Clinical and esthetic outcome with immediate insertion and provisionalization with or without connective tissue grafting in presence of mucogingival recessions: A retrospective analysis with follow-up between 1 and 8 years

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Abstract

Background: Recessions following immediate implant insertion are frequently reported in the literature. Data regarding implant installation in presence of mucogingival recessions are rare.

Purpose: This study observes soft tissue level changes following immediate implant insertion and provisionalization of implants with or without connective tissue grafts in the anterior maxilla in patients with initial mucogingival recession within a follow-up period between one and eight years.

Materials and Methods: Twenty-six patients with marginal gingival recessions, which were designated for extraction and immediate implant insertion in the anterior zone of the maxilla (13-23), were included. Out of a larger group of immediate implants only single tooth replacements with 1 to 3 mm recession and a pre- and post-op CB-CT were selected. Facial bone deficiencies were grafted flaplessly with autologous bone in all sites. In a group of 13 patients the recessions (mean 2.3 ± 0.7 mm, range 1.0-3.0 mm) were grafted additionally by connective tissue (ABG + CTG), in the remaining 13 patients no soft tissue grafting (mean recession 1.8 ± 0.6 mm, range 1.0-3.0 mm) was performed (ABG). The marginal hard and soft tissue level, the width of the keratinized mucosa, the PES, and implant success were evaluated.

Results: After a mean follow-up period of 45 months the recessions were significantly reduced in the ABG group from 1.8 to 0.9 mm. The improvement was even more pronounced in the ABG + CTG group (from 2.3 to 0.5 mm). The PES improved significantly in both groups. At final examination all implants were still in function. Within the observational period, in 5 of 13 implants a marginal bone loss of more than 1 mm was noticed in the ABG, but in none of the ABG + CTG group.

Conclusions: These clinical results provide evidence that immediate implant placement might improve the facial soft tissue level. This was more evident in cases with a greater recession and an additional treatment with connective tissue grafts.

Keywords: autogenous bone grafting, connective tissue grafting, facial hard and soft tissue defect, flapless reconstruction, immediate implant placement, immediate provisionalization, mucogingival recession, soft tissue esthetics

Abbreviations: ABG, autologous bone grafts; ABG + CTG, autologous bone grafts plus connective tissue grafts; BGM, bone graft material; CB-CT, cone beam computed tomography; CEJ, cemento-enamel junction.
1 INTRODUCTION

Immediate implant insertion and provisionalization in extraction sites in the aesthetic zone is a well-documented treatment concept,1–7 which reduces treatment time, pain and costs compared to delayed or two-stage protocols. The fundamental concept and the biological rationale is the preservation of peri-implant tissues, especially the support of soft tissue structures to maintain a natural and esthetic contour. Earlier studies have revealed, that immediate implant insertion with flap elevation and without grafting the facial bony defect between implant surface and facial bone leads to a pronounced horizontal bone resorption8,9 at the implant site.

Based on current literature, immediate implant placement following tooth extraction cannot prevent loss of bundle bone or alveolar bone remodeling,10 even the implant dimension and the alignment within in the socket seems to influence the amount of resorption.11,12 Immediate implant placement with simultaneous guided bone regeneration applying deproteinized bovine bone mineral covered by a collagen membrane is a predictable method, however, on the long run it still implies a deficiency of the vestibular bone contour.13

Moreover, favorable esthetic outcome of immediate implants requires uneventful bone grafting and is highly sensitive even to slight variations of the implant position.14–17 Therefore, systematic reviews and clinical studies observing immediate implant placement recommended specific selection criteria, including a thick tissue biotype and an intact facial socket wall to reduce the esthetic risks.14–18 According to Chappuis et al., thin facial bone walls of 1 mm or less resulted in a vertical loss of 7.5 mm, whereas thick bone walls lead to bone resorption of only 1.1 mm.19 The simultaneous use of soft tissue grafts during immediate implant placement might reduce the risk of midfacial mucosal recession and improve the esthetic outcomes by reinforcement of the marginal tissues.20–25

Only few human studies reported on successful immediate implant insertion in presence of facial partial2,6–26 or total bone loss27–29 using autogenous bone5,18,19 or porcine BGM28 for defect augmentation. An even more challenging situation is the combination of a facial bony defect and a gingival recession-type defect. Although frequent, treatment of this critical defects is scarcely reflected in the literature.18 One clinical case series introduced a promising technique for the repair of facial recessions by grafting with Bio-Oss and a subepithelial connective tissue graft covered by a coronally advanced flap.30 Others used grafts from the maxillary tuberosity.31 However, the indication criteria and the true benefit of a subepithelial connective tissue graft in this highly compromised marginal situation remained to be explored.

