

Vertical soft tissue augmentation to treat implant esthetic complications: A prospective clinical and volumetric case series

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Supplementary Appendix

Clinical measurements

A calibrated examiner collected the following measurements at the pre-surgical visit and 1 year follow-up using a periodontal probe (PCP UNC 15, Hu-Friedy, Chicago, IL, USA), rounding down to the nearest 0.5 mm:

- Peri-implant soft tissue dehiscence depth (PSTD depth): depth of the soft tissue dehiscence measured in a corono-apical direction, from the peri-implant soft tissue margin to the ideal position of the soft tissue margin, which is determined using the gingival margin of the contralateral homologous natural tooth as a reference ¹.

The Mean PSTD coverage at 1 year was calculated using the following formula ^{2,3}:

$$\text{mean PSTD coverage (\%)} = \frac{(\text{PSTD depth at baseline in mm}) - (\text{PSTD depth at 1 year in mm})}{\text{PSTD depth at baseline in mm}} \times 100$$

- Probing depth (PD): recorded on the mesio-, mid- and disto-facial aspect of the implant site and adjacent teeth.
- Recession (REC) depth: apical shift of the gingival margin from the CEJ at the midfacial aspect of the teeth adjacent to the implant with PSTD. Rec depth was recorded at the mesio-, mid- and disto-facial of the adjacent dentition using customized stents.
- Clinical attachment level (CAL): recorded on the mesio-, mid- and disto-facial aspect of the implant site and adjacent teeth using customized stents.
- Keratinized mucosa width (KMW): amount of keratinized mucosa measured at the midfacial aspect of the implant site.
- Attached mucosa width (AMW): amount of KMW that is attached at the implant site, calculated with the following formula:
AMW= KMW – PD.
- Keratinized gingiva width (KGW): amount of keratinized gingiva measured at the midfacial aspect of the mesial and distal dentition.

Mucosal thickness (MT): measured 1.5 mm apical to the soft tissue margin of the implant site using a short injection needle for anesthesia and a silicon disk stop, which was then fixed with a few drops of cyanoacrylate as described by Zucchelli and coworkers ⁴. After needle removal, the distance between the tip of the needle and the disk stop was measured with a digital caliper with 0.01 mm accuracy.

Esthetic assessment

The esthetic outcomes of PSTD treatment was evaluated by a calibrated examiner at the last follow-up visit using an esthetic score specifically introduced for the treatment of PSTDs (Implant soft tissue Dehiscence/deficiency coverage Esthetic Score [IDES])⁵. The IDES incorporates the evaluation of the level of the soft tissue margin, the height of the peri-implant papillae, the color of the peri-implant mucosa and its appearance. The criteria for grading each parameter of the IDES are reported in the table below:

Peri-Implant soft tissue Dehiscence coverage Esthetic Score (IDES)		
Parameter (points)	Condition at least 6 months after treatment	Assigned points
Soft Tissue Margin (STM) (0-5)	No improvement of the PSTD	0
	Partial coverage of the PSTD but the metallic components are still visible	1
	Complete coverage of the metallic components (or abutment) only, but the implant-supported crown is still longer than the homologous tooth	2
	Complete coverage of the metallic components with the mucosal margin at the same level of the homologous tooth	5
Peri-implant papillae height (PPH) (0-3)	Both papillae are more apical than the healthiest papilla tip of the homologous tooth	0
	Only one papilla is at the same level (or more coronal) of the healthiest papilla tip of the homologous tooth	1
	Both papillae are at the same level (or more coronal) of the healthiest papilla tip of the homologous tooth	3
Peri-implant Mucosa Color (PMC) (0-1)	Distinguishable from the adjacent soft tissue	0
	Not distinguishable from the adjacent soft tissue	1
Peri-implant Mucosa Appearance (PMA) (0-1)	Presence of at least one of these conditions: scar tissue, MGJ not-aligned, tissue volume too thin or too thick compared to the adjacent soft tissue or tissue texture not similar to the adjacent soft tissue	0
	Absence of scar tissue, MGJ well aligned, tissue volume in line with the adjacent soft tissue or tissue texture similar to the adjacent soft tissue	1

Patient-reported outcome measures (PROMs)

