Palatal Sliding Strip Flap: Soft Tissue Management to Restore Maxillary Anterior Esthetics at Stage 2 Surgery: A Clinical Report

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A new soft tissue flap design technique, called "the palatal sliding strip flap" (PSSF), has been developed to improve the soft tissue surgical results at stage 2 implant surgery. The purpose of this flap design is to help form papillae between implants and between natural teeth in the anterior area of the maxilla. The flap is designed and managed so that the palatal attached mucosa slides in a labial direction to create papillae and at the same time augment the labial ridge. This surgical approach is valid, predictable, and has a low risk-to-benefit ratio. This new flap design is indicated for a variety of clinical situations, especially for the problematic maxillary soft tissue reconstruction around teeth and implants. (INT J ORAL MAXILLOFAC IMPLANTS 1999;14:30–36)

Key words: flap design, palatal strip, papilla regeneration

The ultimate goal of endosseous implant treatment is to provide support for the replacement of a single missing tooth.[1–3] The single-tooth implant restoration has become a viable treatment option in restorative dentistry.[2,4,5] This clinical application of individual implant restorations has become possible with the introduction of premachined modified and customized prosthetic components.[6–8] To gain the best possible esthetic outcome, the single-implant restoration[9–11] required a subgingival modification of an original supragingival implant concept.[12] This modification, along with some critical factors such as optimal implant position, soft and hard tissue reconstruction, and restorative integration, needs to be addressed to improve esthetic results.

In response to changing treatment concepts, different surgical approaches to single-implant placement have been developed, including immediate placement following tooth extraction,[13] guided tissue regeneration techniques,[14] guided soft tissue augmentation,[15] regeneration of soft tissue and bone around implants with and without membranes,[16–23] and/or a combination of all the above techniques. The cosmetic demands from the profession, as well as from patients, for more esthetic implant restorations in the anterior maxilla has resulted in the creation of a variety of innovative implant components.[24] Particularly for the single-tooth implant restoration, prosthetic components have evolved from a supragingival to a subgingival abutment and from a titanium abutment to an all-ceramic abutment concept.[25–28] The implant restoration must regenerate the relationship between teeth, soft tissue, and lips. To obtain the correct soft tissue profile, site preparation must be improved through soft tissue management.[17] Periodontal plastic procedures have been introduced in implant dentistry. As they are technique sensitive,[29] they could potentially jeopardize long-term final results and may have a high risk-to-benefit ratio.[30–32]

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Regeneration of gingival papillae has been demonstrated in conjunction with single implant treatment.[33] However, preservation, reconstruction, and regeneration of the soft tissue are key factors in the success of implant restorations. Some techniques can be employed at uncovering to avoid additional surgery. Classical surgery has been described for second-stage procedures.[12,34,35] Recent updates and new designs for the partially edentulous patient have been described.[36–39]

The purpose of this report is to describe a new surgical approach for stage 2 surgery. The goals of this technique are to augment the labial periimplant soft tissue and to reconstruct interdental papillae between implants and teeth. The main advantages of this technique are simplicity and predictability with a low risk-to-benefit ratio. This flap technique was inspired by other authors who have developed successful surgical principles and techniques, such as the displaced crestal incision,[40] the palatal roll strip,[41,42] and the semilunar bevel incisor.[39] The technique presented allows a prosthetic restoration to be fabricated with an improved esthetic outcome.

Surgical Technique

Implant placement is performed according to the method described by Adell and coworkers.[42] The implants (Nobel Biocare AB, Göteborg, Sweden) are placed in the anterior maxilla with the following requirements: *(1)* implant located 2 to 4 mm apical to the cementoenamel junction of the adjacent teeth—this is not absolute, but is very much dependent on the style of abutment used; *(2)* centered mesiodistally; and *(3)* with the proper labiopalatal angulation. Approximately 6 months later, stage 2 surgery is performed to uncover the integrated implant and manage the soft tissue for proper reconstruction.