Therefore, this study reports the outcome in patients with and without subepithelial connective tissue grafts in the anterior zone of the maxilla. Specifically, the mucogingival conditions and the esthetic outcome of immediately inserted implants in compromised alveolar sockets were evaluated to clarify the potential of connective tissue grafts and to specify their indication under these inconvenient conditions.

2 MATERIALS AND METHODS

2.1 Patients

In this retrospective study 26 patients received 26 OsseoSpeed (n = 17) or OsseoSpeed Profile (n = 9) implants between May 2007 and September 2015. This cohort is part of a larger group of patients receiving 475 immediately inserted and immediately provisionalized OsseoSpeed implants in various regions of the jaws at the Department of Oral and Maxillofacial Surgery at the University Medicine of Mainz, Germany or in a private clinic for oral surgery in Lindau, Germany.

Since the indications for an immediate implant in the anterior region in case of of soft tissue recessions are very limited and only single tooth implants with preoperative and postoperative available CB-CT were selected, the number of patients fitting to this study is small. Coincidentally, the number of cases, which could be included in the ABG as well as in the ABG + CTG group were 13 cases each.

The inclusion criteria for this subpopulation were as follows: hopeless tooth, deemed to be extracted; single-tooth restoration, 1 to 3 mm mucogingival recession and variable defects of the facial bony wall; expectation of primary stability, flapless procedure, pre- and post-op CB-CT available. Exclusion criteria: known or suspected current malignancy, history of radiation therapy in the head and neck region, chemotherapy within five years prior to surgery, uncontrolled diabetes mellitus, permanent immunosuppressive medication, bone modifier (e.g., bisphosphonate or rank ligand inhibitor) medication, alcohol, and/or drug abuse. Smoking was not regarded as an exclusion criterion.

The average age of this population (12 women, 14 men) was 48.4 years (range, 20–77 years). Twenty patients were nonsmokers, 6 were smokers.

2.2 Ethical approval

This study was approved by the Ethics committee of the county Rheinland-Pfalz, Germany (file no. 837.063.08 (6060)) and conducted according to the recommendations of good clinical practice in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki. Written Informed Consent was obtained from all patients prior to any examination carried out for study purposes.

2.3 Pretreatment examination

At pretreatment examination a cone beam tomography (CB-CT) was performed to evaluate the bone volume and the dimensions of the facial bony lamella. Seven (27%) extraction sockets showed a pristine facial bone wall (between 0 and 1 mm facial bone loss), 13 (50%) sites had partial bony defects (between 1 and 7.5 mm facial bone loss), and 6 (23%) sites presented a total loss of the facial bone wall (between 7.5 and 13 mm facial bone loss).

Due to the lack of established criteria for additional connective tissue grafts with regard to the characteristics of soft tissue deficit and bone defects, there was no "a priori" definition on which patient should or should not receive an additional connective tissue graft at the
beginning of the patients recruitment. Thus, initial decisioning included subsidiary conditions like position of the lip-line, overall gingival biotype and patient’s preferences with regard to additional surgical trauma and costs. After this “explorative” phase and based on preliminary results (Noelken et al., 2014, 2016), connective tissue grafting was specifically recommended for patients with extended hard and soft tissue defects. Thus, the final study groups entail a bias with larger defect sizes being included in the group who received simultaneous bone grafting and connective tissue grafting.

