Journal of Esthetic and Restorative Dentistry

WILEY

CLINICAL ARTICLE

Dual-Hybrid Treatment Approach for Peri-Implant Hard and Soft Tissue Stability

German O. Gallucci[1] | Lorenzo Tavelli[2] | Daniel Buser[3,4] | Ignacio Pedrinaci[1,5] | Ronald E. Jung[6] | Kevser Pala[1,6]

[1]Department of Restorative Dentistry and Biomaterials Sciences, Harvard School of Dental Medicine, Boston, Massachusetts, USA | [2]Department of Oral Medicine, Infection, and Immunity, Division of Periodontology, Harvard School of Dental Medicine, Boston, Massachusetts, USA | [3]School of Dental Medicine, University of Bern, Bern, Switzerland | [4]Centre for Implantology Buser & Frei, Bern, Switzerland | [5]Section of Graduate Periodontology, School of Dentistry, Complutense University, Madrid, Spain | [6]Clinic of Reconstructive Dentistry, Center for Dental Medicine, University of Zurich, Zurich, Switzerland

Correspondence: Kevser Pala (palakevser@gmail.com)

Received: 8 January 2026 | **Revised:** 23 April 2026 | **Accepted:** 1 May 2026

Keywords: case reports | dental implant platform switching | dental implant–abutment connection | dental implant–abutment design | dental implant–abutment interface | dual hybrid

ABSTRACT

Objective: Long-term stability of peri-implant hard and soft tissues is a primary goal of implant treatment. Studies have shown that peri-implant tissue stability is influenced by factors such as the implant characteristics, implant-abutment interface, abutment type/length, and prosthetic design. To enhance tissue stability while offering clinical versatility, this case report utilizes a dual-hybrid approach. This combines (1) a hybrid implant surface design, combining a micro-rough and machined surface, and (2) a hybrid connection where one implant connection allows for two different implant-abutment interfaces (matching platform/non-matching with platform switching).

Clinical Considerations: A patient presented with two posterior teeth deemed "hopeless" due to periodontal and endodontic pathologies. Following extractions, immediate implant placements were performed. Tissue-level implants were placed subcrestally and restored with non-matching abutments. The 3-year follow-up examination showed stable marginal bone levels maintained at the implant shoulder.

Conclusions: This dual-hybrid approach represents an alternative strategy for supporting peri-implant tissue stability. It underscores the importance of versatile implant-abutment connections that preserve tissues while allowing future restorative modifications without compromising the implant. This method retains the option to transition to a matching abutment if clinically indicated in the future, for example if any pathologies lead to changes in the peri-implant tissue levels.

Clinical Significance: The presented dual-hybrid approach represents a treatment strategy designed to support peri-implant tissue stability while maintaining the flexibility to transition to a matching abutment when clinically indicated. Given the prevalence of peri-implantitis reported in the literature, treatment concepts that not only aim to reduce the risk of disease onset but also facilitate effective reintervention without compromising the implant are of critical importance.

1 | Introduction

The primary objective of implant treatment is to achieve long-term peri-implant hard and soft tissue health and stability [1, 2]. Over the past decade, the impact of various factors, including implant micro-configurations, surface modifications, implant placement depth, connection types, abutment type/length, soft tissue thickness, keratinized tissue, and prosthetic design on the peri-implant tissues have been investigated [3–20].