Stage 2 Surgery Technique: The Buccally Positioned Palatal Sliding Strip Flap. *Design for Uncovering a Single-Tooth Implant.* The incision (Figs 1 and 2) involves the dissection of the masticatory mucosa from the underlying bone with a full-thickness sulcular approach in a labiopalatal direction perpendicular to the ridge crest, both on the mesial and distal aspects of the implant. A full-thickness horizontal incision is extended from the distal to the mesial on the palatal side comprising approximately two-thirds of the distance between the 2 teeth. Two incisions, parallel to each other, are then made in a labiopalatal direction to create a partial-thickness flap extending in the palate, leaving the periosteum intact. This extension portion is designed into a strip to be located at the mesial aspect of the implant (Fig 3a). A partial-thickness horizontal dissection is made to connect the 2 parallel incisions to form the sliding palatal strip. A final incision dissects the masticatory mucosa from the bone and incorporates the partial-thickness incision into a full-thickness incision in a labial direction.

Once the incisions are made, the partial- and full-thickness flaps are prepared for flap elevation. The partial-full–thickness flap with a strip is raised to uncover the implant and cover screw (Fig 3b). The healing abutment is connected (Figs 3b and 4a) and a semilunar incision is made to the distal, away from the side of the strip (Fig 4b). Care must be taken that the semilunar incision is coronal to the cementoenamel junction or the gingival line of the adjacent teeth; otherwise, the healing abutment will displace the flap apically and the final gingival margin will heal apical to the gingival line of the adjacent teeth. The semilunar incision will provide a second strip, which gives 2 pedicles (Fig 5a). The distal pedicle created by the semilunar bevel incision will be rotated 90 degrees in the palatal direction around the healing abutment (Fig 5b). The mesial pedicle with the partial thickness component from the palate will fill the interproximal space. This flap manipulation between the teeth and the healing abutment will allow the reconstruction of 2 papillae (Fig 6a). The buccal soft tissue augmentation is related to the support by the healing abutment and the buccal repositioning of the flap. Simple sutures are used around each newly-formed papilla to maintain the flap in position (Figs 6b and 6c). Sutures are removed after 7 days. After several weeks of soft tissue maturation, the final abutment can be selected and connected. Figure 7a shows the edentulous ridge before uncovering and Fig 7b shows the formation of papillae around the definitive crown after 6 months.

Design for Multiple Restorations in the Anterior Maxilla. The flap design for multiple restorations in the anterior maxilla follows the general principle of a palatal strip of split-thickness tail harvested from the palate, combined with a full-thickness flap displaced in the mid-palate toward the sulcus of adjacent tooth. The difference will reside in the location of the palatal strip and the semilunar incisions. The palatal strip of split-thickness connective tissue tail harvested from the palate must be made between the implants (Fig 8). A full-thickness incision displaced in the mid-palatal area dissects the masticatory mucosa toward each adjacent tooth. A final incision dissects the masticatory

Fig 1 Initial situation, occlusal view.

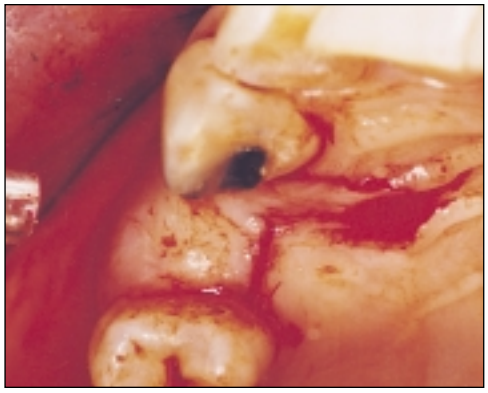

Fig 2 Full-thickness sulcular and palatal displaced incision combined with a partial thickness of the palatal strip.

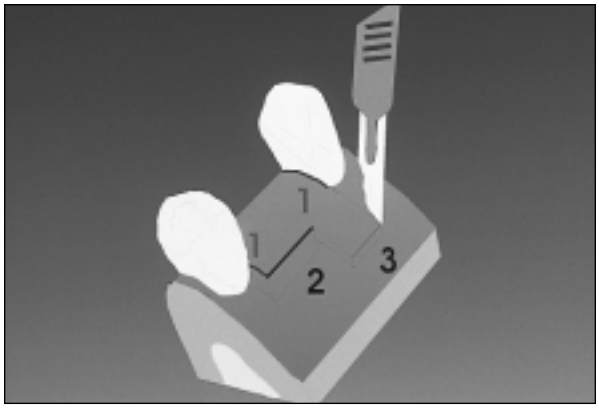

Fig 3a *(1)* Full-thickness sulcular and palatal displaced incision. *(2)* At two-thirds of the distance between the 2 teeth, a full-thickness horizontal incision is prolonged on the palatal side. *(3)* Two incisions, parallel to each other in a buccopalatal direction, are made to create a partial-thickness flap extending in the palate, leaving the periosteum intact.