2.4 | Surgical technique

The diameters of the implants used were between 3.5 and 5.0 mm with a length of 15 and 17 mm. The surgical protocol has been described in detail within previous publications.5,26

Briefly: Surgery followed the guidelines outlined in the manufacturer’s instructions, modified to immediate and flapless implant installation and a one-stage surgical procedure. The teeth were extracted atraumatically to maintain alveolar bone and gingival architecture. The extraction site was cleansed of granulation tissue using a chairside microscope. The implants were aligned to the oral lamella of the socket. Placement depth was determined by the interproximal and facial soft tissue and bone height. Healing abutments were used during the short time of fabrication of the temporary restoration.

In the autologous bone grafting (ABG) group the implants were inserted immediately and flaplessly with an autologous bone graft but without soft tissue grafting while in the autologous bone grafting + connective tissue graft (ABG + CTG) group the implant sites received an additional connective tissue graft according to the tunnel technique described by Allen32 using a microsurgical approach under a chair-side microscope. The subepithelial connective tissue graft was harvested at the palate in the premolar region. In the recipient sites a supraperiostal tunnel was prepared without separating the papillae. After lateral and apical extension of the preparation crossing the mucogingival border the graft was incorporated, aligned and fixed in the tunnel by mattress sutures.

2.5 | Immediate and final restorations

Fabrication and management of the immediate temporary and final restorations has also been described in detail in previous communications.5,26 Briefly: The temporary restorations were either manufactured from acrylic denture teeth to be cemented on top of titanium abutments (TiDesign; Dentsply Sirona Implants, Mannheim, Germany) using a temporary cement (Temp Bond; Kerr Hawe SA, Bioggio, Switzerland) or individual temporary screw-retained restorations were fabricated by a laboratory technician using temporary abutments. All temporary restorations were inserted at the day of implant placement, adjusted to clear all contacts and splinted to neighboring teeth or to each other using a glass fiber ribbon (Ribbond THM; Ribbond, Seattle, Washington) for eight weeks.

After a minimum of three months, the final restoration was fabricated. Zirconia crowns were cemented on top of zirconia abutments (Atlantis zirconia abutment or ZirDesign; Astra Tech AB) using a temporary cement (Temp Bond; Kerr Hawe SA).

2.6 | Follow-up and definition of outcome variables

The primary outcome parameter of this retrospective study was the facial soft tissue level. The secondary outcome parameters were the width of the keratinized mucosa, the interproximal and facial marginal bone levels, the soft tissue esthetics, and overall implant success.
The patients were examined preoperatively, at implant placement, at prosthetic delivery, and at annual follow-up visits up to nine years following implant insertion.

2.7 | Evaluation of primary outcome parameter

The primary outcome parameter was the midfacial soft tissue level compared to the contralateral tooth. This level was measured as the distance from the cemento-enamel junction (CEJ) to the midfacial soft tissue by a periodontal probe with 1 mm calibration. In case of the elongation of the hopeless tooth the original position of the tooth was calculated for measuring this distance. At the implant site this distance was calculated in relation to a tangent between the CEJs of the neighboring teeth.

2.8 | Evaluation of secondary outcome parameters

- The width of the keratinized and attached gingiva/mucosa at the midfacial aspect of the teeth or implant sites and the periimplant probing depths was measured by a periodontal probe with 1 mm calibration.
- The PES assessed the configuration of the mesial/distal papillae, the vertical level, the contour and symmetry of the soft tissue margin, and the texture and color of the soft tissue on a rating scale (0–2).
- All clinical esthetic evaluations were performed by one investigator (TP), who was experienced with the PES evaluation and not involved in the primary surgical or prosthetic treatment of the patients and was blinded to the radiological data and to the initial esthetic status of the patients.
- The status of the interproximal marginal bone level was determined by digital periapical radiographs with paralleling technique. The vertical distances between the mesial and distal bone level and the first microthread (interproximal reference level) were measured. Bone levels crestal to this reference level were designated as positive values and vice versa.
- The status of the facial bone level was determined by CB-CT data, specifically by the reconstruction according to the long axis of the teeth/implants. The thickness of the facial bone wall was measured at 1, 3, and 6 mm apical to the facial reference level. This level, designated as “a” in Figure 1, was defined as a line at bone level parallel to the connecting line between the oral and vestibular CEJ and likewise as a plane perpendicular to the long axis of the implant at the first microthread at implant sites.
- Implant success was rated according to the criteria established by Buser. Additionally, implant success was estimated by combining

FIGURE 3  A. Vertical root fracture of an upper lateral incisor with a mucogingival recession of 2 mm. B. Almost complete coverage of the mucogingival recession by immediate implant insertion and facial defect grafting by autogenous bone chips at three-year follow-up examination. C. CB-CT at preoperative examination showing the total loss of the buccal bony wall following a vertical root fracture. D. Complete reconstruction of the buccal bony wall coronal to implant shoulder level at three-year follow-up examination
these criteria with bone loss less than 1 mm (mean between mesial and distal measurement).

