



# Transmucosal Implant Placement with Submarginal Connective Tissue Graft in Area of Shallow Buccal Bone Dehiscence: A Three-Year Follow-Up Case Series



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*The aim of the present case series study was to evaluate the short- and long-term (3 years) soft tissue stability of a surgical technique combining transmucosal implant placement with submarginal connective tissue graft (CTG) in an area of shallow buccal bone dehiscence. A sample of 20 patients were treated by positioning a transmucosal implant in an intercalated edentulous area. A CTG sutured to the inner aspect of the buccal flap was used to cover the shallow buccal bone dehiscence. Clinical evaluations were made at 6 months ( $T_1$ ) and 1 ( $T_2$ ) and 3 ( $T_3$ ) years after the surgery. Statistically significant increases in buccal soft tissue thickness and improvement of vertical soft tissue level were achieved at the  $T_1$ ,  $T_2$ , and  $T_3$  follow-ups. A significant increase in keratinized tissue height was also found at  $T_3$ . No significant marginal bone loss was recorded. The submarginal CTG technique was able to provide simultaneous vertical and horizontal soft tissue increases around single implants with shallow buccal bone dehiscence and no buccal mucosal recession or clinical signs of mucositis or peri-implantitis at 1 and 3 years. Int J Periodontics Restorative Dent 2016;36:621–630. doi: 10.11607/prd.2537*

Dental rehabilitation of partially or totally edentulous patients with oral implants has become a routine treatment modality in recent decades, with reliable long-term results.<sup>1–12</sup> However, unfavorable local conditions of the alveolar ridge due to atrophy, periodontal disease, or trauma sequelae may provide insufficient bone volume, potentially compromising the long-term survival of implants or rendering implant placement inadvisable from a functional and esthetic viewpoint.

In particular, if a horizontal defect is present implant placement may result in a dehiscence or a fenestration defect, exposing part of the implant body. Data reported in the literature seem to demonstrate that guided bone regeneration (GBR) procedures are a reliable means for treating dehiscences and fenestrations created during implant placement. Survival rates of implants placed in sites augmented with GBR are consistent with those reported for implants placed in sites not needing bone augmentation procedures.<sup>13</sup> However, since a marginal bone level change between 1.7 and 2.2 mm can be expected with or without GBR treatment after 5 years,<sup>14</sup> it can be argued that GBR is indeed indicated only when the initial defect size is larger than 2 mm in the vertical dimension. Recent systematic reviews concluded that

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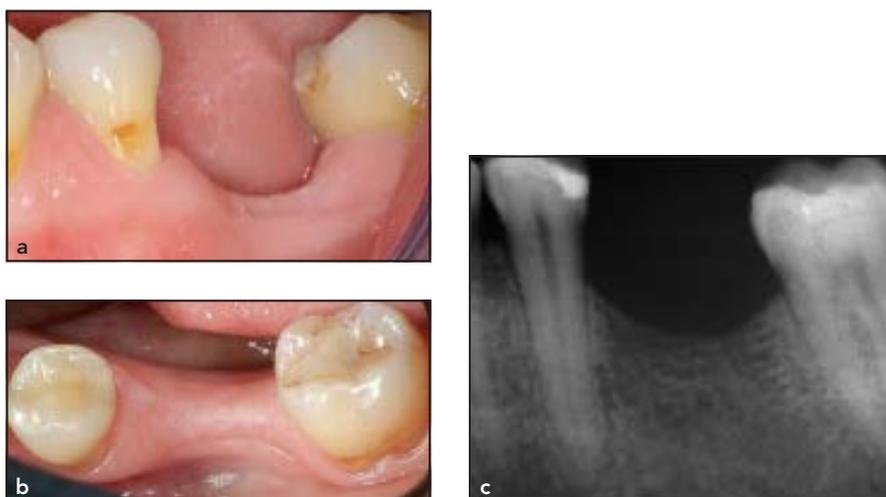
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**Fig 1** Clinical photographs (a,b) and a standardized intraoral radiograph (c) showing the situation at baseline.

there is not enough evidence demonstrating the need to cover fenestration/dehiscences to guarantee a better outcome as far as long-term implant survival is concerned.<sup>15,16</sup> Moreover, from the available literature it can be assumed that most treated buccal bone dehiscences are not completely covered by regenerated bone,<sup>17</sup> even though this does not appear to have a negative effect on long-term survival of the implants. Only one study related the residual buccal bone dehiscence (RBD) to long-term peri-implant health.<sup>18</sup> The author observed that implants exhibiting RBD values > 1 mm were at higher risk of developing peri-implant disease and mucosal recession, which could compromise the overall esthetic outcome of implant therapy.

