Peri-implant Soft Tissue Level Secondary to a Connective Tissue Graft in Conjunction with Immediate Implant Placement: A 2-Year Follow-up Report of 11 Consecutive Cases

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The purpose of this case series was to evaluate secondary soft tissue level changes of a single-stage surgical protocol combining immediate implant placement and connective tissue grafting in maxillary incisors associated with gingival recession defects. Ten patients underwent the proposed combined treatment consisting of 11 single-tooth implant restorations. Peri-implant soft tissue level and the width of keratinized gingiva were evaluated at baseline, the time of implant restoration connection, and 2 years postrestoration. All parameters used to assess esthetic outcomes showed improvements. The proposed clinical procedure can be considered an alternative approach to achieving an ideal esthetic anterior restoration. (Int J Periodontics Restorative Dent 2012;32:213–222.)

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Immediate implant placement into extraction sockets has been shown to be a predictable treatment protocol with high success rates.[1–3] One of the important benefits of this approach is that the number of surgical procedures and length of treatment time are reduced.[4–6] However, there are some critical pitfalls in the immediate implant placement technique that could potentially jeopardize clinical success. In the esthetic zone, the level of crestal and interproximal bone as well as the quality and quantity of soft tissue surrounding preexisting teeth may be a critical factor for success, and therefore must be considered in the treatment-planning stages.

Recently, studies[7,8] have demonstrated the efficacy of an autogenous connective tissue graft combined with immediate implant placement to obtain a harmonious esthetic restoration. Bianchi and Sanfilippo[7] evaluated the prolonged effect of a combined surgical protocol using immediate implant placement and subepithelial connective tissue grafting in single-tooth replacement

	Table 1	Patient demographic data			
Patient no.	Age (y)/ sex	Location of implant(s)*	BG, M, and CTG		Restoration placement (mo)[†]
1	22/F	22	BG + M + CTG		6
2	50/F	22	BG + M + CTG		6
3	55/M	11	BG + M + CTG		6
4	56/F	22	BG + M + CTG		6
5	47/F	22	BG + M + CTG		6
6	47/F	22	BG + CTG		4
7	57/F	11	BG + CTG		4
		22	BG + CTG		4
8	29/F	12	BG + CTG		4
9	45/F	11	BG + CTG		5
10	56/M	22	BG + CTG		5

BG = bone graft; M = membrane; CTG = connective tissue graft.
*FDI tooth-numbering system.
[†] Time of definitive restoration placement after surgery.

protocols. Covani et al[8] also reported that implant placement immediately after tooth extraction with a simultaneous connective tissue graft was considered a successful approach and that the technique could be considered a treatment option for nonsalvageable teeth showing gingival recession and absence of attached gingiva. In these studies, free connective tissue grafts were used as a biologic barrier to cover the residual alveolar defects associated with an immediate implant to allow undisturbed healing of the peri-implant deep tissue.

In the present case series, immediate implant placement and connective tissue grafting were carried out as a single-stage surgical protocol to reduce the number of surgical interventions. The objective of this case series was to evaluate secondary soft tissue level changes of the single-stage surgical protocol in the maxillary incisors associated with mild to moderate gingival recession defects.

Method and materials

Subjects comprised 10 patients treated with 11 implant-supported single crowns treated at Seoul National University Dental Hospital, Seoul, Korea, between 2003 and 2005 (Table 1). Patient cases were restricted to those who had immediate implant placement in

Fig 1 *Preoperative clinical view. A maxillary lateral incisor required replacement with an implant-supported restoration. Arrows depict the three measurements of the soft tissue level.*
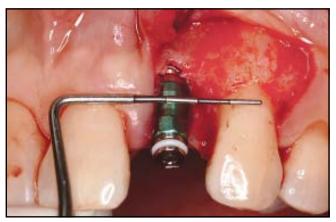

Fig 2 *Implant placement after tooth extraction.*

conjunction with a connective tissue graft for maxillary incisor teeth with preexisting mild to moderate gingival recessions (≤ 5 mm; mean, 3.1 ± 0.7 mm). Cases were excluded if clinical and photographic data were incomplete during the observation period.