2.9 | Statistical analysis

Success probabilities were estimated by the Kaplan–Meier method. Due to the variability of the baseline conditions in the ABG and the ABG + CTG groups we refrain from a statistic comparison between these groups. However, subpopulations (thin vs. thick biotype, smokers vs. nonsmokers) were compared using the nonparametric U-Test on a "per patient" basis. The pretreatment to post-treatment changes of vertical facial bone level, thickness of the facial bone wall, soft tissue level, PES, and width of the attached mucosa within were compared using the nonparametric Wilcoxon signed rank test for related samples per

| TABLE 1 | Mean changes of midfacial soft tissue level, the width of keratinized mucosa, the alveolar process contour and the PES sum from preoperatively to three-year follow-up examination |
|----------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|          | Pre-op                                                      | Delivery                                                      | One-year                                                      | Two-year                                                      | Three-year                                                      |
| midfacial soft tissue recession | ABG group | 1.8 ± 0.6 mm  
 n = 13 | 0.9 ± 0.6 mm  
 n = 13 | 0.8 ± 0.7 mm  
 n = 12 | 0.9 ± 0.8 mm  
 n = 10 | 1.0 ± 0.7 mm  
 n = 10 |
|                   | ABG + CTG group | 2.3 ± 0.7 mm  
 n = 13 | 0.4 ± 0.6 mm  
 n = 13 | 0.3 ± 0.4 mm  
 n = 9 | 0.4 ± 0.7 mm  
 n = 8 | 0.4 ± 0.7 mm  
 n = 5 |
| Width of keratinized mucosa | ABG group | 4.1 ± 1.0 mm  
 n = 13 | 4.7 ± 0.7 mm  
 n = 13 | 4.4 ± 1.1 mm  
 n = 12 | 4.2 ± 0.8 mm  
 n = 10 | 4.5 ± 1.1 mm  
 n = 10 |
|                   | ABG + CTG group | 3.3 ± 1.1 mm  
 n = 13 | 3.9 ± 1.0 mm  
 n = 13 | 3.9 ± 0.9 mm  
 n = 9 | 4.1 ± 1.4 mm  
 n = 9 | 5.0 ± 0.6 mm  
 n = 5 |
| PES: Alveolar process contour | ABG group | 1.9 ± 0.3  
 n = 13 | 1.5 ± 0.5  
 n = 13 | 1.4 ± 0.5  
 n = 12 | 1.4 ± 0.5  
 n = 10 | 1.3 ± 0.5  
 n = 5 |
|                   | ABG + CTG group | 1.8 ± 0.4  
 n = 13 | 1.9 ± 0.3  
 n = 13 | 1.9 ± 0.3  
 n = 9 | 1.9 ± 0.3  
 n = 8 | 2.0 ± 0.0  
 n = 5 |
| PES sum | ABG group | 10.3 ± 1.5  
 n = 13 | 12.0 ± 1.1  
 n = 13 | 12.4 ± 1.2  
 n = 12 | 12.2 ± 0.9  
 n = 10 | 12.2 ± 0.6  
 n = 5 |
|                   | ABG + CTG group | 8.7 ± 2.6  
 n = 13 | 11.2 ± 1.2  
 n = 13 | 12.0 ± 0.9  
 n = 9 | 12.2 ± 1.2  
 n = 8 | 13.0 ± 1.2  
 n = 5 |

FIGURE 4 A, Periodontally hopeless central incisor with a mucogingival recession of 3 mm. B, Complete coverage of the mucogingival recession by immediate implant insertion and facial defect grafting with autogenous bone chips and connective tissue at 12 months. C, CB-CT at preoperative examination showing the dehiscence defect of the facial bony wall at the left central incisor. D, At 12 months the complete reconstruction of the facial bony wall was documented by CB-CT.
implant. The analysis exploring the linkage between facial marginal bone level and the midfacial soft tissue level utilized the Spearman's rank-based correlations. The reported P-values are two-sided. Due to the explorative nature of the study, alpha-adjustment was not performed. All calculations were carried out using SPSS 22 (SPSS Inc, Chicago, Illinois).