The influence of implant surface characteristics on peri-implant hard tissue response has been extensively investigated [21–25]. In this context, hybrid implants, incorporating both micro-rough and machined surfaces in the infrabony part of the implant, were developed to address concerns related to marginal bone stability and peri-implant health [26–28]. The rationale for this design was based on the suggestion that lower bacterial adhesion was exhibited at the machined part of these implants [29]. Investigations stated that, although hybrid implants may limit bacterial colonization at the machined coronal surface, this effect may be accompanied by reduced osteoblastic activity in that region [30]. Nevertheless, stable marginale bone levels have been reported for hybrid implants [31]. Overall, literature provides heterogeneous findings regarding the biological and clinical implications of hybrid implants. Clinical studies comparing hybrid and micro-rough surfaces showed no significant differences in radiographic, clinical, microbiological characteristics and in the risk of peri-implantitis [32, 33]. Additionally, a study evaluating different implant surfaces in the transmucosal portion of the implants reported comparable progression of experimental mucositis between surface types [34]. However, it has been stated that exposed micro-rough surfaces could hinder effective plaque removal [35], and untreated peri-implantitis has been shown to progress more rapidly on moderately rough surfaces than on polished surfaces [36]. These observations suggest that exposure of micro-rough surfaces may increase susceptibility to peri-implant diseases.

Furthermore, various aspects of the selected abutments were discussed in the literature with regards to their impact on peri-implant tissues [37–43]. The influence of connection types and connection stability on peri-implant tissues has been assessed in previous studies [37, 38]. Traditionally, soft tissue level implants were exclusively restored with abutment types matching the diameter of the implant—the so-called matching connection. The introduction of dental implants that share the same connection across bone- and tissue-level implant designs enabled multiple options for implant-supported restorations. Thus, non-matching abutment types could be used to restore soft-tissue level implants (Figure 1).

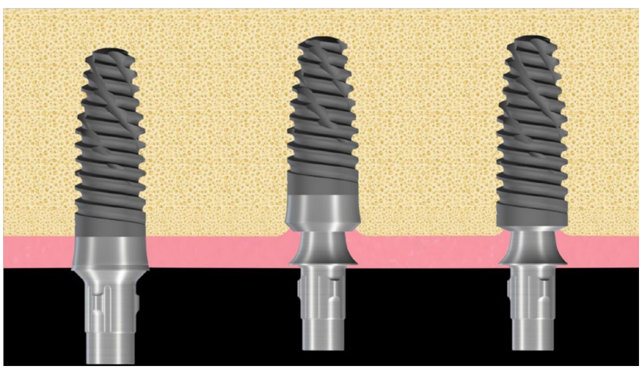

FIGURE 1 | From left to right: Tissue level implant placed with machined/rough-transition at the bone level and restored with a matching abutment; tissue level implant placed subcrestally and restored with a non-matching abutment (double hybrid); bone level implant placed subcrestally restored with a non-matching abutment.

The aim of this case report is to present a dual-hybrid method describing the incorporation of a hybrid approach in two aspects of the implant-prosthetic treatment: (1) a hybrid design on the implant surface, combining a micro-rough and machined surface, and (2) a hybrid connection where one implant connection allows for two different implant-abutment interfaces (matching/non-matching).

In addition, in the presented case example, the peri-implant tissue response was assessed at 2 years using cone beam computed tomography (CBCT) and ultrasonography and at 3 years using CBCT.

2 | Clinical Considerations

2.1 | Patient Information, Clinical Findings, Diagnostic Assessment, and Treatment Plan

Patient consent: Written informed consent was obtained prior to treatment.

A healthy 67-year-old adult female presented with localized inflamed gingiva, circumferential bone loss, deep probing pocket depth, bleeding on probing, and mobility grade 2 (Miller classification) at the upper right first molar and second premolar. The radiographic evaluation using CBCT revealed that booth teeth presented with radiologically insufficient root canal treatments, periapical radiolucency and attachment loss (Figures 2 and 3). Upper right first molar and second premolar were deemed hopeless. Consequently, the treatment plan included extraction and tooth replacement using implant-supported fixed dental prosthesis with an immediate placement and delayed loading protocol (1C).