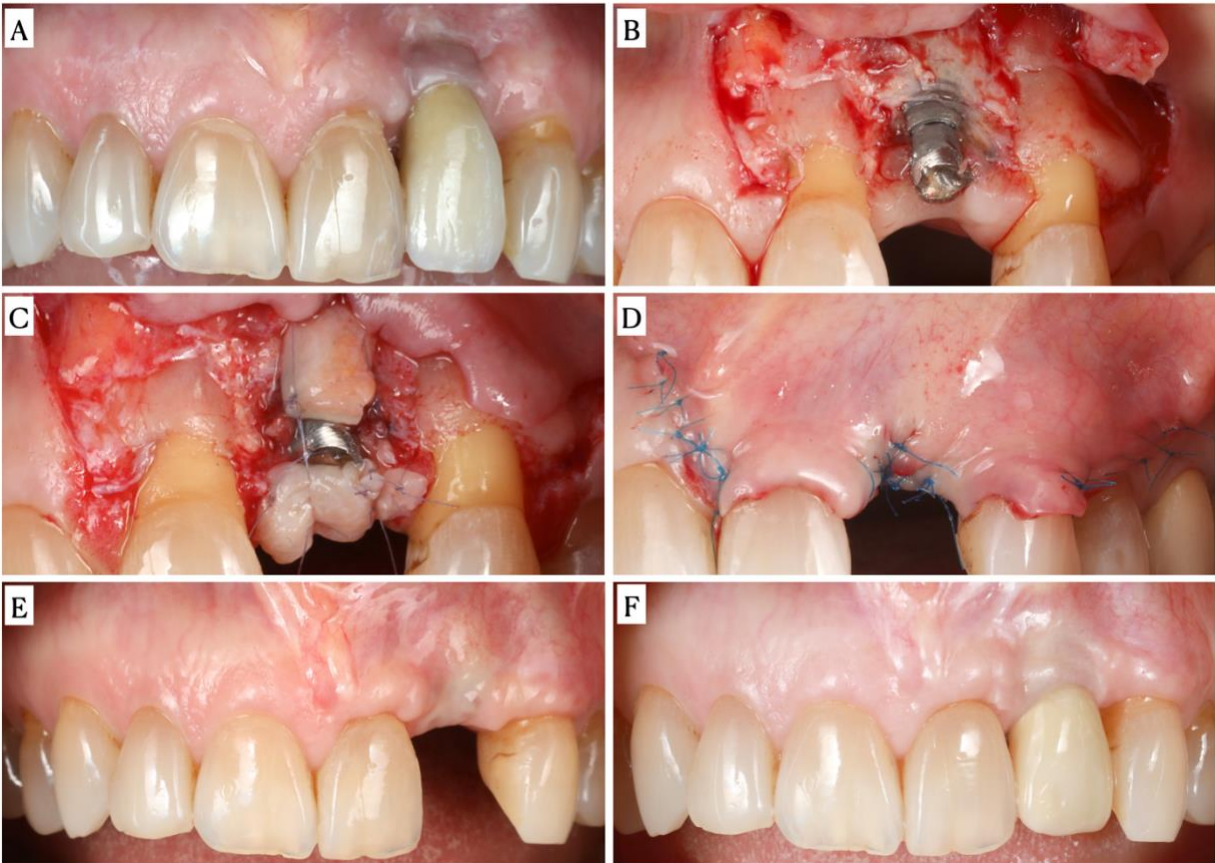
Patients were asked to record the perceived post-operative discomfort/pain using a questionnaire with 0-10 visual analogue scales (VASs) for the first 14 post-surgical days. At the 1-year follow-up patients were given a questionnaire with a 0-10 VAS for grading the esthetic outcomes at the treated implant site. In addition, subjects were also asked whether they would be willing to redo the same procedure, if necessary. The questionnaire included only “yes” and “no” as possible answers.

Supplementary Table 1. Results of the regression analysis for exploring factors related to the final outcome of mean PSTD coverage (in %) after 1 year.

Factor	Model Estimate	Confidence Intervals [lower bound, upper bound]	P-value
Age	-0.95	[-1.94, 0.04]	0.052
Sex (Male)	-35.9	[-53.50, -18.31]	<0.01
PSTD depth at baseline	10.67	[-12.41, 33.75]	0.38
KMW at baseline	0.15	[-19.11, 19.42]	0.98
AM at baseline	8.69	[-19.55, 36.93]	0.55
MT at baseline	-0.41	[-123.6, 122.83]	0.99
PSTD Class	12.68	[-21.65, 46.92]	0.48

Legend. AM: attached mucosa. BL: baseline. KMW: keratinized mucosa width. MT: mucosal thickness. PSTD: peri-implant soft tissue dehiscence. SD: standard deviation.

Supplementary Figure 1. Vertical soft tissue augmentation on a maxillary lateral incisor. A) Baseline. B) Flap design and elevation. C) One connective tissue graft was sutured on the buccal aspect over the implant fixture, while the other connective tissue graft was sutured over the implant platform and the de-epithelialized occlusal ridge. D) Flap advancement and closure. E) Outcomes at 3 months. F) Outcomes at 12 months.



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