3 | RESULTS

3.1 | Patients, implants, and follow-up

The reason for tooth removal was an endodontic failure in 7, a long-axis root fracture in 10, a nonrestorable decay in 2, an external root resorption in 1, and periodontitis in 2 sites. Four teeth were lost due to trauma.

Altogether 26 implants were placed in 26 patients. Thirteen implants in 13 patients were inserted with autogenous bone grafting without soft tissue grafting in the ABG group, 13 implant sites in 13 patients received an autogenous bone graft plus simultaneous connective tissue graft (ABG + CTG group). There were 14 implants replacing central incisors, 11 replacing lateral incisors, and one implant replacing a canine. Chronic peri-radicular infection was present in 17 sites, acute infection in 2 sites. The mean follow-up for all implants was 45 ± 23 months (range, 14–93 months), for the ABG 61 ± 21 months (range, 31–93 months) and for the ABG + CTG group 29 ± 11 months (range, 14–48 months).

3.2 | Midfacial soft tissue level

The mean recession level at all implant sites changed significantly from 2.1 ± 0.7 mm preoperatively, to 0.7 ± 0.7 mm at final examination (P < .001).

The recession was significantly reduced in both the ABG group and in the ABG + CTG group. The mean improvement of the recession was 1.8 ± 0.7 mm (range from 0.5 to 2.5 mm, pre-op 2.3 ± 0.7, final 0.5 ± 0.6, P = .001) in the ABG + CTG group and 0.9 ± 1.0 mm (range from −1.00 to 2.5 mm, pre-op 1.8 ± 0.6, final 0.9 ± 0.8, P = .014) in the ABG group. 31% of the sites in the ABG group and 54% in the ABG + CTG group sites showed complete coverage of the recession at the final examination.

The soft tissue level changes from preoperatively to the three-year follow-up examination are summarized in Table 1 and Figure 2. Surprisingly, the initial midfacial soft tissue level was not influenced by the amount of facial bone loss (P = .128).

| TABLE 2 | Mean interproximal marginal bone level changes in relation to the reference level from implant insertion to the three-year follow-up |
|---------|-------------------------------------------------|----------------|----------------|----------------|----------------|
| Insertion | Delivery | One-year | Two-year | Three-year |
| ABG group | 0.6 ± 0.8 mm (n = 13) | 0.1 ± 0.5 mm (n = 13) | 0.2 ± 0.4 mm (n = 11) | 0.1 ± 0.7 mm (n = 10) | 0.0 ± 0.7 mm (n = 10) |
| ABG + CTG group | 0.9 ± 0.6 mm (n = 13) | 0.1 ± 0.2 mm (n = 13) | 0.1 ± 0.4 mm (n = 9) | 0.1 ± 0.4 mm (n = 7) | 0.1 ± 0.3 mm (n = 5) |

| TABLE 3 | Mean facial marginal bone level change in relation to the reference level |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|
|         | Pre-op          | Final examination | Mean change | P = |
| ABG group | range | -2.4 ± 2.2 mm | -0.3 ± 0.9 mm | 2.2 ± 2.6 mm | .002 |
|           | range | -11.7 to 0 mm | -2.2 to 0.8 mm | |
| ABG + CTG group | range | -5.5 ± 4.1 mm | 0.9 ± 0.6 mm | 6.4 ± 4.2 mm | .001 |
|           | range | -12.2 to -0.5 mm | 0.0 to 1.8 mm | |
| All implants | range | -4.0 ± 3.6 mm | 0.3 ± 1.0 mm | 4.3 ± 4.0 mm | .000 |
|           | range | -12.2 to 0.0 mm | -2.2 to 1.8 mm | |