2.2 | Therapeutic Intervention

2.2.1 | Surgical Phase

The procedure was performed under local anesthesia (lidocaine 2% with epinephrine 1:100′000). The upper right second premolar and first molar were extracted in the least traumatic

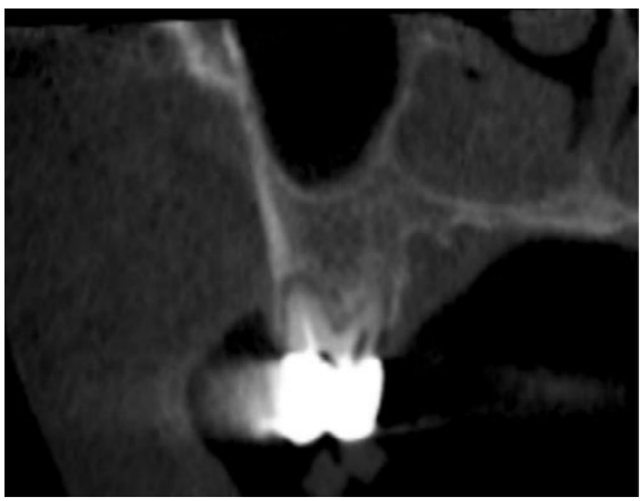

FIGURE 2 | Initial CBCT of the upper right first molar.

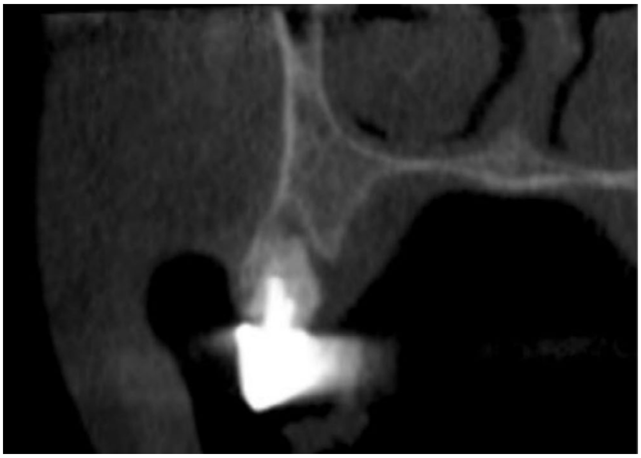

FIGURE 3 | Initial CBCT showing the upper right second premolar.

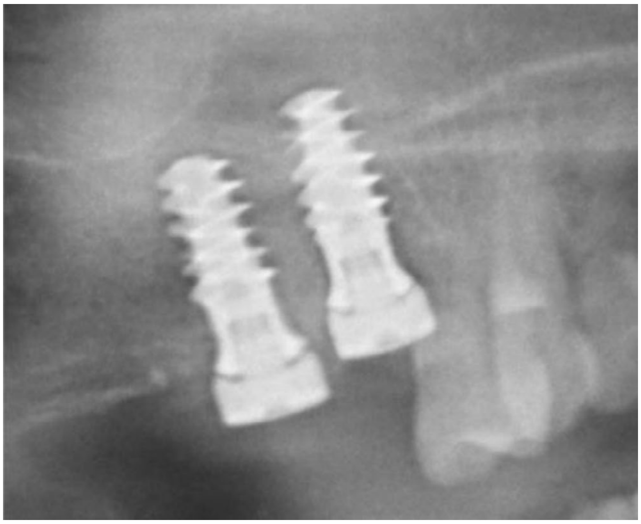

FIGURE 4 | Panoramic radiograph after implant placement.

manner, preserving the surrounding soft and hard tissues. The sockets were debrided using a curette to remove remnants of ligaments and/or granulation tissues. The osteotomy was performed following a non-guided computer-assisted implant surgery [44], and two one-piece soft-tissue level implants with a 1.8 mm smooth neck height (Straumann TLX SP Implant Study; Straumann AG) were placed subcrestally using a 1-C placement and loading protocol [45, 46]. Primary stability was achieved, and bone grafting material (Bio-Oss Granules; Geistlich Pharma AG) was used to graft the extraction socket and bone defects around the dental implants [47, 48]. Prefabricated healing abutments were inserted, and the implants were left for transmucosal healing (Figure 4). Follow-up was performed at 2 weeks after implant placement. A standard healing process without any signs of adverse events was observed.