Crestal bone changes after implant placement were also related to soft tissue thickness.<sup>19</sup> In this

controlled clinical trial, it was concluded that when soft tissue thickness was less than 2.0 mm, crestal bone loss of up to 1.45 mm could be expected. Conversely, in the presence of thicker soft tissues significant marginal bone recession could be avoided if the implant-abutment junction was positioned approximately 2 mm above the bone level.

The positive effect of the soft tissue thickness raises a question as to whether it is indicated to preventively increase the thickness of the buccal mucosa at dehiscenced implant sites to reduce the risk of mucosal recession and crestal bone loss.

The aim of the present case series study was to evaluate short- and long-term (3 years) soft tissue stability after a surgical technique combining transmucosal implant placement with submarginal connective tissue graft (CTG) in an area of shallow buccal bone dehiscence.

## Materials and methods

A sample of 20 subjects (8 men and 12 women) were selected among individuals referred to the dental clinic at Bologna University. The study protocol and informed consent were in full accordance with the ethical principles of the Declaration of Helsinki of 1975, as revisited in 2000.

All participants were aged > 18 years and periodontally and generally healthy, had no medical contraindication for implant surgery, and were nonsmokers. All patients presented with an intercalated edentulous area (one missing tooth) distal to the canine in the maxilla or mandible, at least 4 mm of bone width, and 10 mm of bone height measured by cone beam computerized tomography (CBCT) and had healthy soft tissue (bleeding on probing [BOP] < 15%; Plaque Index [PI] < 15%), a minimum of 2 mm keratinized gingiva at the edentulous area, and no previous bone augmentation procedures (Fig 1).<sup>20-23</sup>

### Implant selection

All patients received one Straumann Standard Plus transmucosal implant of 10-mm length and a diameter of 3.3 mm for replacing premolars and 4.1 mm for replacing molars.

### Initial therapy and clinical measurements

All patients received a session of prophylaxis to remove microbial deposits with an ultrasonic instrument,

a rubber cup, and a low-abrasive polishing paste, and were instructed in proper oral hygiene measures. Full-mouth and local plaque and bleeding scores (FMPS and FMBS) were recorded as a percentage of total surfaces (four per tooth), which revealed the presence of plaque<sup>24</sup> and bleeding, respectively.

All measurements were carried out by a single masked examiner (M.M.), who did not perform the surgeries.

The following clinical measurement was taken before surgery ( $T_b$ ):

- Vertical soft tissue level (VSTL). In all patients, a resin stent extended to the occlusal surfaces of teeth adjacent to the edentulous ridge was prepared. A reference point (slot) was impressed on the stent at the midbuccal area of the implant site to allow reproducible periodontal probe positioning. The VSTL was measured as the distance from the most apical extension of the edentulous area to the reference point of the stent (SRP).

The following clinical measurements were taken during surgery ( $T_o$ ):

- Soft tissue thickness (STT), measured 2 mm apical to the line of the crestal incision with a caliper accurate to the nearest 0.1 mm<sup>25</sup>
- Keratinized tissue height (KTH), measured from the line of the crestal incision to the mucogingival line, identified with Lugol stain

- Bone dehiscence (BD), measured as the linear distance from the most apical extension of the transmucosal implant collar to the most apical extension of the buccal bone crest
- Graft thickness (GT), measured with a caliper accurate to the nearest 0.1 mm<sup>25</sup>

The following clinical measurement was taken at the end of the surgery ( $T_a$ ):

- VSTL as the distance from the buccal soft tissue margin to the SRP

The following clinical measurements were made at the time of the final restoration (6 months after implant placement) ( $T_1$ ) and 1 ( $T_2$ ) and 3 years ( $T_3$ ) after the final restoration:

- VSTL, measured at  $T_1$ , immediately before definitive crown placement, and at  $T_2$  and  $T_3$  after removal of the crown.
- Probing pocket depth (PPD), measured from the buccal soft tissue margin to the tip of the probe inserted in the sulcus.
- Clinical attachment level (CAL), measured from the SRP to the tip of the probe inserted in the sulcus.
- KTH, measured from the buccal soft tissue margin to the mucogingival line.
- Presence of peri-implant disease, assessed as follows:<sup>18</sup>
- Peri-implant mucositis: positive BOP and PPD < 5 mm

- Peri-implantitis: positive BOP with or without pus formation and PPD > 5 mm
- STT, measured 2 mm apical to the gingival margin with a short needle for anesthesia with a silicon disk stop. The penetration depth was measured with a caliper accurate to the nearest 0.1 mm.<sup>25</sup>

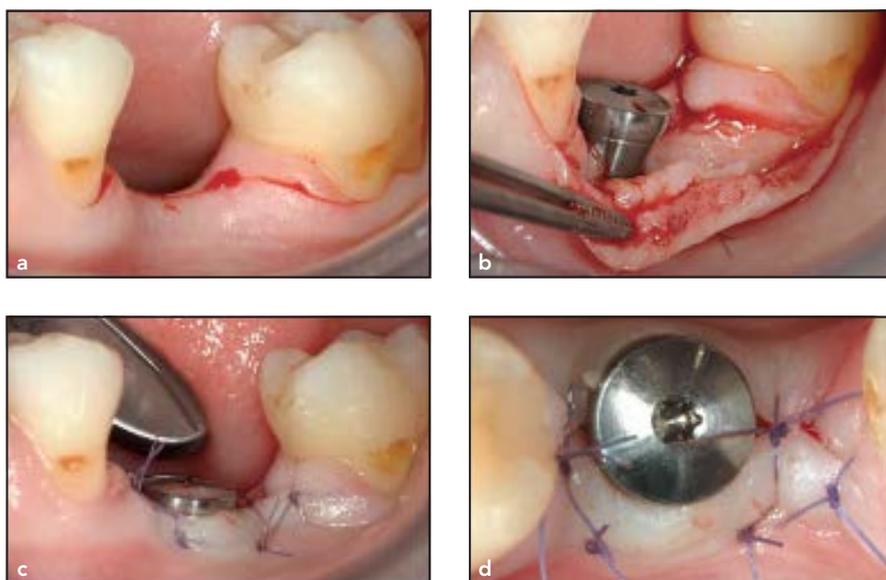
All measurements were performed using a manual probe (PCP UNC 15, Hu-Friedy) (with the exception of STT, as noted above) and were rounded to the nearest millimeter.

#### *Radiographic examination*

Standardized intraoral radiographs were performed for each patient at  $T_a$ ,  $T_o$ ,  $T_1$ ,  $T_2$ , and  $T_3$ . Paralleling technique with a Rinn film holder was used for radiographic examination. The images were obtained in such a way that the implant-abutment interface and the threads would be clearly visible. Crestal bone level changes were calculated with a dedicated software (Instrumentarium Dental, CLINIVIEW), calibrated by using the implant diameter as a reference point.

#### *Surgical technique*

A midcrestal incision of the edentulous ridge was performed with two short mesial and distal releasing incisions to preserve the adjacent interdental tissue. The buccal flap was elevated full thickness beyond the



**Fig 2** Surgical technique. (a) Midcrestal incision. (b) After implant placement, a CTG was sutured at the inner surface of the buccal flap, 1 mm apical to the flap KT margin (submarginal CTG). (c) The buccal flap was coronally advanced, and the flap KT was tightly adapted to the 2-mm-high healing cap with sling suture. (d) Interrupted sutures were used to accomplish, as much as possible, primary intention wound healing between the transmucosal portion of the implant and the adjacent teeth.

mucogingival line to completely expose the buccal bone. The palatal/lingual flap was raised minimally to provide access to the implant site. The site was prepared using traditional burs. During the preparation of the implant site, special care was taken to preserve at least 1 mm of lingual/palatal bone. Implants were positioned with the transmucosal collar above the crestal bone, and 2-mm-high healing caps were placed. A CTG resulting from the extraoral de-epithelialization with the knife blade of a free gingival graft harvested from the palate was sutured, with two horizontal mattress sutures, at the inner surface of the buccal flap, 1 mm apical to the flap KT margin (submarginal CTG). The mesiodistal length of the CTG was 6 mm greater than the diameter of the implant, and the apicocoronal dimension was chosen to cover the transmucosal

portion of the implant, the implant exposure, and 2 mm of bone apical to the buccal BD. The buccal flap was coronally advanced by means of periosteal and muscle incisions, and the flap KT was tightly adapted to the 2-mm-high healing cap with sling suture. Interrupted sutures were used to accomplish, as much as possible, primary intention wound healing between the transmucosal portion of the implant and the adjacent teeth (Fig 2).

