Early Implant Placement With Simultaneous Guided Bone Regeneration Following Single-Tooth Extraction in the Esthetic Zone: 12-Month Results of a Prospective Study With 20 Consecutive Patients

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**Background:** Early implant placement is one of the treatment options in postextraction sites in the anterior maxilla. Implant placement is performed after a soft tissue healing period of 4 to 8 weeks. Implant placement is combined with a simultaneous guided bone regeneration (GBR) procedure to rebuild esthetic facial hard and soft tissue contours.

**Methods:** In this prospective case-series study, 20 consecutive patients treated with an implant-borne single crown were prospectively followed for 12 months. Clinical, radiologic, and esthetic parameters were recorded to assess treatment outcomes.

**Results:** At the 12-month examination, all 20 implants were successfully integrated, demonstrating ankylotic stability and healthy peri-implant soft tissues as documented by standard parameters. The esthetic outcomes assessed by a pink esthetic score (PES) and a white esthetic score (WES) demonstrated pleasing results overall. The WES values were slightly superior to the PES values. The periapical radiographs showed minimal crestal bone loss around the used bone level implants, with mean bone loss of 0.18 mm at 12 months. Only one implant showed >0.5 mm bone loss, combined with minor mucosal recession of 0.5 to 1.0 mm.

**Conclusions:** This prospective case series study evaluating the concept of early implant placement demonstrated successful tissue integration for all 20 implants. The short-term follow-up of 12 months revealed pleasing esthetic outcomes overall, as assessed by objective parameters. The risk for mucosal recession was low; only one patient showed minor recession of the facial mucosa. These encouraging results need to be confirmed with 3- and 5-year follow-up examinations. J Periodontol 2009;80:152-162.

**KEY WORDS**
Bone graft; bone regeneration; case series; clinical trial; gingival recession.

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Implant placement following extraction of a single tooth is an often-encountered clinical situation in daily practice. For the clinician(s), this indication for implant therapy is particularly challenging in the esthetic zone, because patients often have the highest expectations in terms of an esthetic treatment outcome. This challenge is based on a variety of local risk factors that are often present in the anterior maxilla. In addition to immediate and late implant placement, early implant placement is one of the treatment options currently used by numerous clinicians. This concept uses a delayed approach, with 4 to 8 weeks of healing to achieve healed soft tissues in the extraction site. The corresponding biologic rationale and surgical procedures were recently described in detail in a methodology article.

A 2004 review article based on the documents and conclusions of an ITI Consensus Conference held in 2003 analyzed the available evidence in the literature concerning immediate and early implant placement. This analysis clearly demonstrated that both approaches were well documented in terms of implant survival. However, the authors also noted that there was a lack of studies reporting on esthetic treatment outcomes for both approaches.

Since 2004, several studies have been published on esthetic results for single-tooth implants placed in postextraction sites. For immediate implants, four studies documented mucosal recession using this surgical approach. For early implant placement, a recent cross-sectional retrospective study of 45 patients reported satisfactory esthetic outcomes without notable mucosal recession. However, this study could not address the predictability of this approach, because the patients enrolled were not prospectively documented. Therefore, a prospective study was initiated to provide this missing information.

Consequently, the aim of the present prospective case-series study was to assess the esthetic treatment outcomes of early implant placement in single-tooth gaps located in the esthetic zone. A further aim of the study was to provide detailed information about the predictability of esthetic outcomes, assessed by clinical, radiographic, and objective esthetic parameters. In this context, a bone-level implant was used that was designed to minimize bone loss in the crestal area following restoration.

**MATERIALS AND METHODS**

**Patient Selection**

Between November 2005 and July 2006, 20 partially edentulous patients were consecutively admitted to the study. All 20 patients signed an informed consent form. The study protocol was approved by the standing ethical committee for clinical studies of the State of Bern (approval number 30/05). Only patients with the need for a single-tooth replacement in the anterior maxilla, subsequent to an inevitable tooth extraction, were included in the study. Exclusion criteria were systemic diseases that could alter the tissue integration of dental implants, pregnancy, or smoking more than 10 cigarettes per day.

The group consisted of five male and 15 female patients with a mean age of 41.7 years (range: 24 to 60 years). The treatment sites included 14 central incisors, three lateral incisors, one canine, and two first premolars. Sixteen patients were non-smokers, and four patients were light smokers (<10 cigarettes/day).