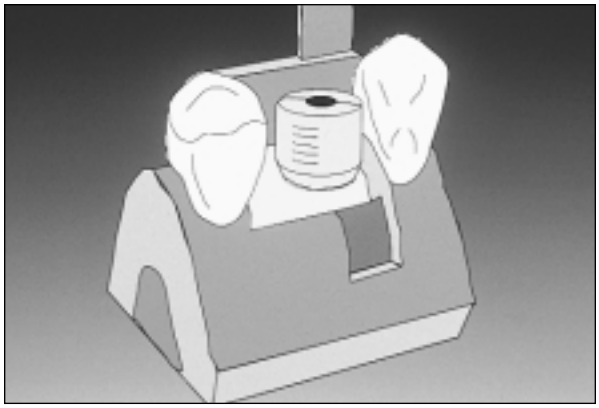

Fig 3b The healing abutment is inserted.

Fig 4a Buccal reflection of the flap sustained by the healing abutment.

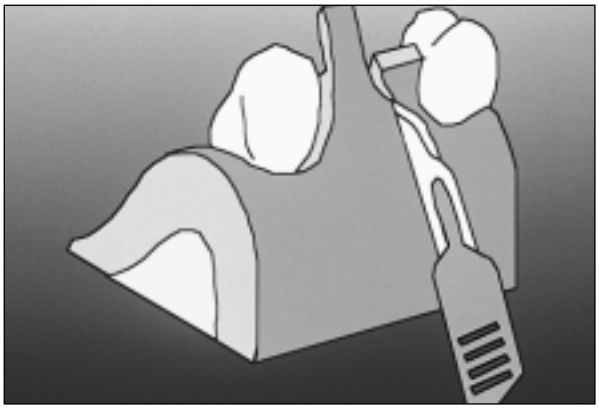

Fig 4b A semilunar incision is made in the direction of the contralateral side of the strip.

Fig 5a The semilunar incision provides 2 pedicles.

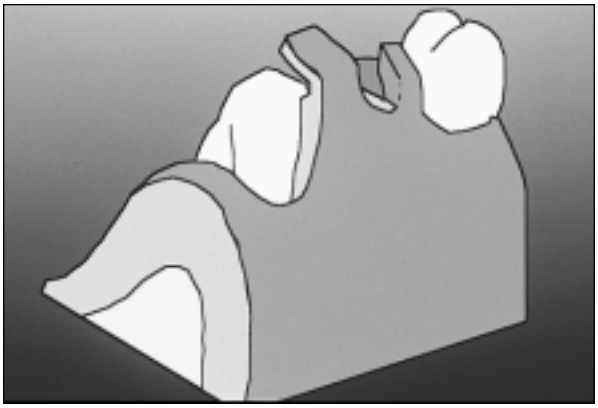

Fig 5b The pedicles are disengaged and rotated toward the palatal direction to fill the interproximal space.

Fig 6a Soft tissue management between the teeth and the healing abutment will allow the reconstruction of the 2 papillae.

Fig 6b Simple sutures, with no tension, are made around each papilla to maintain the flap in position.

Fig 6c Palatal view of the sutures, which leave a small exposed wound that will heal by secondary intention.

Fig 7a Preoperative view.

Fig 7b Postoperative view at 6 months. Final restoration appears as if the crown is exiting the sulcus, and papillae are reconstructed in accordance with the natural dentition.

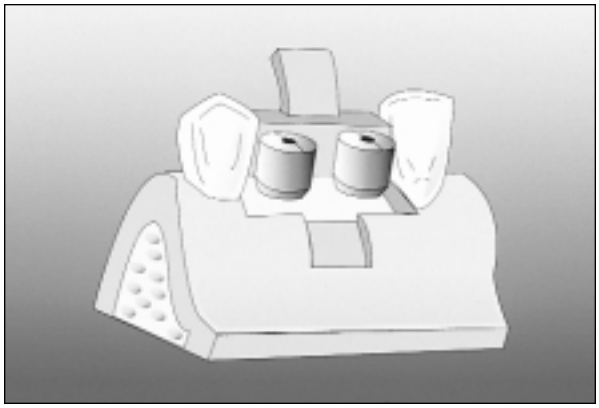

Fig 8 Flap reflected showing the partial-thickness strip flap made between the implants. Healing abutments are placed, sustaining the buccal reflection of the flap.