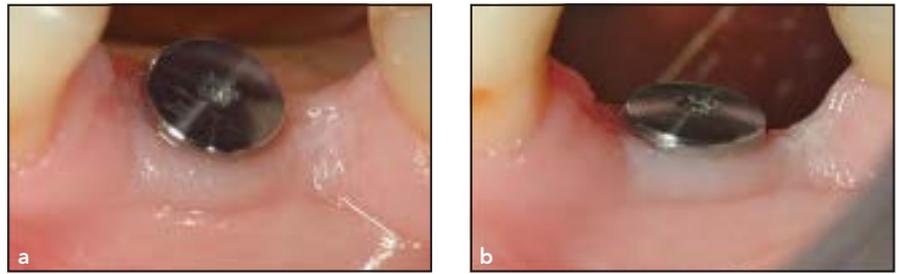
#### *Postsurgical instructions and infection control*

Patients received a prophylactic dose of 2 g amoxicillin plus clavulanic acid 1 hour before the surgery.

An anti-inflammatory drug (ibuprofen) was prescribed the day of surgery and only if necessary afterward. Patients were instructed not to

brush the treated area, but to rinse for 1 minute with a 0.12% chlorhexidine solution three times a day. Two weeks after the surgical treatment, the sutures were removed. Plaque control in the surgically treated area was maintained by rinsing with chlorhexidine for 2 weeks after suture removal. Patients were again instructed to clean the teeth in the treated area with an ultrasoft toothbrush and a roll technique for 1 month and to rinse with chlorhexidine twice a day. Then patients were instructed to use a soft toothbrush and rinse with chlorhexidine once a day for another month. When chlorhexidine was discontinued, full mechanical interproximal cleaning in the surgical area was reinstated. The patients were recalled for prophylaxis every 2 weeks after suture removal for the first 2 months and subsequently once a month until the final restoration.

**Fig 3** Clinical photographs taken 1 month after surgery. Note the minimal postsurgical horizontal (a) and vertical (b) soft tissue shrinkage.



**Table 1** Descriptive statistics

| Parameter (mm) | T <sub>b</sub> (mean ± SD) | T <sub>0</sub> (mean ± SD) | T <sub>a</sub> (mean ± SD) | T <sub>1</sub> (mean ± SD) | T <sub>2</sub> (mean ± SD) | T <sub>3</sub> (mean ± SD) |
|----------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| VSTL           | 13.75 ± 1.02               | NM                         | 10.65 ± 0.93               | 10.55 ± 0.69               | 10.25 ± 0.64               | 9.8 ± 0.77                 |
| BD             | NM                         | 1.5 ± 0.51                 | NM                         | NM                         | NM                         | NM                         |
| PPD            | NM                         | NM                         | NM                         | 2.45 ± 0.51                | 2.7 ± 0.47                 | 2.6 ± 0.50                 |
| CAL            | NM                         | NM                         | NM                         | 13.00 ± 0.97               | 12.95 ± 0.76               | 12.40 ± 0.88               |
| KTH            | NM                         | 2.25 ± 0.72                | NM                         | 2.60 ± 0.60                | 2.80 ± 0.70                | 3.05 ± 0.76                |
| STT            | NM                         | 1.04 ± 0.16                | NM                         | 2.29 ± 0.17                | 2.61 ± 0.24                | 2.73 ± 0.25                |
| GT             | NM                         | 1.33 ± 0.12                | NM                         | NM                         | NM                         | NM                         |
| MBL-M          | NM                         | 2.48 ± 0.32                | NM                         | 2.51 ± 0.35                | 2.62 ± 0.35                | 2.69 ± 0.33                |
| MBL-D          | NM                         | 2.48 ± 0.29                | NM                         | 2.54 ± 0.27                | 2.62 ± 0.26                | 2.68 ± 0.27                |

T<sub>b</sub> = before surgery; T<sub>0</sub> = during surgery; T<sub>a</sub> = after surgery; T<sub>1</sub> = prosthesis delivery; T<sub>2</sub> = 1-year follow-up; T<sub>3</sub> = 3-year follow-up; VSTL = vertical soft tissue level; BD = bone dehiscence; PPD = pocket probing depth; CAL = clinical attachment level; KTH = keratinized tissue height; STT = soft tissue thickness; GT = graft thickness; MBL = marginal bone level (mesial and distal); NM = not measured.