**Surgical and Restorative Treatment**

The surgical procedures associated with the early implant placement concept have been described in detail. First, tooth extraction was carried out without flap elevation. The extraction sockets were subsequently allowed to heal for 4 to 8 weeks, depending on the socket diameter. Implant surgery was performed following this soft tissue healing period. Implant placement was combined with a simultaneous contour augmentation on the facial aspect using the guided bone regeneration (GBR) technique. In all patients, the flap design consisted of mucoperiosteal flaps with a slightly palatal crest incision, sulcular extensions to the facial aspect of the adjacent teeth, and divergent distal line-angle releasing incisions. The implant used was a bone-level implant featuring a chemically modified, sand-blasted and acid-etched surface in the endosseous portion, with a platform diameter of 4.1 mm and a length of 10 or 12 mm. Special attention was paid to correct prosthetic positioning of the implant platform in all three dimensions. The goal was to stay ≥1 mm away from adjacent root surfaces and to place the implant shoulder mid-facially ~3 to 4 mm apical to the mucosal margin and ~1 to 1.5 mm palatal to the prosthetic point of emergence of the future implant crown (Figs. 1 and 2). Following implant insertion with good primary stability, most implants demonstrated a crater-like peri-implant bone defect on the facial aspect, which was augmented with autogenous bone chips, mainly harvested with a flat chisel at the nasal spine within the same flap, followed by a superficial layer of deproteinized bovine bone mineral (DBBM). The augmentation material was covered with a non-cross-linked porcine-derived collagen membrane soaked in blood and applied in a double layer. Following the release of the mucoperiosteal flap by means of incisions in the periosteum, a tension-free primary wound closure was achieved. For all implant surgeries,
perioperative antibiotic prophylaxis was initiated 2 hours prior to surgery and maintained for 3 days postsurgically (amoxicillin, 1 g twice a day, orally). Post-surgical medication also included a chlorhexidine digluconate (0.1%) rinse three times per day. Depending on the size of the peri-implant bone defect, a reopening procedure without flap elevation was performed 8 to 12 weeks later using a circular incision with a 12b blade to gain access to the top of the healing abutment of the osseointegrated implant. The day of reopening was set as day 0 for the study. Within 7 days, screw-retained provisional acrylic crowns were inserted to initiate the peri-implant soft tissue conditioning phase. Some of these provisional crowns were gradually enlarged, if required, to optimize the soft tissue contour or the form and volume of the restoration itself. The provisional crowns stayed in place until the 6-month follow-up examinations. Thereafter, final impressions were taken using screw-retained prefabricated impression posts and an open tray technique. The master casts were mounted in a second-generation semiadjustable articulator, using a quick-mount face-bow. Additionally, the laboratory technician was provided with an alginate impression of the provisional restoration. Prefabricated titanium milling cylinders, directly connected to the implant analog, were individualized to serve as meso-structures for the final all-ceramic implant crowns. For all patients, a biscuit-bake try-in session was carried out prior to finalizing the zirconia-based all-ceramic suprastructures. To allow the removal of the implant crowns during the planned annual follow-up examinations, all ceramic crowns except one were bonded to the screw-retained meso-structures with composite resin using an adhesive protocol, including sand-blasting and silane treatment. This procedure included a small opening at the palatal aspect of the crowns to provide access to the abutment screw. Furthermore, in four of the patients in whom an implant had been placed in the position of the central incisor, the existing defective ceramic crown of the contralateral central incisor had to be replaced as well.

Follow-Up Examinations
To assess the specific treatment outcomes in these 20 patients, the following parameters were examined at various time points:

**Standard soft tissue parameters routinely used in prospective long-term studies for ~20 years.**

- Modified plaque index (mPI), modified sulcus bleeding index (mSBI), and probing depth (PD) were assessed at four aspects around the implants. In addition, the width of keratinized mucosa (KM) was assessed on the facial aspect. These parameters were assessed with the crowns in place at 3, 6, and 12 months.

- Distance from the mucosal margin to the implant shoulder (DIM). At the 12-month examination, the screw-retained crowns were removed, and DIM was measured with a periodontal probe to the nearest millimeter at four locations in the implant site. This was only feasible in 19 crowns, because one implant was restored with a cemented all-ceramic crown.