| TABLE 4 | Mean facial bone thickness changes at 1, 3, and 6 mm apical to reference level from preoperative examination to final follow-up |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|
|         | Level (mm) | Pre-op | Final | Mean change | P = |
| ABG group | 1 | 0.2 ± 0.3 | 1.4 ± 1.3 | 1.2 ± 1.4 | .013 |
|          | 3 | 0.4 ± 0.4 | 1.7 ± 1.4 | 1.3 ± 1.5 | .002 |
|          | 6 | 0.6 ± 0.7 | 1.9 ± 1.4 | 1.3 ± 1.1 | .006 |
| ABG + CTG group | 1 | 0.1 ± 0.2 | 1.8 ± 1.0 | 1.8 ± 0.9 | .001 |
|          | 3 | 0.2 ± 0.2 | 1.7 ± 0.7 | 1.6 ± 0.7 | .001 |
|          | 6 | 0.3 ± 0.5 | 1.4 ± 0.7 | 1.1 ± 0.8 | .001 |
| All implants | 1 | 0.1 ± 0.3 | 1.6 ± 1.2 | 1.5 ± 1.2 | <.001 |
|          | 3 | 0.3 ± 0.3 | 1.7 ± 1.1 | 1.5 ± 1.1 | <.001 |
|          | 6 | 0.5 ± 0.6 | 1.7 ± 1.1 | 1.2 ± 0.9 | <.001 |

| TABLE 5 | Mean periimplant probing depths at final examination for the ABG and ABG + CTG group |
|---------|-----------------|-----------------|-----------------|-----------------|-----------------|
|         | Mesio-facial | Mid-facial | Disto-facial | Mesio-oral | Mid-oral | Disto-oral |
| ABG     | 2.7 ± 0.7 | 2.5 ± 0.9 | 2.6 ± 0.6 | 2.7 ± 0.4 | 2.2 ± 0.3 | 2.8 ± 0.7 |
| ABG + CTG | 3.0 ± 1.0 | 2.5 ± 0.9 | 2.8 ± 0.7 | 2.7 ± 0.4 | 2.2 ± 0.4 | 3.0 ± 0.6 |
3.3 | Width of the keratinized and attached gingiva/mucosa

The width of the keratinized and attached gingiva/mucosa changed from 4.1 ± 1.0 to 4.3 ± 1.2 mm in the ABG group (P = .359) and improved significantly in the ABG + CTG group from 3.3 ± 1.1 to 4.3 ± 1.3 mm (P = .024) in the final follow-up examination. The changes of the width of the keratinized gingiva/mucosa from preoperatively to the three-year follow-up examination are displayed in Table 1.

3.4 | Esthetics

The detailed changes of the PES from preoperative to three-year follow-up examination are displayed in Table 1. Mean PES at all implants changed from pre-op 9.5 ± 2.3 to 12.2 ± 1.2 (P < .001) at final examination.

An improved or stable score of the PES was noticed in 11 of 13 sites in the ABG group, while all sites in the ABG + CTG group improved (Figures 3A,B and 4A,B).

3.5 | Interproximal marginal bone level

The final interproximal marginal bone level (compared to the reference level) was 0.1 ± 0.5 (range, −1.4 to 1.1 mm) in the ABG group and 0.0 ± 0.5 (range, −1.0 to 0.9 mm) in the ABG + CTG. The marginal bone level changes from insertion to the three-year follow-up examination are displayed in Table 2.

3.6 | Facial bone level and thickness

CB-CTs were recorded preoperatively and in the follow-up period for all cases. The mean facial marginal bone level in relation to the reference level improved considerably as described in Table 3. The dimension of the facial bony lamella showed an increase of thickness in both groups (Table 4; Figures 3C,D and 4C,D).

3.7 | Probing depths

The periimplant probing at final examination for the ABG and ABG + CTG group are displayed in Table 5 and shows no differences between those two groups.