Treatment protocol

All surgical procedures were completed by one surgeon. Figures 1 to 8 depict the steps involved in the surgical and restorative protocols, as well as the follow-up phases.

After the treatment-planning process, all patients underwent scaling and root planing and re-ceived thorough oral hygiene instructions. Chlorhexidine mouth-rinse was used immediately prior to surgery for approximately 2 minutes. Under local anesthesia, a sulcular incision was made around the teeth. The tooth was removed with extreme care to preserve the integrity of the marginal bone. The socket was curetted thoroughly af-ter tooth removal.

To facilitate possible bone grafting and membrane placement, a small vertical incision was made on the distofacial aspect of the adjacent tooth, and a mucoperi-osteal flap was elevated. An im-plant (AVANA USII, Osstem) was placed into the prepared socket site according to the manufacturer's os-teotomy protocol. The platform of the implant was placed 2 to 3 mm below the cementoenamel junction of the adjacent teeth (Fig 2). After a slightly flared healing abutment was connected, the existing labial bone dehiscence or gap between the implant and alveolar housing within the extraction socket was filled with bovine xenograft (Bio-Oss, Geistlich). If the bone graft had a dimension of more than 3 mm in any direction (mesiodistal or apicocoronal), a resorbable col-lagen barrier membrane (Bio-Gide, Geistlich) was placed to fully cover the graft material (Figs 3 and 4). An autogenous connective tissue graft (1 to 1.5 mm in thickness) was harvested from the palate. Free

connective tissue was placed immediately under the mucoperiosteal flap in all cases, whether or not collagen barrier membrane was used (Fig 5). The flap was advanced to cover the connective tissue graft passively and sutured. The edentulous area was provisionalized by bonding the crown of the extracted natural tooth or a resin tooth to the adjacent teeth. Systemic antibiotics (augmentin 625 mg two times daily), nonsteroidal anti-inflammatory medication (aceclofenac 100 mg two times daily), and chlorhexidine mouthrinse were prescribed for 5 days. Sutures were removed 7 days after surgery. Patients were followed-up every 4 weeks.

Metal-ceramic crowns were constructed to match the contour and contact areas of the adjacent teeth 4 to 6 months after implant placement. The contours and contact points of the restorations were designed to allow the soft tissue to adapt to its optimal embrasure form. No attempt was made to artificially fill in the missing soft tissue with the contours of the prosthesis. All crowns were screw-retained. After the prosthetic restoration, all patients were recalled at 3- or 6-month intervals.

Soft tissue level measurements

Soft tissue level measurements were performed using digital photographic images. At baseline and subsequent recall appointments, photographic images were taken using predetermined magnification ratios. The measurements were initially carried out on digital photographic images using image-analyzing software (Tomoro Scope Eye, Techsan Digital Imaging). The dimensions measured on the photographic images were then converted mathematically to actual lengths. A periodontal probe was included in the photograph whenever possible and was used as a reference for consistency and to account for any image distortion.

Soft tissue levels were measured at three points on the facial aspect of the implant (Figs 1 and 8), similar to the method reported by Priest.[9] Measurements were made from a tangent to a line connecting the incisal edges or cusp tips of the teeth adjacent to the implant restoration and recorded to the nearest 0.5 mm. Three vertical measurements were made from this tangential line: *(1)* to the mesiocoronal extent of the facial papilla (MP), *(2)* to the distocoronal extent of the facial papilla (DP), and *(3)* to the most apical extent of the midfacial gingival margin (GM). The measurements were carried out on the images acquired at baseline (MP0, DP0, and GM0), crown placement (MPCr, DPCr, and GMCr), and 2 years postrestoration (MP2y, DP2y, and GM2y). To evaluate mean natural tooth recession during the examination period, the same vertical measurement was also made from the tangential line to the midfacial gingival margins of the natural teeth adjacent to the implant restoration.