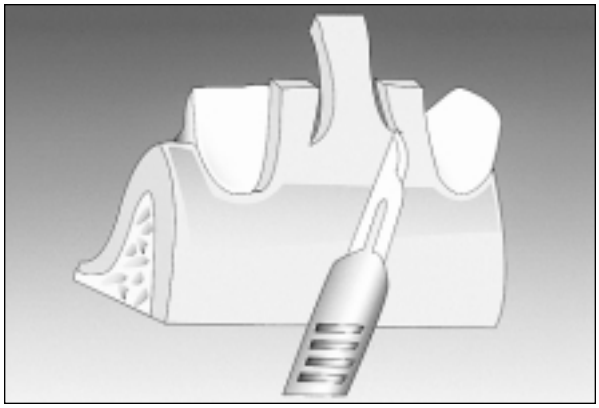

Fig 9 Semilunar incisions are designed in the direction of the adjacent tooth.

Fig 10 Simple sutures, with no tension, are placed around each papilla and the strip flap to maintain the flap in position.

mucosa from the bone over the ridge crest, creating a full-thickness sulcular incision. Once the incisions are made, the partial- and full-thickness flaps are prepared for elevation.

The partial-full–thickness flap with a strip adjacent to the distal tooth is raised to uncover the implants and their cover screws. The healing abutments are connected, allowing the flap to be sustained on the buccal side. Two semilunar incisions are made toward the contralateral side of the strip (Fig 9). Care must be taken that the semilunar incision is coronal to the cementoenamel junction; otherwise the healing abutment will displace the flap apically. The 2 semilunar incisions will provide 2 small pedicles. They are rotated in the palatal direction, each one creating a tissue augmentation in the interproximal space between the tooth and the implant. The palatal strip of partial thickness will be foiled to fill the interproximal space between the 2 implants. The soft tissue augmentation will be the result of the contention of the healing abutment and the buccal repositioning of the flap. The soft tissues are repositioned and sutured within the pedicles using simple sutures, with no tension around each newly formed papilla (Fig 10).

Discussion

Classical uncovering incisions and flap designs[19] might result in compromised esthetic soft tissue. The major benefit of the palatal sliding strip flap is the improved esthetic result. The palatal sliding strip flap is easy to perform and has been shown to be reproducible in a series of patients. Furthermore, the principles of this flap design, created for the management of single implants, have proven to be applicable for the partially edentulous ridge with multiple implants. The principle of a strip flap harvested from the palate may resolve many situations in which soft tissue is lacking, more specifically in the interdental or interimplant space.

The flap design for second-stage surgery appears to have several advantages: *(1)* minimal surgical trauma; *(2)* flap nutrition preservation; *(3)* soft tissue augmentation; *(4)* formation of papilla-like tissue; and *(5)* avoidance of a donor site with a second surgical area or multiple surgeries. The residual palatal wounds have healed uneventfully by secondary intention. This modification of the Abrams technique[40] has the benefit of increased blood supply, lack of donor site, ability to achieve primary closure, and greater soft tissue thickness in the anterior region of the palate.

True papilla regeneration is not possible because the peri-implant soft tissue does not have the same structure as the periodontium.[43,44] Therefore, the term "papilla-like" tissue formation or "implant papilla" is used. The resultant "implant papilla" is the product of soft tissue depth and volume, which differs at various positions around the implant; thus it is a surgical creation.

When providing single-implant restorations, the major problem is the narrow edentulous space between each tooth. In an attempt to minimize soft tissue complications, some authors have proposed special flap management for single-tooth restorations.[9,16–20] The advantage of the present technique, because it includes the remaining papillae adjacent to each tooth, is that it provides a larger flap with a convenient blood supply. Flap incisions and flap management are sensitive techniques. Consideration for the blood supply necessitates a strip flap to avoid failures. Therefore, experience has led to the use of only 1 palatal strip flap for the single-tooth restoration. A design with 2 palatal strips would make them so narrow that necrosis might occur.

Some limitations must be addressed relative to the risk of soft tissue compression. As the edentulous space is not uniform, the placement of a standard healing abutment might be too compressive to heal the soft tissue in the interdental space. Therefore, the question arises as to the use and advantages of different shapes and forms of healing or regular abutments. Biologic principles of blood supply and reaction to soft tissue compression must be addressed to improve healing and to allow soft tissue maturation after uncovering. The authors consider the buccally positioned palatal sliding strip flap to be a useful surgical approach for soft tissue augmentation and papilla regeneration because of its favorable risk-to-benefit ratio.

