

## Interproximal Papillae Reconstruction in Maxillary Implants\*

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**Background:** *Gingival esthetics has become an important factor in the overall success of most maxillary implant-supported restorations. Periodontal plastic surgery procedures may be used to enhance esthetics in the maxillary anterior region. The purpose of the present study was to evaluate a new surgical approach, performed at implant exposure, to reconstruct interdental papillae around maxillary implant-supported restorations.*

**Methods:** *The surgical procedure was performed on 32 patients, in which 36 consecutive single tooth osseointegrated implants were exposed in the anterior and premolar maxillary region. Previous to implant exposure and 6 months postoperatively, once the implant-supported restoration was in place, mesial and distal papilla contour measurements were calculated, based on a modification of the papillary index score (PIS). Statistical analysis consisted of paired t test, Pearson's correlation, and ANOVA with repeated measures.*

**Results:** *Preoperative PIS ranged from 0 to 3 and from 1 to 3 at the 6 months follow-up control. A mean of mesial and distal papilla, within the same tooth, was used for paired t test statistical analysis. A mean increase of 1.07 (SD 0.43) in PIS was statistically significant ( $P < 0.001$ ). At the second measurement, in no site was PIS smaller (0%) while in 64 sites PIS was higher (89%). In 51 papilla (71%) there was an increase of 1 PIS unit and 13 (18%) of 2 PIS units between both measurements.*

**Conclusions:** *The presented surgical technique performed at second stage implant surgery was useful for partial or total interproximal papilla reconstruction adjacent to maxillary single-implant restorations. J Periodontol 2000;71:308-314.*

### KEY WORDS

Dental implants; esthetics, dental; dental papilla/anatomy and histology; dental prostheses, implant-supported.

Root form osseointegrated implants are well documented as predictable long-term replacements for natural dentition.<sup>1-6</sup> Initially, the factors considered while evaluating success included direct contact between alveolar-supporting bone and dental implants, together with lack of clinical and radiographic signs of inflammation.<sup>2</sup>

With the growing use of implant-supported oral rehabilitation in the partially edentulous patient, emphasis has changed towards achieving predictable esthetic success.<sup>7</sup> The common esthetic factor in the anterior maxilla, single tooth implant-supported restorations is the soft-tissue profile, which ideally should be identical to that of the contralateral natural healthy tooth. Soft tissue management has, therefore, become an important topic in implant dentistry and gingival esthetics has become a critical factor in the overall success of an implant-supported restoration.<sup>8-10</sup> Periodontal plastic surgery enables enhanced esthetics in the anterior maxillary region, where minor surgical procedures can improve gingival contours. It is generally accepted that a more ideal and functional soft tissue-implant interface can be established if an adequate zone of keratinized mucosa is present. This will lead to enhanced esthetics, easier restorative manipulation, less gingival recession, easier plaque control, and routine maintenance.<sup>11</sup> Surgical procedures that minimize soft tissue recession, enlarge the zone of keratinized mucosa and recreate the appearance of interdental papilla have been reported.<sup>10,12-19</sup>

Four potential time points can be differentiated for soft and/or hard tissue management: prior to implant placement; at time of placement or during the healing phase of the implant; at second-stage surgery; and in the maintenance phase.<sup>10</sup> The purpose of the present study was to evaluate a novel surgical approach, performed at second-stage, implant-exposure surgery, for creating or reconstructing interdental papillae around maxillary osseointegrated implants.

### MATERIALS AND METHODS

The surgical procedure was performed on 32 patients, at second-stage implant exposure surgery, in which

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36 consecutive single osseointegrated implants were exposed in the anterior and premolar maxillary region. Implants were proximal to natural teeth. All patients willing to participate in the study signed an informed consent form and an appropriate university authority accepted the research protocol.