- Distance from the implant shoulder to the first bone-to-implant contact (DIB). Periapical radiographs were taken with bite blocks at day 0 (baseline) and at 3, 6, and 12 months and were analyzed to assess DIB on the mesial and distal aspects. For each implant and each examination period, one DIB value was calculated as the average of the obtained mesial and distal values. The radiographic readings were performed by one experienced examiner not involved in the surgical or prosthetic treatment of the patients.
Cast analysis. Impressions were taken at 1, 3, 6, and 12 months to produce study casts of the maxilla. The casts were photographed with a standardized technique using a millimeter grid as reference. The mid-facial height of the implant crown (IC) and the corresponding height of the contralateral tooth crown (TC) were measured on these digital pictures (Fig. 3) to identify potential changes in crown height or mucosal recessions.

Esthetic parameters. To objectively examine the esthetic outcome of the implant crowns at the 12-month examination, the respective casts and intraoral pictures were critically analyzed by two examiners (LG and UCB) according to two specific indices, pink esthetic score (PES) and white esthetic score (WES), each with five parameters (Table 1). The PES/WES indices were described in detail in a publication analyzing 45 single-tooth implants in a retrospective, cross-sectional study.\textsuperscript{18} These indices each use a maximum score of 10, representing optimum esthetic outcome with respect to the peri-implant soft tissue conditions and the ceramic restoration itself. As per definition, the threshold of clinical acceptability was set by the investigators at a value of 6 (out of 10) for each index.\textsuperscript{18}

Statistical Analysis
First, all data were analyzed with descriptive methods using box plots. The Wilcoxon signed-rank test was used to analyze potential differences in the gingival parameters, implant mobility, and radiographic findings over time. To compensate for multiple testing situations, the $P$ values were adjusted according to the method of Holm,\textsuperscript{19} which allowed them to be compared to the usual alpha level of 0.05.

The esthetically relevant facial DIM values were tested separately compared to the interproximal and oral values of the 12-month examination using Wilcoxon paired signed-rank tests to avoid pooling the data of dependent variables.

Data sets of the cast analysis were evaluated descriptively, and the difference between IC and TC was calculated for each time point separately. The Wilcoxon signed-rank test was used to detect

Table 1.

<table>
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<tr>
<th>PES</th>
<th>Parameter</th>
<th>Absent</th>
<th>Incomplete</th>
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<td>Curvature of facial mucosa</td>
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<td>Level of facial mucosa</td>
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<td>Maximum total PES score</td>
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<table>
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<th>WES</th>
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<td>Tooth volume/outline</td>
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<td>Color (hue/value)</td>
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<td></td>
<td>Maximum total WES score</td>
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</table>
statistically significant differences between the D\textsubscript{IC}–TC values.

The level of significance for all tests was $P<0.05$. All analyses were performed using a computer software program.\textsuperscript{¶} The $P$ value adjustment was done using an Internet-based program.\textsuperscript{20}

**RESULTS**

**Healing Period**

No noteworthy complications were observed during healing, and the reopening procedures could be performed as planned. When restored with provisional restorations, all implants demonstrated firm integration in the tissues, and no signs of implant mobility were observed throughout the study period.

**Standard Soft Tissue Parameters (Table 2)**

In general, the patients performed good home care. The mean mPI was 0.08 for the 3-month examination. The mean mPI value remained the same for the 6-month examination, and it increased to 0.36 at the 12-month visit. This increase proved to be statistically significant compared to the values from the 3- and 6-month examinations ($P=0.0148$ and $P=0.0060$, respectively). The peri-implant soft tissues revealed little tendency to bleed following probing and were clinically healthy. The mean mSBI was 0.26 at the 3-month examination, and it remained stable throughout the study period. The mean PD was 3.69 mm at the 3-month examination, increasing to 3.75 mm at the 6-month examination and 4.43 mm at the 12-month examination. The differences between the 3- and 12-month PD values ($P=0.0018$) and the 6- and 12-month PD values ($P=0.0003$) were statistically significant. The mean KM at the 3-month examination was 4.06 mm, indicating a wide band of keratinized mucosa on the facial aspect of the implant crowns. The mean KM values at the 6- and 12-month examinations remained stable.

**Radiographic Findings/DIB Values**

The radiographs obtained of each implant did not reveal any signs of continuous peri-implant radiolucency throughout the observation period. At baseline (reopening = day 0), the mean DIB was 0.00 mm for the 20 implants. The peri-implant crestal bone showed a remodeling pattern during the following 12 months with functional loading. The mean DIB value increased to 0.09 mm at 3 months, 0.14 mm at 6 months, and 0.18 mm at 12 months of loading (Table 3). The value at 12 months was statistically significant compared to baseline ($P=0.0006$; Table 3). The frequency analysis of $\Delta$DIB\textsubscript{12months–day0} (Fig. 4) revealed little variability.