In addition to papilla level measurement, Papilla Index score[10] was assessed at crown placement and the 2-year follow-up. The index designated five different levels indicating the amount of papilla present as the following:

- Score 0: No papilla is present and there is no indication of curvature of the soft tissue contour adjacent to the restoration.
- Score 1: Less than half of the height of the papilla is present. A convex curvature of the soft tissue contour adjacent to the single-implant crown and the adjacent tooth is observed.
- Score 2: At least half of the height of the papilla is present, but not all the way to the contact point between the teeth. Papilla is not completely in harmony with the adjacent papillae between permanent teeth. Acceptable soft tissue contour is in harmony with the adjacent teeth.
- Score 3: Papilla fills the entire proximal space and is in good harmony with the adjacent papillae. There is optimal soft tissue contour.
- Score 4: Papilla is hyperplastic and covers too much of the single-implant restoration and the adjacent tooth. The soft tissue contour is more or less irregular.

Width of the keratinized gingiva (WKG) was measured from the most apical gingival margin to the mucogingival junction. Data were collected at the following intervals: baseline (WKG0), the time of crown placement (WKGCr), and 2 years postrestoration (WKG2y).

Fig 3 *Abutment connection with bovine bone graft used to cover the extraction site defects.*

Fig 4 *Collagen membrane placed over the bone graft material.*

Fig 5 *Connective tissue graft placed above the membrane and sutured.*

Fig 6 *Flap covered.*

Fig 7 *Clinical view at the time of crown delivery.*

Fig 8 *Clinical view 2 years after implant crown placement. Arrows depict the three measurements of the peri-implant soft tissue level.*

Table 2	Changes in soft tissue level (mm) (mean ± SD)		
	GM	**MP**	**DP**
Baseline (0)	11.9 ± 0.7	6.5 ± 0.6	6.7 ± 0.5
Crown placement (Cr)	9.8 ± 0.7*	7.1 ± 0.7[†]	7.2 ± 0.6[‡]
2 y postrestoration (2y)	10.1 ± 0.6*,[NS1]	6.6 ± 0.6[NS2]	7.0 ± 0.5[NS3]
Cr – 0	–2.1 ± 0.7	0.6 ± 0.3	0.5 ± 0.4
2y – Cr	0.4 ± 0.4	–0.5 ± 0.5	–0.3 ± 0.3
2y – 0	–1.7 ± 0.7	0.1 ± 0.5	0.3 ± 0.5

SD = standard deviation; GM = tangential line to most apical extent of midfacial gingival margin; MP = tangential line to mesiocoronal extent of the facial papilla; DP = tangential line to distocoronal extent of the facial papillae..
*$P < .01$, significantly different from GM0; [NS1]$P > .01$, not significantly different from GMCr.
[†]$P < .01$, significantly different from MP0; [NS2]$P > .01$, not significantly different from MP0 and MPCr.
[‡]$P < .01$, significantly different from DP0; [NS3]$P > .01$, not significantly different from DP0 and DPCr.

Statistical analysis

Descriptive statistics were expressed as means ± standard deviations. Repeated-measures analysis of variance was used to test longitudinal alterations for the measurements GM, MP, DP, and WKG. Statistical significance of differences was confirmed with a P value $< .01$.

The Wilcoxon signed rank test for paired comparisons was used to statistically test changes in the Papilla Index at placement and follow-up on the mesial and distal aspects of the single-implant restoration. A P value $> .01$ was considered not significant.

Results

In all cases, the surgical procedures, which combined immediate implant placement with connective tissue grafting, were carried out without complication. Postsurgical healing was uneventful in all cases. All 11 implants were stable and well integrated both clinically and radiographically. All implants were successfully restored with screw-retained metal-ceramic crowns 4 to 6 months after surgical placement. All restorations were loaded to full masticatory function. At the time of crown placement, gingival recession defects were successfully treated, restoring their gingival margins to normal anatomical positions, and these gingival margins were well maintained for up to 2 years in all cases.

Table 2 shows the change in GM, MP, and DP from baseline to 2 years after implant placement. When compared to baseline, mean coronal gain of GM was 2.1 mm at the time of crown placement (GMCr – GM0). However, a slight

Table 3	Distribution of Papilla Index scores				
	Papilla Index score*				
	0	**1**	**2**	**3**	**4**
Mesial papilla					
Placement	0	2	6	3	0
2-y follow-up	0	0	6	5	0
Distal papilla					
Placement	0	2	7	2	0
2-y follow-up	0	0	8	3	0

*There was no significant increase in Papilla Index score at either the mesial (*P* > .01) or distal (*P* > .01) sites between crown placement and the 2-year follow-up.