2.2.2 | Restorative Phase

Three and a half months after implant placement, scan bodies (Straumann CARES RB Mono Scanbody; Straumann AG) were attached to the implants, and a digital intraoral scan was performed using an intraoral scanner (TRIOS;

FIGURE 5 | Clinical situation at restoration delivery.

3Shape). Implant-supported single-unit fixed dental prostheses were designed to fit onto non-matching titanium-base implant abutments (Figure 1, central). The abutments used in this case had a gingival height of 2.5 mm and 3.5 mm (implant region first molar and second premolar, respectively). Subsequently, screw-retained CAD/CAM monolithic zirconia prostheses were subtractively manufactured by milling and were extraorally bonded to prefabricated titanium abutments (Straumann Variobase RB; Straumann AG). Upon delivery, the seating of the crowns, the contact points, and occlusal contacts were controlled and adjusted if needed (Figure 5). The restorations were delivered 1 month after the digital impression was taken. The screws were torqued to 35 Ncm, and screw access holes were closed using polytetrafluoroethylene tape and composite resin.

2.3 | Follow Up and Outcomes

Follow-up examinations were performed at 1, 2, and 3 years after implant placement. Clinical and radiographic examinations were performed at the follow-up visits. Clinical examinations showed no signs of inflammation. Stable and healthy tissue conditions were observed (Figures 6–8). Peri-apical radiograph and CBCT examinations showed stable marginal bone levels at the level of the implant shoulder for both implants (Figures 9–12), when comparing the vertical distance between

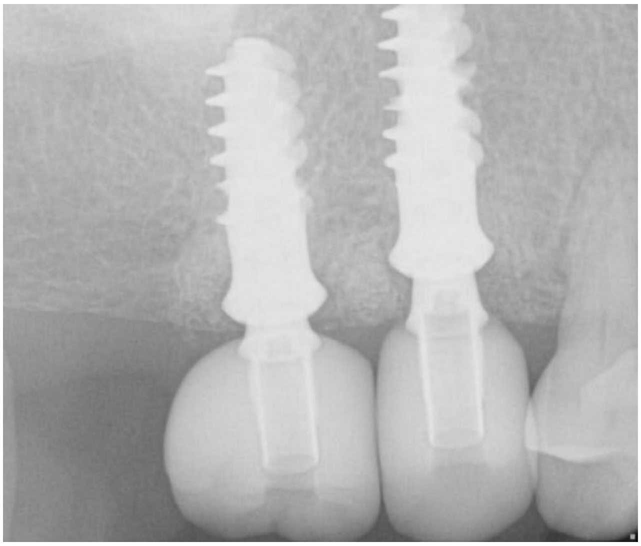

FIGURE 6 | Periapical radiograph at 1 year follow-up.

FIGURE 8 | Clinical situation at 2-year follow-up after implant placement.

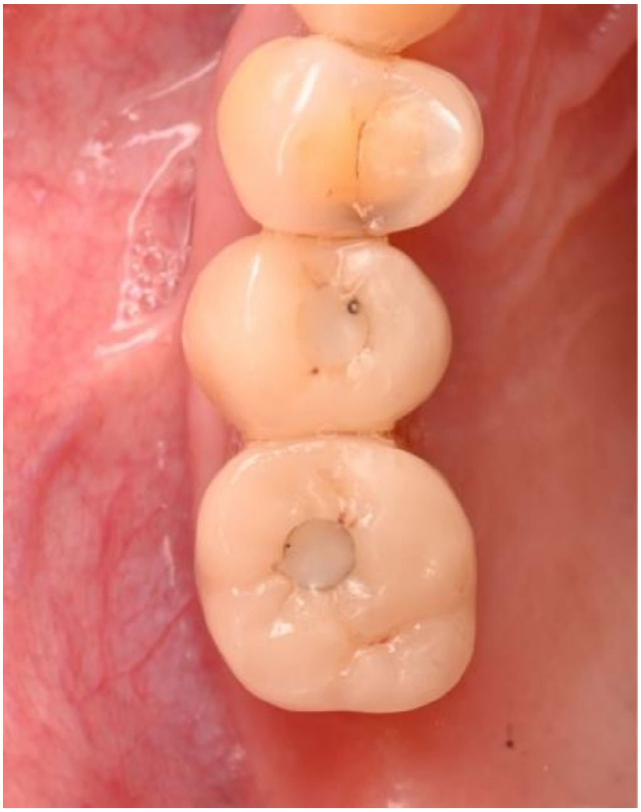

FIGURE 7 | Clinical situation at 2-year follow-up after implant placement.