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\[\text{Table 2.}\]

**Clinical Parameters of the 20 Implants (mean ± SD)**

<table>
<thead>
<tr>
<th>Examination</th>
<th>mPI</th>
<th>mSBI</th>
<th>PD (mm)</th>
<th>KM (mm)</th>
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<tr>
<td>3 months</td>
<td>0.08 ± 0.24$^a$</td>
<td>0.26 ± 0.29</td>
<td>3.69 ± 0.62$^a$</td>
<td>4.06 ± 1.43</td>
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<tr>
<td>6 months</td>
<td>0.08 ± 0.20$^b$</td>
<td>0.16 ± 0.23</td>
<td>3.75 ± 0.46$^b$</td>
<td>4.10 ± 1.41</td>
</tr>
<tr>
<td>12 months</td>
<td>0.36 ± 0.33$^{ab}$</td>
<td>0.21 ± 0.17</td>
<td>4.43 ± 0.57$^{ab}$</td>
<td>4.50 ± 1.54</td>
</tr>
</tbody>
</table>

Statistically significant differences between the gingival parameter scores are marked with the same letters.

\[\text{Table 3.}\]

**Radiographic DIB of the 20 Implants**

<table>
<thead>
<tr>
<th></th>
<th>0 Months</th>
<th>3 Months</th>
<th>6 Months</th>
<th>12 Months</th>
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</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0*</td>
<td>0.09</td>
<td>0.14</td>
<td>0.18$^*$</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.17</td>
</tr>
<tr>
<td>Maximum</td>
<td>0</td>
<td>0.54</td>
<td>0.90</td>
<td>0.76</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SD</td>
<td>0.00</td>
<td>0.16</td>
<td>0.25</td>
<td>0.20</td>
</tr>
</tbody>
</table>

* Statistically significant difference between the radiographic parameter values.

\[\text{Figure 4.}\]

Frequency distribution of bone loss around the 20 implants using the $\Delta$DIB\textsubscript{12months–day0} values.
demonstrated that 15 of 20 implants showed minimal bone resorption (<0.25 mm), as demonstrated by the radiographs of all 20 implants at the 12-month examination (Fig. 5). Only one implant showed bone loss >0.5 mm (DIB = 0.76 mm; Fig. 5L).

**DIM Values at the 12-Month Examination**

DIM values were measured following removal of the crowns. The analysis demonstrated a mean value of –3.53 mm for facial DIM. This value was statistically significantly different ($P = 0.0004$ for all tests) from the mesial and distal values when analyzed using the Wilcoxon paired signed-rank test (Table 4). Summarizing these clinical and radiographic parameters, all 20 implants could be considered successfully integrated at up to 12 months of follow-up according to strict success criteria that have been used in implant dentistry for almost 20 years.$^{15}$

**Cast Analysis**

IC and TC values performed similarly over the study period, not showing any statistically significant changes over time. The highest mean crown length (10.03 mm) was obtained in the IC group at the 12-month examination. Nevertheless, these values did not reach the level of significance when tested within the IC group over time or compared to TC values at different time points (Table 5). The ΔIC–TC values over the study period also remained stable, with a slight increase to 0.18 mm for the 12-month data, also not reaching the level of significance.

**Esthetic Parameters: PES/WES Values**

The esthetic parameters are depicted for all 20 implants in Table 6. The analysis revealed a mean PES score of 8.10 and a mean WES score of 8.65, for a total mean score of 16.75. Overall, the esthetic outcomes were favorable, keeping in mind the threshold of clinical acceptability set at a value of 12 for both indices combined and as demonstrated in Figure 6 with the clinical photographs of all 20 crowns at the 12-month examination. Of the five parameters of the PES index, the papilla height showed the lowest mean values (1.45 for mesial papilla and 1.50 for distal papilla), whereas the level of the facial mucosa performed the best, with a mean value of 1.9. One implant crown (patient 12) had the lowest total score, i.e., 13, indicating a slightly compromised esthetic outcome, in particular with a PES value of only 5 (Table 6). The mucosal margin of this specific implant restoration demonstrated a recession between 0.5 and 1.0 mm (Fig. 6L). It was the same implant that showed bone loss.
resorption of 0.76 mm at the 12-month examination (Fig. 5L). No severe recession \( \geq 1 \) mm was observed. Among the five parameters of the WES index, surface texture and translucency had excellent mean values of 1.95 and 2.0, respectively, whereas color showed the lowest mean value (1.4).