### Prosthetic phase

Six months after surgery, a final impression was taken and the resulting cast was used for final crown design. A metal-ceramic crown was used to rehabilitate the implants.

### Statistical analysis

The statistical analysis was performed using statistical application software (Small Stata version 12.0, Statacorp). Descriptive evaluation of all variables was recorded as mean ± SD. Statis-

tically significant differences regarding VSTL, PPD, CAL, KTH, and STT among groups were determined by one-way analysis of variance (ANOVA). When a significant difference between groups was found, a post hoc analysis with Bonferroni test was performed. A significance level of .05 was chosen for all tests.

### Results

Following the initial oral hygiene phase and post-treatment examinations, all subjects showed a good

standard of supragingival plaque control (FMPS < 15%, FMBS < 15%). Healing was uneventful for all treated test cases (Fig 3). No implant sites showed signs of peri-implantitis or mucositis.

The descriptive statistics for the clinical parameters measured at T<sub>b</sub>, T<sub>a</sub>, T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> are shown in Table 1. Statistically significant differences are shown in Table 2.

For VSTL, significant decreases were observed between T<sub>b</sub> and T<sub>a</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> (*P* < .01); between T<sub>a</sub> and T<sub>3</sub> (*P* < .05); and between T<sub>1</sub> and T<sub>3</sub> (*P* < .05). No significant



**Fig 4** Clinical photographs taken at 1 year (a, c) and 3 years (b, d) after implant placement.



**Fig 5** Standardized intraoral radiographs taken (a) before definitive crown placement (6 months after implant placement), (b) at the 1-year follow-up recall visit, and (c) at the 3-year follow-up recall visit. Note the minimal amount of marginal bone loss.

| <b>Table 2</b> |                      | <b>Statistically significant parameters between times</b> |                      |                      |  |
|----------------|----------------------|---|----------------------|----------------------|--|
|                | <b>T<sub>b</sub></b> | <b>T<sub>0</sub></b>                                      | <b>T<sub>a</sub></b> | <b>T<sub>1</sub></b> |  |
| T <sub>a</sub> | VSTL                 |   |                      |                      |  |
| T <sub>1</sub> | VSTL                 | STT   |                      |                      |  |
| T <sub>2</sub> | VSTL                 | STT   |                      | STT                  |  |
| T <sub>3</sub> | VSTL                 | KTH, STT  | VSTL                 | VSTL, STT            |  |

T<sub>b</sub> = before surgery; T<sub>0</sub> = during surgery; T<sub>a</sub> = after surgery; T<sub>1</sub> = prosthesis delivery; T<sub>2</sub> = 1-year follow-up; T<sub>3</sub> = 3-year follow-up; VSTL = vertical soft tissue level; KTH = keratinized tissue height; STT = soft tissue thickness.

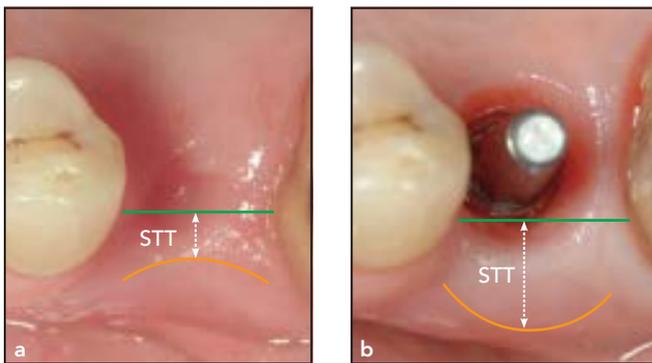
differences between T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> were found for PD or CAL. For KTH, significant increases were observed between T<sub>0</sub> and T<sub>3</sub> ( $P < .05$ ). For STT, significant increases were observed between T<sub>0</sub> and T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> ( $P < .01$ ) and between T<sub>1</sub> and T<sub>2</sub> and T<sub>3</sub> ( $P < .01$ ). For MBL, no significant differences were found between T<sub>0</sub> and T<sub>1</sub>, T<sub>2</sub>, or T<sub>3</sub> ( $P < .01$ ).