FIGURE 9 | Bucco-oral cross-section of implant regio upper right first molar at 2-year follow-up after implant placement.

the implant shoulder and the first bone-to-implant contact between the different time points. At the 2 year follow-up visit, high-frequency ultrasonography examination was performed at the implant sites to assess further the peri-implant hard and soft tissues, echointensity of the supracrestal soft tissue, and blood flow, as previously described (Figures 13 and 14) [49–51]. The ultrasound scans showed stable bone levels at the level of the implant shoulder at both sites, with no signs of buccal bone dehiscence. The supracrestal tissue height was 2.59 and 1.43 mm for implant in regio first molar and second premolar, respectively. A thick peri-implant mucosa was observed at the level of the dual-hybrid abutment compartment (2.46 mm for the implant regio first molar and 3.27 mm for the implant regio second premolar). The echointensity of the supracrestal soft tissue was 121.75 GL at the implant regio first molar and 131.82 GL at the implant regio second premolar. Tissue perfusion was uniform and within normal limits at the examined region of interest. Ultrasonographic outcomes are depicted in detail in Table 1.

There were no adverse events during the treatment or in the follow-up period.

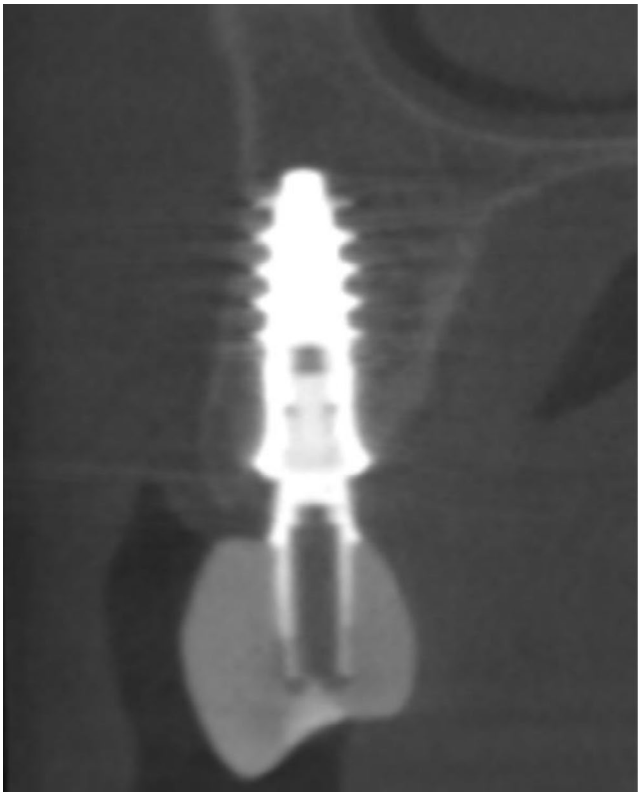

FIGURE 10 | Bucco-oral cross-section of implant regio upper right second premolar at 2-year follow-up after implant placement.