With the present technique, the question arises concerning possible complications and the long-term outcome related to peri-implant soft tissue stability. Relative to postoperative complications, necrosis of the pedicles might occur. The soft tissue will heal, providing buccal augmentation, but in the absence of the formation of "papilla-like" tissue. Recession and pseudopocket formation may be the 2 major complications occurring after a prolonged period of loading.[45] The technique described can result in buccal soft tissue augmentation and papilla-like tissue formation around the single implant. It appears to offer advantages over currently used techniques.

Summary

A new design of the flap at stage 2 surgery can lead to a beneficial, functional, and esthetic result. Specific attention must be given to the soft tissue management of the periodontium, selecting surgical procedures capable of achieving the best dentogingival harmony possible. Minor soft tissue manipulation may create restorative opportunities otherwise considered less possible.

References

1. Jemt T, Lekholm U, Gröndahl K. A 3-year follow up study of early single implant restorations ad modum Brånemark. Int J Periodontics Restorative Dent 1990;10:340–349.
2. Jemt T, Laney W, Harris D, Henry P, Krogh P, Polizzi G, et al. Osseointegrated implants for single tooth replacement: A 1-year report from a multicenter prospective study. Int J Oral Maxillofac Implants 1991;6:29–36.
3. Schmitt A, Zarb G. The longitudinal effectiveness of osseointegrated dental implants for single-tooth replacement. Int J Prosthodont 1993;6:197–202.
4. Henry P, Laney W, Jemt T, Harris D, Krogh P, Polizzi G, et al. Osseointegrated implants for single-tooth replacement: A prospective 5-year multicenter study. Int J Oral Maxillofac Implants 1996;11:450–455.
5. Ekfeldt A, Carlsson G, Börjesson G. Clinical evaluation of single-tooth restorations supported by osseointegrated implants: A retrospective study. Int J Oral Maxillofac Implants 1994;9:179–183.
6. Jemt T. Modified single and short-span restorations supported by osseointegrated fixtures in the partially edentulous jaw. J Prosthet Dent 1986;55:243–247.
7. Steven L, Beumer J, Perri G, Hornburg W. Single tooth implant supported restorations. Int J Oral Maxillofac Implants 1988;3:25–30.
8. Andersson B, Ödman P, Carlsson L, Brånemark P-I. A new Brånemark single tooth abutment: Handling and early clinical experience. Int J Oral Maxillofac Implants 1992;7:105–111.
9. Öhrnell L-O, Hirsh J, Ericsson I. Single-tooth rehabilitation using osseointegration. A modified surgical and prosthodontic approach. Quintessence Int 1988;12:871–876.
10. Lekholm U, Jemt T. Principles for single tooth replacement. In: Albrektsson T, Zarb GA (eds). The Brånemark Osseointegrated Implant. Chicago: Quintessence, 1989:117–126.
11. Öhrnell L-O, Palmquist J, Brånemark P-I. Single tooth replacement. In: Worthington P, Brånemark P-I (eds). Advanced Osseointegration Surgery: Applications in the Maxillofacial Region. Chicago: Quintessence, 1992: 211–232.
12. Brånemark P-I, Zarb GA, Albrektsson T. Tissue-Integrated Prostheses. Osseointegration in Clinical Dentistry. Chicago: Quintessence, 1985.
13. Becker W, Becker B. Guided tissue regeneration for implants placed into extraction sockets and for implants dehiscence. Surgical technique and case reports. Int J Periodontics Restorative Dent 1990;10:377–391.