Implant exposure was performed 6 to 8 months after placement. Implant distribution was 10 central incisors (28.5%), 8 lateral incisors (22.2%), 6 canines (16.6%), 6 first premolars (16.6%), and 6 second premolars (16.6%). Patients ranged in aged from 29 to 65 years (mean 46.3 years, SD 9.43). Mesial and distal papilla contour measurements, based on a modification of the papilla index score (PIS) described by Jemt,<sup>20</sup> were calculated prior to implant exposure and 6 months postoperatively, once the implant-supported restoration was in place. The same operator performed all clinical procedures and measurements. Since implants were not exposed, first papilla measurements were calculated taking in consideration the proximal teeth and imaginary contour of the future restoration (Figs. 1, 2, and 3). Four different index scores were used to measure papillae: PIS 0: no papilla and no curvature of the soft tissue contour; PIS 1: less than half the height of the papilla in the proximal teeth and a convex curvature of the soft tissue contour; PIS 2: at least half the height of the papilla in the proximal teeth, but not in complete harmony with the interdental papilla of the proximal teeth; and PIS 3: papillae able to fill the interproximal embrasure to the same level as in the proximal teeth and in complete harmony with the adjacent papillae.



**Figure 1.**  
Occlusal aspects of ridge in left maxillary central incisor prior to implant exposure.



**Figure 2.**  
Buccal aspects of ridge in left maxillary central incisor prior to implant exposure. Note flattened proximal papilla.



**Figure 3.**  
Imaginary contour of the future implant-supported restoration, graphically added to Figure 2, illustrates how preoperative measurements were calculated. Mesial and distal papilla were classified as PIS 1 and PIS 0, respectively.

Paired *t* test, Pearson's correlation, and ANOVA with repeated measures were used for statistical analysis.

#### **Surgical Procedure**

The incision was U-shaped, open towards the buccal aspect of the implant site with slightly divergent arms. Adjacent papilla remained adhered to the proximal teeth. Both sides of the incision were palatally connected at approximately the palatal aspect of the implant cover screw. The outer edges of the incision and approximal papillae were de-epithelialized (Figs. 4 and 5). A full thickness flap was

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raised, using a back-action instrument, an Orban knife, and blunt dissection with a thin periosteal elevator. The implant cover screw was then retrieved and a standard healing abutment, cylindrically shape, inserted. The flap was split in its center through its whole thickness, separating it in mesial and distal parts (Fig. 6). This incision was extended to the desired location of the buccal gingival margin of the future restoration. Each part of the buccal flap was positioned over de-epithelialized papillae and secured

to the palate with vertical mattress sutures. Monofilament sutures (4-0 or 5-0) with an atraumatic needle were used. Further sutures connected the buccal flap to the proximal tissues, while overlapping the de-epithelialized margins (Fig. 7). Sutures were removed after 7 to 10 days. Restorative procedures were usually initiated one month postsurgery. Post-operative control and PIS second measurements were calculated 6 months following the described procedure (Figs. 8 and 9).



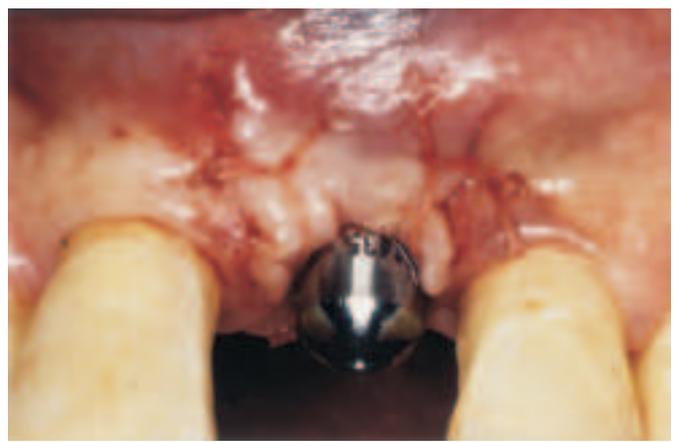
**Figure 4.** Occlusal aspects of ridge showing U-shaped incision presenting divergent arms. Papilla remain adhered to proximal teeth. Both sides of the incision are connected, approximately at the palatal aspect of the implant cover screw. Outer edges of the incision and approximal papillae were de-epithelialized.



**Figure 5.** Buccal aspect of incision described in Figure 4.



**Figure 6.** Following retrieval of the implant cover screw and insertion of healing abutment, the flap was split in its center through its whole thickness, separating it in mesial and distal parts.



**Figure 7.** Each part of the buccal flap was positioned over de-epithelialized papilla and secured to the palate with 5-0 monofilament, vertical mattress sutures. Further sutures connected the buccal flap to the proximal tissues while overlapping the de-epithelialized margins.



