and depth. Implementing these techniques into clinical practice provides dental professionals with an effective means of preserving the interproximal papillae and ensuring the development of proper gingival aesthetics.

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### References

1. Sanavi F, Weisgold AS, Rose LF. Biologic width and its relation to periodontal biotypes. *J Esthet Dent* 1998;10(3):157-163.
2. Becker W, Ochsenbein C, Tibbetts L, Becker BE. Alveolar bone anatomic profiles as measured from dry skulls. *J Clin Periodontol* 1997;24(10):727-731.
3. Kois J. Altering gingival levels: The restorative connection, Part I: Biologic variables. *J Esthet Dent* 1994;6:3-9.
4. Gargiulo AW, Wentz FM, Orban B. Dimensions and relations of the dentogingival junction in humans. *J Periodontol* 1961;32:261-267.
5. Ingber JS, Rose LF, Coslet JG. The "biologic width" — A concept in periodontics and restorative dentistry. *Alpha Omegan* 1977;70(3):62-65.
6. Vacek JS, Gher ME, Assad DA, et al. The dimensions of the human dentogingival junction. *Int J Periodont Rest Dent* 1994;14(2):154-165.
7. Van der Veldon U. Regeneration of the interdental soft tissue following denudation procedures. *J Clin Periodontol* 1982;9(6):455-459.
8. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol* 1992;63(12):995-996.
9. Meyenberg KH, Imoberdorf MJ. The aesthetic challenges of single tooth replacement: A comparison of treatment alternatives. *Pract Periodont Aesthet Dent* 1997;9(7):727-735.
10. Landsberg CJ, Bichacho N. A modified surgical/prosthetic approach for optimal single implant supported crowns. Part I — The socket seal surgery. *Pract Periodont Aesthet Dent* 1994;6(2):11-17.
11. Salama H, Salama MA. The role of orthodontic extrusive remodeling in the enhancement of soft and hard tissue profiles prior to implant placement: A systematic approach to the management of extraction site defects. *Int J Periodont Rest Dent* 1993;13(4):312-334.
12. Mantzikos T, Shamus I. Forced eruption and implant site development: Soft tissue response. *Am J Ortho Dentfac Orthop* 1997;112(6):596-606.
13. Misch CM. The extracted tooth pontic — Provisional replacement during bone graft and implant healing. *Pract Periodont Aesthet Dent* 1998;10(6):711-718.