### DISCUSSION

The present prospective case-series study with 20 consecutive patients provides additional evidence that early implant placement for single-tooth replacement in the anterior maxilla offers successful treatment outcomes with high predictability and a low risk for complications. The prospective 12-month follow-up demonstrated that all 20 implants achieved and maintained successful tissue integration, documented by standard clinical and radiographic parameters. Mean mPI, mSBI, and PD values at the 12-month examination indicated healthy peri-implant soft tissues. The mean values obtained were all in line with previous prospective studies\(^{15,16,21,22}\) using the same parameters. Therefore, all 20 implants fulfilled strict success criteria,\(^{15}\) resulting in a survival and success rate of 100% at 12 months of follow-up.

However, the main focus of this study was the esthetic outcome of this treatment approach. Three different methods were applied in an attempt to objectively assess the esthetic outcomes in these 20 patients. First, the esthetic outcomes were evaluated with PES and WES. Motivated by previously published esthetic indices,\(^{23,24}\) Belser et al.\(^{18}\) proposed these indices to comprehensively evaluate the pink and white dimensions of esthetics. Each index has a total score of 10 points. A minimal threshold for esthetic acceptability was set at 6 for each index.\(^{18}\) In the present study, the overall results were highly satisfying, with a mean total score of 16.75 for both indices. The mean WES score was slightly higher than the mean PES score. This is not surprising because the WES index is mainly dependent on the quality and experience of the dental technician. In the present study, all 20 all-ceramic crowns were produced by one technician with excellent expertise in esthetic restorations. The technician had some problems with the color, because this parameter only had a mean value of 1.4, whereas surface texture and translucency were rated highly by the two examiners.

The PES evaluates the soft tissue esthetics, including the height of the mesial and distal papillae, the level and curvature of the facial mucosa, root convexity, and tissue color. The mean PES value was 8.1. Among the five parameters of the PES, the papilla height was given a score of 1 in \( \approx 50\% \) of cases, indicating a slightly reduced height. It may be speculated that the surgical approach caused the reduced papilla height in some patients. A potential cause for the papilla reduction could be the selected incision technique that included the elevation of both adjacent papillae during implant surgery. A clinical study\(^{25}\) showed that the elevation of adjacent papillae caused more bone loss compared to a flap technique that does not include the papillae. However, the ideal incision technique seems to be an open question, because a recent study\(^{26}\) also showed a reduction in papilla height \( \sim 6\% \), even in patients with a flapless immediate implant placement. In addition, two randomized clinical trials\(^{8,27}\) comparing different placement protocols following extraction demonstrated no influence of the tested surgical approaches on the papilla height. Another potential explanation is that anatomical aspects primarily caused the papilla reduction, because clinical studies\(^{28,29}\) clearly indicated that the bone level at adjacent root surfaces is an important factor for peri-implant papilla height in single-tooth gaps. In the present study with 20 consecutive patients, the average age at implant surgery was \( \sim 42 \) years. Consequently, some of these patients demonstrated a reduced bone level at the initiation of therapy due to local infection. Thus, it can be speculated that the reduced papilla height observed in
some patients was caused by vertical bone deficiencies at adjacent root surfaces. Most likely, the cause of observed papilla height reduction is multifactorial. To resolve this open question of an optimal incision technique and related esthetic outcomes, a randomized clinical trial that includes the presented surgical technique concerning tooth extraction, timing, and implant placement with a simultaneous GBR procedure, but with two incision techniques randomly assigned (with and without papilla elevation), seems appropriate.

In addition to papilla height, the level of the facial mucosa is an important soft tissue parameter for the esthetic outcome, and it has gained increasing attention in recent years. To achieve a correct mucosa level on the facial aspect, two prerequisites need to be fulfilled: the implant has to be correctly positioned in the orofacial and corono-apical directions, and the mucosa must be supported by a facial bone wall of sufficient height and thickness, because the peri-implant mucosa has a rather constant dimension of 3.5 to 4.5 mm on the facial aspect.