3.8 | Implant success

No implant was lost, all implants were still in function after a mean follow-up of 45.0 ± 22.9 months (range, 14–93 months) and, thus, fulfilled the success criteria of Buser. Five implants in the ABG group and no implant in the ABG + CTG group, however, showed an interproximal or facial marginal bone level more than 1 mm apical to the reference level. According to the second endpoint definition combining the success criteria established by Buser with bone loss less than 1 mm, the estimated cumulative success rate was 38.7% for the ABG group and 100% for the ABG + CTG group (Figure 5).

4 | DISCUSSION

This retrospective study analysed soft tissue level changes, implant success, peri-implant marginal bone levels, and soft tissue esthetics following immediate implant insertion in extractions sites with gingival recessions between 1 and 3 mm with or without connective tissue grafting within a follow-up between 14 to 93 months. In contrast to the literature, the mean recession size was significantly reduced in both the ABG and the ABG + CTG group. After a mean follow-up period of 45 months, regeneration of the facial bone wall, improved esthetic soft tissue ratings and a high survival rate were found. However, the interproximal or facial bone loss turned out as a major obstacle for implant success in the ABG group, at least when strict success criteria were applied. Most interestingly, the additional CTGs seemed to provide some protective effect on the facial and interproximal bone maintenance.

Regarding the well-documented issue of a higher risk of recessions with the immediate insertion protocol, it was contrary to the expectation to find a significantly improved facial soft tissue level in both groups. The mean reduction of the recession in ABG + CTG group was 1.8 mm and, thus, even comparable to the results obtained by the combination of BioOss, connective tissue graft and an additional coronally advanced flap. It seems, however, noteworthy, that the follow-up period in the presented study almost doubled the observation period of Lee et al., which supports sustainability of the results.

Fortunately, the used surgical technique already led to a reduction of the recession even without a connective tissue graft. However, some volume resorption of the alveolar bone contour was visible as expressed by the reduction of the PES variable “alveolar process contour” from 1.9 to 1.3. Adding a connective tissue graft to our “standard procedure" resulted in a stabilization or even a slight improvement of the alveolar contour.

To counteract the typical horizontal bone resorption following immediate implant insertion without facial defect grafting, the implants in this series were strictly aligned to the oral cortical lining.
placed without elevating a flap and grafted with autogenous bone chips at the facial aspect. As a result, the interproximal marginal bone level stabilized in both groups at the level of the implant shoulder. This finding was in line with results for immediate loading of OsseoSpeed implants in healed sites at five-years and for immediate insertion in favorable bony situation and immediate provisionalization at three and five years.²⁴⁰

Although the initial status of the facial bony lamella was substantially compromised, CB-CT data documented the vertical regeneration and thickening of the facial bone wall in both groups. Even though the initial defect dimension was more pronounced in the ABG + CTG group, the bony regeneration to the level of facial implant shoulder was successful. These results are in line with the previous literature documenting flapless facial periimplant defect grafting using autogenous bone or porcine BGM.²⁸

The width of the keratinized and attached gingiva was initially wider in the ABG group (4.1 ± 1.0 mm) when compared to the ABG + CTG group (3.3 ± 1.1 mm). In both groups, the width of the keratinized gingiva was preserved or even improved (especially in the ABG + CTG group). This improvement in the ABG + CTG is in line with the results of Le et al, who documented an increase of keratinized tissue of 2.5 mm following connective tissue grafting and immediate implant placement.²⁵

It is a weakness of this observational study that our "explorative" patient recruitment created a bias towards larger defect sizes being included in the ABG + CTG group. This poses considerable limitations or even rules out a sound statistical intergroup comparison. However, both marginal bone levels and esthetic parameters suggest that adding a connective tissue graft at least compensated for the even worse initial situation of gingival recession in the respective group and might perhaps support interproximal and facial bone stability. Hence, a prospective study design with balanced baseline conditions will be necessary to substantiate this preliminary interpretation of retrospective data.

5 | CONCLUSION

This retrospective observational study provides evidence that immediate implant placement might improve the facial soft tissue level and soft tissue esthetics in sites with initial recessions between 1 and 3 mm. This was more evident in cases with a greater recession and an additional treatment with a connective tissue graft, which improved significantly the width of the keratinized mucosa and protected the marginal bone level against initial resorption.

CONFLICT OF INTEREST

The authors declare no conflict of interest in relation to this manuscript.

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