**Figure 8.**

Healing site after 6 months, without implant-supported restoration. Note improved papillary form.



**Figure 9.**

Final implant-supported restoration in place. Interproximal papilla are in good harmony with adjacent teeth. Mesial and distal papillae classified as PIS = 2 (prosthetic work by Dr. Yosi Shay).

## RESULTS

Healing was uneventful. In most cases, there was only slight postoperative pain and/or local tenderness. Preoperative PIS ranged from 0 to 3 and from 1 to 3 at 6 months postoperative control. ANOVA test with repeated measures and paired *t* test showed no statistically significant difference between mesial and distal papillae measurements (pre- and post-surgery and their difference). Pearson's test showed a trend for negative correlation between postoperative PIS and age ( $r = -0.4$ ,  $P = 0.016$ ).

**Table 1.**

### Summary of Pre- and Post-Operative PIS for All Papilla

	PIS	Preoperative				Total
		0	1	2	3	
Postoperative	0	0	0	0	0	0
	1	8	3	0	0	11
	2	3	32	3	0	38
	3	0	10	11	2	23
Total		11	45	14	2	72

Table 1 summarizes the results. Generally, a higher PIS was recorded at the 6-month control than preoperatively. In no case was PIS smaller; 8 (11%) remained the same; and in the other 64 (89%), PIS was higher. An increase of 1 PIS unit was shown in 51 papillae (71%) and in 13 (18%) of 2 PIS units, between both measurements. At the preoperative measurement, 3% of the papillae were judged to be in optimal harmony with the adjacent papilla (PIS 3), while at the 6 months control, 32% showed PIS 3. In the 11 sites (15%) where complete lack of papilla (PIS 0) was recorded at the preoperative visit, a 1 or 2 PIS was later seen.

Since there were no statistically significant differences between mean mesial and distal papilla measurements, a mean of both, within the same tooth, was considered as a unit for paired *t* test statistical analysis. The mean preoperative PIS was 1.1 (SD 0.58); the corresponding value at the postsurgery measurement was 2.17 (SD 0.56). Therefore, the mean increase in the PIS between both measurements was 1.07 (SD 0.43). The increase in PIS was statistically significant ( $P < 0.001$ ).

## DISCUSSION

The presented implant uncovering surgical technique produced an increase in the interproximal papillary height in 89% of the sites. The mean change in PIS was 1.07 units and was statistically significant ( $P < 0.001$ ) and clinically appreciable. Apical displacement of the soft tissue margins usually occurs during the early stages of healing, mainly during the first months after installing restoration.<sup>20-22</sup> Recession of the soft tissue margin was recorded in 38% of implant-supported restorations with non-mobile peri-implant soft tissue.<sup>21</sup> Most recession was noted

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after implant-supported oral rehabilitation placement and during the early observation phase. In the present study, an increase in the papillary height was noted in most sites, between the two measurements, 6 months after implant exposure.

In another study,<sup>20</sup> it was reported that 58% of the papilla adjacent to single-implant restorations regenerate to some extent after 1 to 3 years, without any clinical manipulation of the soft tissue, and could completely recover in harmony with the adjacent natural teeth. However, individual results are unpredictable. In the present study, the second measurement was calculated 6 months postsurgery, after all final restorations were in place even though they had been in place for only a few months. Further regeneration of the papilla, to some extent, can be expected after 1 to 3 years without any additional manipulation of the soft tissue.<sup>20</sup> A trend towards a negative correlation between postoperative PIS and age was seen, therefore, a smaller increase in papillary height could be expected in older patients. In view of the good results achieved with the presented technique, a control group was not included in this study. Several sources of possible error should be considered while evaluating the results of the present study. The first papilla measurements were calculated taking into account the proximal teeth and imaginary contour of the future restoration and not a fixed reference point. Local plaque and gingival indices were not evaluated. The same operator carried out procedures and measurements. In the natural dentition, the distance between the crestal bone to the base of the contact

area between two proximal teeth is correlated to the presence or absence of the interdental papilla.<sup>23</sup> Therefore, a distance of 5 to 7 mm appears to be desirable for implant-supported dental restorations. Bone reconstructive techniques performed previous to and/or at time of implant placement are recommended for enhanced final esthetic results in some cases.<sup>14</sup>