Table 4	Change in WKG
WKG	**Mean ± SD (mm)**
WKG0	1.1 ± 0.4
WKGCr	3.7 ± 0.7*
WKG2y	3.6 ± 0.5*,NS
WKGCr – WKG0	2.6 ± 0.5
WKG2y – WKGCr	–0.1 ± 0.3
WKG2y – WKG0	2.5 ± 0.6

WKG = width of keratinized gingiva;
SD = standard deviation; 0 = baseline;
Cr = crown placement; 2y = 2-year follow-up.
*P < .01, significantly different from WKG0.
NSP > .01, not significantly different from WKGCr.

recession was observed over the following 2 years (GM2y – GMCr; mean, 0.4 mm). In natural teeth adjacent to the implant restorations, the gingival recession at 2 years postrestoration was minimal (0.1 ± 0.2 mm). When compared with baseline, mesial and distal papillae had collapsed slightly by the time of crown placement. The mean amount of papilla collapse in this time period (MP0 – MPCr and DP0 – DPCr) was 0.6 mm in mesial sites and 0.5 mm in distal sites. However, the papillae tended to grow into the embrasure space during the 2 years following implant prosthesis placement. The mean amount of papilla regeneration from crown placement to 2 years postrestoration (MP2y – MPCr and DP2y – DPCr) was 0.5 mm in mesial sites and 0.3 mm in distal sites.

The distribution of the Papilla Index scores at placement and the 2-year follow-up is presented in Table 3. The mean score for the mesial and distal papillae at crown placement was 2.09 ± 0.70 and 2.00 ± 0.63, respectively. The corresponding mean values at the 2-year follow-up were 2.45 ± 0.52 and 2.18 ± 0.40 for the mesial and distal sites, respectively. There was no increase for both mesial and distal sites (*P* > .01). Twenty-three percent (5 of 22) of papillae were judged to be in optimal harmony with the adjacent papillae (index score, 3) at the time of crown insertion. At the 2-year follow-up, 8 papillae (36%) had recovered completely.

WKG increased significantly after surgery (Table 4). The mean increase in WKG from baseline to 2 years postrestoration was 2.5 mm (WKG2y – WKG0). All cases had a WKG of more than 3 mm at 2 years after prosthesis connection.

Discussion

Achieving harmonious gingival esthetics in the anterior region with an implant restoration is a challenging procedure. This is especially so when the anterior teeth have a preexisting periodontal compromise, such as gingival recession. The present case series demonstrated that the technique of immediate implant placement with simultaneous free connective tissue grafting can be considered a predictable procedure for the treatment of teeth with preexisting gingival recession defects.

The progressive involution of the alveolar bone begins following tooth extraction and is accompanied by a reduction in the quantity of soft and hard tissues. It has been demonstrated in several animal research[11–14] and clinical studies[15,16] that immediate implant placement

after tooth extraction may reduce alveolar bone resorption. The immediate placement approach also has additional benefits since it facilitates both ridge preservation and prosthetically driven implant placement, enabling the implant to maintain the natural tooth position. In addition, a reduction in treatment time is considered another advantage.

Recently, studies[7,8] have suggested that a surgical protocol consisting of immediate implant placement and a free connective tissue graft can be considered a valuable procedure to obtain an excellent functional and cosmetic implant restoration. However, despite good results, these protocols used a connective tissue graft to cover and submerge the implants placed immediately after tooth extraction, requiring a second surgical step to expose the implant for abutment connection. On the contrary, the authors have postulated a single-stage nonsubmerged protocol to have comparable clinical results in the replacement of a single anterior tooth, combining immediate implant placement and connective tissue grafting. This single surgical procedure protocol has obvious benefits for both the operator and patient. Notwithstanding the fact that more than one surgery is needed, multistage surgery has an intrinsic weakness in that the risk for complications such as soft tissue loss is introduced multiple times. Therefore, single-stage surgical approaches are arguably

desirable for esthetic reasons if an adequate width of marginal gingiva does not exist. Excellent clinical results from the present case series may support this argument.