Table 6. PES and WES of 20 Implant-Supported Single Crowns

<table>
<thead>
<tr>
<th>Patient</th>
<th>Implant Site</th>
<th>Mesial Papilla</th>
<th>Distal Papilla</th>
<th>Curvature of Facial Mucosa</th>
<th>Level of Facial Mucosa</th>
<th>Root Convexity, Soft Tissue Color and Texture</th>
<th>Total PES</th>
<th>PES Tooth Form</th>
<th>PES Tooth Volume/Outline</th>
<th>PES Color</th>
<th>PES Surface Texture</th>
<th>PES Translucency</th>
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sites, significant ridge alterations occur on the facial aspect, as documented in experimental and clinical studies. As a consequence, bone-augmentation procedures are most often needed in postextraction sites in the anterior maxilla.

In the present study, the esthetic outcomes on the facial aspect were reflected by high PES values. Of 20 patients, only one (5%) demonstrated minor mucosal recession of 0.5 to 1.0 mm. No severe recession ≥1 mm was observed. These results confirm the favorable results of a retrospective study of 45 patients using the same surgical approach. That study with a 2- to 4-year follow-up also showed a low risk for mucosal recession. Both studies demonstrated that the concept of early implant placement with a simultaneous GBR procedure provides successful bone augmentation on the facial aspect with high predictability.

The applied surgical technique is characterized by the use of non–cross-linked collagen membranes in combination with locally harvested autogenous bone chips and DBBM granules. Although autogenous chips speed up new bone formation at the bone–implant interface as a result of their osteogenic potential, DBBM granules offer good volume stability for contour augmentation because of their low substitution rate. Using this surgical approach, an advantage of predictable contour augmentation with a low-substitution bone filler is a clearly reduced risk for mucosal recession compared to immediate implant placement.

Four recently published studies with immediate implant placement reported a high incidence of mucosal recession (30% to 40%). The investigators discussed potential causes of this esthetic complication, such as a thin gingival biotype; a U-shaped defect morphology, underscoring the importance of preoperative risk assessment and proper case selection; or a facial malpositioning of the implant in

Figure 6.
A through T: Clinical status of all 20 implant restorations at the 12-month follow-up. Note the stability of the facial mucosa. Only one implant showed minor mucosal recession between 0.5 and 1.0 mm.
extractions. Consequently, it is advisable to use immediate implant placement only in well-selected patients with a low risk profile.

Two additional methods were used to evaluate the esthetic outcomes in the present study. One was the measurement of DIM values on the facial aspect of the implant. The implant crown had to be removed at the 12-month examination to directly measure this distance with a periodontal probe. The assessed mean DIM value of −3.53 mm confirmed that the implant shoulders of the 20 implants were located where they were intentionally positioned during surgery. None of the values were −1 mm or even 0 mm. The 12-month DIM values will now be used as baseline, because the measurement will be repeated at annual intervals; the implant crowns will be carefully removed to allow additional direct measurements of DIM. The comparison of DIM values over time will allow the observation of changes in the mucosal margin at the mid-facial aspect.

The third method of esthetic assessment was the measurement of IC and TC on study casts. The comparison of these values at 1, 3, 6, and 12 months showed no significant changes over time. However, these results have to be interpreted with caution because the values at 1, 3, and 6 months were obtained with provisional acrylic crowns, whereas the 12-month examination was made with definitive full-ceramic crowns. In addition, the contralateral tooth received a new crown after the 6-month examination in five of 20 patients to improve the esthetic outcome. However, these IC and TC values will become important between the 1- and 5-year examinations, because no changes in crown shape will occur from this point. The 12-month values will serve as the baseline to objectively assess longitudinal changes of the mucosal margin on the mid-facial aspect.

CONCLUSIONS

In the present study, so-called “bone-level implants” were used that follow the concept of a platform-switching design. This implant design has gained attention in recent years because it is believed to show minimal bone resorption at the crest level during functional loading. The present study confirms this hypothesis, since the 20 implants showed an average bone loss of only 0.18 mm between the day of loading and 12 months of follow-up. Bone loss >0.5 mm was noted for only one implant. This rate of bone loss is much less than the one cited in the retrospective study of 45 implants using the same surgical approach. In that study, standard titanium implants without a platform-switching concept were used, and the mean DIB value was 2.18 mm. However, the 12-month follow-up of the present study represents only a short-term observation period. A longer observation period is required to confirm the superiority of bone-level implants with regard to crestal bone stability.

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