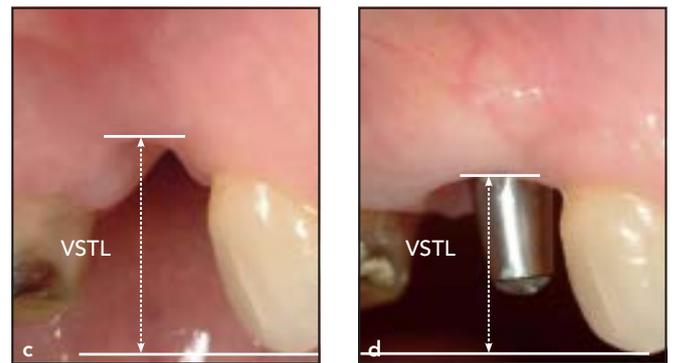
**Fig 6** Buccal view of a second clinical case showing the difference in VSTL: (a) baseline, (b) at 1 year, and (c) at 3 years.



**Fig 7** Occlusal view of the second clinical case showing the increase in STT at (a) baseline, (b) 1 year, and (c) 3 years.



**Fig 8** Occlusal views of the second case at baseline (a) and 3 years (b) showing the increase in STT.



**Fig 9** Buccal views of the second case at baseline (a) and 3 years (b) showing the difference in VSTL.

Clinical and radiologic outcomes at 1 and 3 years of one of the treated cases are shown in Figs 4 and 5, respectively. A comparison between the baseline situation and clinical outcomes at 1 and 3 years of a second case are shown in Figs 6 to 9.

## Discussion

The results of this study showed that the proposed surgical approach combining transmucosal implant placement with submarginal CTG covering shallow buccal bone dehiscences was able to provide successful long-term (3 years) results in terms of marginal soft tissue stability and peri-im-

plant health, with no signs of peri-implantitis or mucositis.

Regarding the esthetics of the rehabilitation, buccal bone dehiscences should be covered for at least three reasons: (1) soft tissue recession at the buccal aspect, leading to exposure of implant threads; (2) gray areas on soft tissues overlying the dehiscence, especially in patients with thin peri-implant tissues,

due to the transparency of the mucosa; and (3) flattened aspect of the alveolar ridge in the buccal side due to the horizontal defect.<sup>15</sup>

The capability of connective tissue to firmly attach to the titanium with fibers running parallel to the surface and the efficacy of this connective tissue attachment in preventing subgingival plaque accumulation are both well documented in the literature.<sup>26</sup> Furthermore, it has been demonstrated that the type of connective tissue graft used in the present study, deriving from the extraoral disepithelization of a free gingival graft, is more stable and less prone to resorption than one taken with connective tissue harvesting techniques. This was attributed to the better quality of the dense collagen-rich subepithelium palatal connective tissue compared with that closer to the palatal bone, which is richer in fatty and glandular tissue.<sup>25</sup>

The importance of increasing buccal soft tissue thickness to prevent gingival recession and colored transparency and the capability of surgical soft tissue augmentation procedures to give the prosthetic crown a natural esthetic emergence profile has been well documented.<sup>27</sup> In the present study, together with a significant STT increase, a significant decrease in VSTL corresponding to a clinical vertical soft tissue augmentation was observed. This allowed the soft tissue margin of the final prosthetic crown to be positioned more coronally (about 3 mm in mean value) with respect to the baseline soft tissue level of the edentulous area. A simultaneous

vertical and horizontal soft tissue augmentation was not previously reported in studies analyzing horizontal bone augmentation procedure and must be interpreted as an esthetic advantage of the proposed surgical technique. The vertical soft tissue augmentation could be explained by the capability of CTG to prevent coronally advanced flap (CAF) shrinkage.<sup>28,29</sup> In the present surgical technique the submarginal positioning of the CTG, 1 mm more apical than the flap KT margin, and the coronal advancement of the flap could explain the minimum postsurgical soft tissue shrinkage. This has been confirmed by the data of the present study showing no statistically significant differences between VSTL at the end of the surgery and 6 months later, at the final rehabilitation. In the present study, both the buccal soft tissue thickness and the vertical soft tissue augmentation continued after the 1-year follow-up. This could be attributed to the so-called creeping phenomena, which is the tendency of the thickened soft tissue to migrate coronally.