In the present case series, the connective tissue graft technique was successfully employed to restore a soft tissue defect during an immediate implant placement procedure for teeth with preexisting gingival recessions. In addition, the newly created gingival margin around the implant restorations was well maintained for up to 2 years. The facial gingival margin receded, on average, 0.4 mm in the 2 years following implant restoration placement. Other studies[17–21] have suggested facial gingival recession to be a common occurrence with implant restoration following definitive prosthesis placement. Kan et al[22] reported that midfacial gingival recessions of approximately 0.5 mm were readily observed in immediate implant cases even after 1 year of follow-up. These results are comparable to the data from the present series, suggesting that the procedure used in this study is efficient in maintaining the gingival architecture including the midfacial gingival margins.

In the present case series, papillae levels showed slight increasing tendencies in height from the time of crown connection to the 2-year follow-up. Gingival papilla regeneration was on average 0.5 mm mesially and 0.3 mm distally. These results are comparable to previous studies.[9,23] Priest[9] reported a mean increase in

mesial and distal papilla height of 0.65 mm and 0.62 mm, respectively, in a 3.5-year follow-up study of single-tooth implant restorations. Grunder[23] showed that the mean papilla regeneration was 0.375 mm at 1 year postrestoration in a study of 10 single-tooth implants. Considering data from these existing studies and the present cases, it is safe to state that papillae around single-tooth implant prostheses tend to regenerate after the time of restoration placement, although large deviations in the amount of papilla regrowth may also be observed. When evaluating the change in Papilla Index scores from crown placement to the 2-year follow-up, both sides of the papilla showed a slightly increasing tendency in score values. However, the increase in the score value was not statistically significant.

In the anterior esthetic area, adequate width of keratinized tissue is important for a harmonious mucosal appearance around implant prostheses and to maintain sufficient depth of the facial vestibule. In the present cases, a significant increase in WKG was observed after the surgical protocol. This zone of keratinized tissue did not change in dimension after placement of the restoration. Every case in this report maintained more than 3 mm of gingiva at restoration placement and at 2 years postrestoration. Based on this report and from the authors' clinical experience, a 3-mm width of keratinized tissue seems to be the requirement for an acceptable esthetic outcome.

In the present cases, healing abutments were connected at the time of surgery, which suggests that excellent results can be obtained without the use of provisional restorations. A provisional restoration may allow the tissue to develop sooner, but the results are likely to be the same. Others have reported that the type of provisional restoration has little effect on the outcome,[21] and a similar degree of papilla preservation was observed using provisional crowns and standard abutments.[24]

In this retrospective observation, a great deal of effort was spent to acquire more accurate and objective measurements. Soft tissue measurement parameters were employed according to the method reported by Priest.[9] Priest used 10× digital images fabricated by scanning conventional films. However, in this report, all images were taken using a digital camera to reduce any image-processing error that may have occurred during scanning. Also, measurements were performed through the magnified digital image to permit relatively more precise measurement than actual measurement in the oral cavity. However, some limitations exist in this protocol. While photographic images were taken using predetermined magnification ratios at baseline and subsequent recall appointments, the camera projection angle may be slightly different at each appointment. Therefore, accuracy can be compromised simply from camera angles not being consistent. To reduce the image distortion error as much as possible, a periodontal probe was included in the photograph whenever possible and used as a mathematic reference for consistency. Other shortcomings may include bias of the surgeon, prosthodontist, or laboratory technician in data collection.[9]

Conclusion

Within the limits of this retrospective case analysis, single-tooth replacement using immediate implant placement and connective tissue grafting was demonstrated to be a reliable procedure. Moreover, taking into consideration the positive outcomes in peri-implant soft tissue levels, the results suggest that the proposed clinical procedure can be considered an alternative approach to achieving an ideal esthetic anterior restoration associated with harmonious gingival architecture.

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