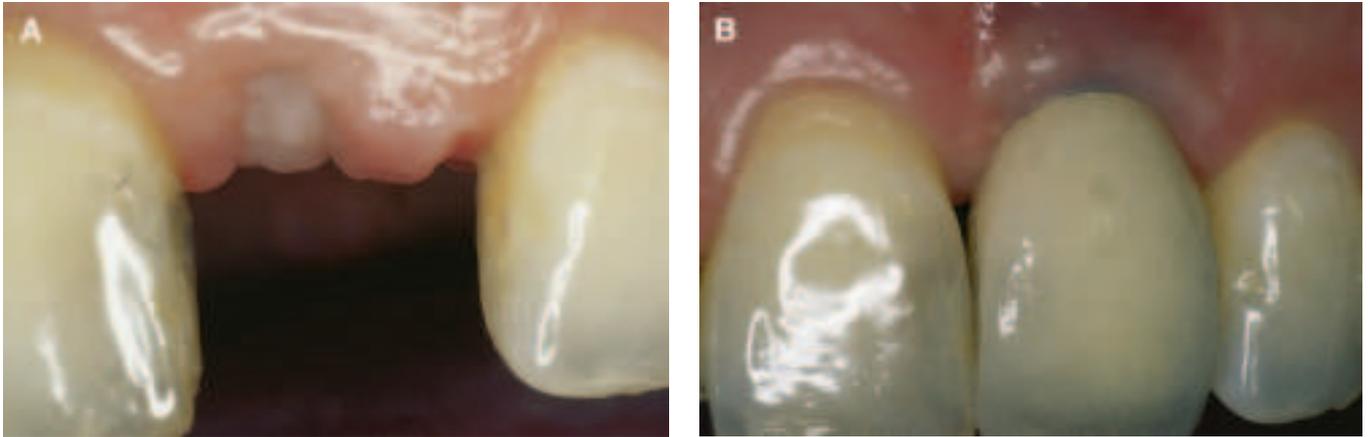
This technique is not indicated when apical repositioning of the mucogingival junction is needed, due to the presence of inadequate buccal masticatory mucosa. Use of rotated and rotated split palatal flaps, which obviate the need for coronally repositioning the buccal flap at time of implant placement, have been described.<sup>24-26</sup> Implant sites bordered by non-keratinized or movable tissue show greater recession and with a higher incidence than sites with masticatory, non-movable marginal tissue.<sup>20</sup> Other implant exposure surgical techniques have been described for cases with reduced or non-existent buccal masticatory mucosa.<sup>18,27</sup>

The presented surgical approach is relatively easy to perform, although, location of the buccal gingival margin must be accurately planned while splitting the buccal flap. A thicker tissue over the implant cover screw is advisable in order to achieve higher papilla contour. Where a thin gingiva covers the implant, a free connective tissue graft, performed one month previous to second stage implant surgery is indicated. The subepithelial connective tissue is harvested from the palate and inserted over the top of the implant following a pouch preparation of the



**Figure 10.**

**A.** Preoperative aspect of missing left central incisor. Mesial PIS = 2, distal PIS = 1. **B.** Postoperative aspect of left central incisor with restoration in place. Note increase in PIS for mesial and distal papillae (prosthetic work by Dr. Juan Pupkin).



**Figure 11.**

**A.** Preoperative aspect of missing right central incisor. **B.** Same tooth area as **A**, with restoration in place. PIS increase is evident (prosthetic work by Dr. Shlomi Mashiach).



**Figure 12.**

**A.** Preoperative aspect of missing left canine. Note minimal PIS in distal of lateral incisor. **B.** Final implant-supported restoration fitted. Note increase in PIS (prosthetic work by Dr. Ephraim Winocur).

recipient site. The purpose of this procedure is to increase the tissue thickness over the cover screw, which will later be displaced to reconstruct the interproximal papilla.

The results of this study indicate that the evaluated implant exposure surgical technique is useful for partial or total interproximal papillae reconstruction adjacent to anterior maxillary single implant restorations (Figs. 10, 11, and 12).

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