14. Dahlin C, Lekholm U, Lindhe A. Membrane-induced bone augmentation at titanium implants. A report of 10 fixtures followed from 1 to 3 years after loading. Int J Periodontics Restorative Dent 1991;11:273–281.
15. Salama H, Salama M, Garber D, Adar P. Developing optimal peri-implant papillae within the esthetic zone: Guided soft tissue augmentation. J Esthet Dentistry 1995;7:125–129.
16. Tarnow D, Eskow R. Considerations for single-unit esthetic implant restorations. Compend Contin Educ Dent 1995;16:778–788.
17. Garber D, Belser U. Restoration-driven implant placement with restoration-generated site development. Compend Contin Educ Dent 1995;16:796–804.
18. Rose L, Salama H, Bahat O, Minsk L. Treatment planning and site development for the implant-assisted periodontal reconstruction. Compend Contin Educ Dent 1995;16:726–742.
19. Tarnow D, Eskow R, Zamzok J. Aesthetics and implant dentistry. Periodontology 2000 1996;11:85–94.
20. Siebert J, Salama H. Alveolar ridge preservation and reconstruction. Periodontology 2000 1996;11:69–84.
21. Miller P, Allen E. Development of periodontal plastic surgery. Periodontology 2000 1996;11:7–17.
22. Tarnow D, Eskow R. Preservation of implant esthetics: Soft tissue and restorative considerations. J Esthet Dent 1996;8:12–19.
23. Langer B. The regeneration of soft tissue and bone around implants with and without membranes. Compend Contin Educ Dent 1996;17:268–278.
24. Sherwood R, Sullivan D. Concepts and techniques of single-tooth implant restorations. Esthet Dent Update 1991;2:16–22.
25. Prestipino V, Ingber A. Esthetic high-strength implant abutments Part I. J Esthet Dent 1993;5:29–36.
26. Prestipino V, Ingber A. Esthetic high strength implant abutments. Part II. J Esthet Dent 1993;5:63–68.
27. Ingber A, Prestipino V. High-strength ceramic abutment provides esthetic functional alternative. Dent Implantol Update 1991;2:82–83.
28. Ingber A, Prestipino V. High-strength ceramic abutment provides esthetic functional alternative. Dent Implantol Update 1991;2:70–72.
29. Han TJ, Takei HH. Progress in gingival papilla reconstruction. Periodontology 2000 1996;11:65–68.
30. Esposito M, Ekestubbe A, Gröndahl K. Radiological evaluation of marginal bone loss at tooth surfaces facing single Brånemark implants. Clin Oral Implants Res 1993;4:151–157.
31. Malevez C, Hermans M, Daelemans P. Marginal bone levels of Brånemark system implants used for single tooth restoration. The influence of implant design and anatomical region. Clin Oral Implants Res 1996;7:162–169.
32. Becker W, Becker B. Flap designs for minimization of recession adjacent to maxillary anterior implant sites: A clinical study. Int J Oral Maxillofac Implants 1996;11:46–54.
33. Jemt T. Regeneration of gingival papillae after single-implant treatment. Int J Periodontics Restorative Dent 1997;17:327–333.
34. Jaffin RA. Biologic and clinical rationale for second-stage surgery maintenance. Dent Clin North Am 1989;33:683–699.
35. Moy PK, Weinlaender M, Kenney EB. Soft tissue modifications of surgical techniques for placement and uncovering of osseointegrated implants. Dent Clin North Am 1989;33:665–681.
36. Palacci P. Amenagement des tissus peri-implantaires interet de al regeneration des papilles. Réal Clin 1992;3:381–387.
37. Israelson H, Pelmons JM. Dental Implants, regenerative techniques, and periodontal plastic surgery to restore maxillary anterior esthetics. Int J Oral Maxillofac Implants 1993;8:555–561.
38. Palacci P. Peri-implant soft tissue management: Papilla regeneration technique. In: Palacci P, Ericsson I, Engstrand P, Rangert B (eds). Optimal Implant Positioning and Soft Tissue Management for the Brånemark System. Chicago: Quintessence, 1995:59–70.
39. Langer B, Langer L. The overlapped flap: A surgical modification for implant fixture installation. Int J Periodontics Restorative Dent 1990;10:209–215.
40. Abrams L. Augmentation of the deformed residual edentulous ridge for fixed prosthesis. Compend Contin Educ Dent 1980;1:205–207.
41. Beagle JR. Reconstruction chirurgicale de la papille interdentaire: Cas cliniques. Int J Periodontics Restorative Dent 1992;12:145–151.
42. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 1981;10:387–416.
43. Berglundh T, Lindhe J, Eriksson I, Marinello CP, Liljenberg B, Thompsen P. The soft tissue barrier at implants and teeth. Clin Oral Implants Res 1991;2:81–90.
44. Listgarten M, Lang NP, Schroeder HE, Schroeder A. Periodontal tissues and their counterparts around endosseous implants. Clin Oral Implants Res 1991;2:1–19.
45. Bengazi F, Wennstrom JL, Lekholm U. Recession of the soft tissue margin at oral implants. A 2-year longitudinal study. Clin Oral Implants Res 1996;7:303–310.