The ability of the bilaminar technique to obtain simultaneous horizontal and vertical soft tissue augmentation was reported in a study on the treatment of single implants with buccal soft tissue dehiscence.<sup>30</sup> In this pilot study the same type of disepithelized CTG was applied submarginally, compared with the CAF tightly adapted to the smooth surface of the implant abutment, which was reduced 1 month before the surgery. Great increase in buccal soft tissue thickness and

complete coverage at the level of the homologous contralateral natural tooth was achieved in 75% of the treated defects.

The use of transmucosal implants seems to be critical to the success of the proposed surgical technique and for the maintenance phase. From a surgical standpoint, it allowed adaptation of both the CTG and the CAF to a hard and smooth surface in a more coronal position compared with the bone crest. This would have been theoretically possible even with the use of a bone-level implant and a higher healing cap. However, in the latter case the implant-abutment connection would have been more subgingival after healing and thus more difficult for the patient and dental hygienist to clean and more susceptible to infection. Furthermore, Linkevicius et al<sup>19</sup> demonstrated that greater bone loss can be expected in the presence of naturally thin soft tissue (< 2 mm) and that marginal bone loss can be almost completely avoided if the implant-abutment junction is positioned above the bone level and the soft tissue is naturally thick (> 2 mm) or thickened by means of surgical soft tissue augmentation procedures. In the present study, 3 years after the surgery no clinical signs of peri-implant mucositis or perimplantitis were recorded in any treated implant sites. In the present study, baseline and follow-up radiographs were obtained using a parallel technique with a Rinn film holder, and individual silicone/resin devices were not constructed. A similar approach was used in prior

prospective clinical studies<sup>19,31</sup> and can be considered adequate for bone loss measurements. Although some limitations in this method to compare radiographs cannot be excluded, the amount of mesial and distal bone loss over the 3 years is similar to that reported by Linkevicius et al<sup>19</sup> and less than the one reported in the literature for successful bone level implants.<sup>32,33</sup>

In most of the clinical cases in the present study, especially those with less baseline KTH, the bone dehiscence was covered by the alveolar mucosa. Thus, it seemed rational to increase the thickness of the alveolar mucosa by placing a submarginal CTG to prevent soft tissue recession or transparency of the gray area. The increase in buccal soft tissue thickness was not associated with an equal increase in KTH, especially at 6 months and 1 year. This is only an apparent discrepancy because the increase in KTH due to graft application can remain completely undetectable if there is no dehiscence of the covering flap. It can be speculated that some increase in gingival thickness did not become increase in KTH because the graft remained covered by the alveolar mucosa of the covering flap. Conversely, this allowed for a reduction in graft resorption and improved esthetic outcomes that could be jeopardized by the white-scar appearance of the exposed graft. Different from the 1-year outcome, the increase in KTH became statistically significant after 3 years. The same long-term results had already been reported after CAF for the treatment of gingival recession and were ascribed to the

tendency of the mucogingival line to regain its genetically determined position.<sup>34</sup> The increase in KTH with time further improved the esthetic camouflaging of the surgically treated area compared with the adjacent soft tissue and facilitated long-term patient plaque control. Longer-term data are recommended to evaluate and compare the stability of peri-implant soft tissue in cases where an increase in buccal soft tissue thickness has been recorded with no or minor increase in KTH, and vice versa.

## Conclusions

The results of a case report study should always be interpreted with caution, and randomized controlled clinical trials in which bone augmentation procedures are compared with submarginal CTG are recommended. Nevertheless, within the limits of the present case series study the following conclusions can be drawn:

- The transmucosal implant placement with submarginal CTG technique was able to provide simultaneous increase in buccal soft tissue thickness and improvement in vertical soft tissue level around a single implant with a shallow (< 3 mm) buccal bone dehiscence.
- These successful results were achieved with no buccal mucosal recession or clinical signs of mucositis or peri-implantitis at either the 1-year or the 3-year follow-up.

- The augmented buccal soft tissue thickness together with the transmucosal implant placement minimized the marginal bone loss.

## Acknowledgments

The authors reported no conflicts of interest related to this study.

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