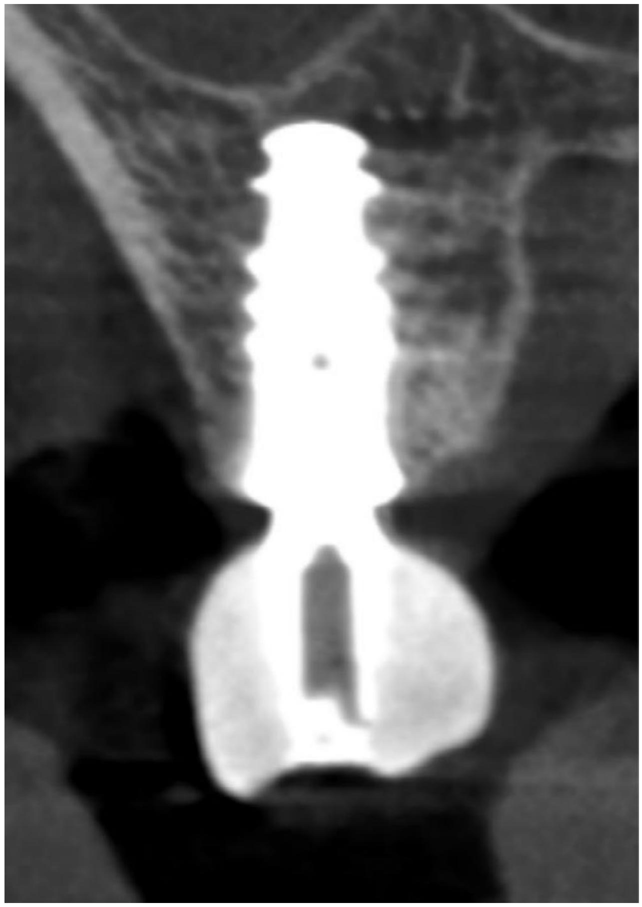

FIGURE 11 | Bucco-oral cross-section of implant regio upper right first molar at 3-year follow-up after implant placement.

3 | Discussion

The presented case, restoring subcrestally placed tissue-level implants using non-matching abutments, resulted in stable radiographic marginal bone levels at the level of the implant shoulder at 3 years after implant placement.

When assessing marginal bone and soft tissue level changes around dental implants, various factors such as the implant-abutment interface, emergence angle, and profile of prosthetic components have been discussed [6, 7, 11]. The implant-abutment interface was evolved with the development of non-matching implant abutments, introducing a horizontal offset between the implant shoulder and the implant-abutment junction [14]. The objective of non-matching implant abutments is to move the implant-abutment junction away from the crestal bone to reduce bone remodeling around dental implants [14]. This type of implant-abutment interface is utilized when restoring bone-level implants, whereas tissue-level implants were typically restored using a matching abutment type. Additionally, the placement depth of different implant types in relation to the crestal bone levels was assessed. Tissue-level implants were associated with increased bone remodeling when placed subcrestally [15, 16]. Therefore, it was traditionally recommended to position the transition between the rough and machined surface epicrestally to minimize the amount of bone remodeling [15, 16]. Furthermore, a study comparing bone level changes around non-matching implant-abutment interfaces in implants with and without a machined collar placed at different levels in relation to the crestal bone showed no significant differences between the two implant groups, even if the implants were placed subcrestally [17, 19]. Another study showed the influence of the implant-abutment interface in implants with a machined collar placed at different levels in relation to the crestal bone comparing an internal Morse taper connection and an external hex connection; within this study the internal Morse taper connection exhibited better results in regard to marginal bone level changes [18]. A clinical study evaluating the impact of non-matching abutments on implants with a machined collar showed no difference in results compared to matching abutments. However, the sample size was very limited and the follow-up period only included 6 months [37]. Furthermore, studies have shown that the implant-abutment connection design might influence the connection stability during loading and the potential microgap and might therefore have an influence on the peri-implant bone remodeling [38]. Therefore, it could be assumed, that with a stronger and more stable implant-abutment connection, there will be less biological impact on the peri-implant tissues. These findings lead to the question of whether the bone remodeling associated with subcrestally placed tissue-level implants is influenced by the machined collar, the typically utilized matching implant-abutment interface or the type and stability of implant connection and suggest that this rather appears to be a multifactorial process. Furthermore, marginal bone levels might be influenced by bone compression at time of implant placement. As illustrated in Figure 1 we suggest the use of

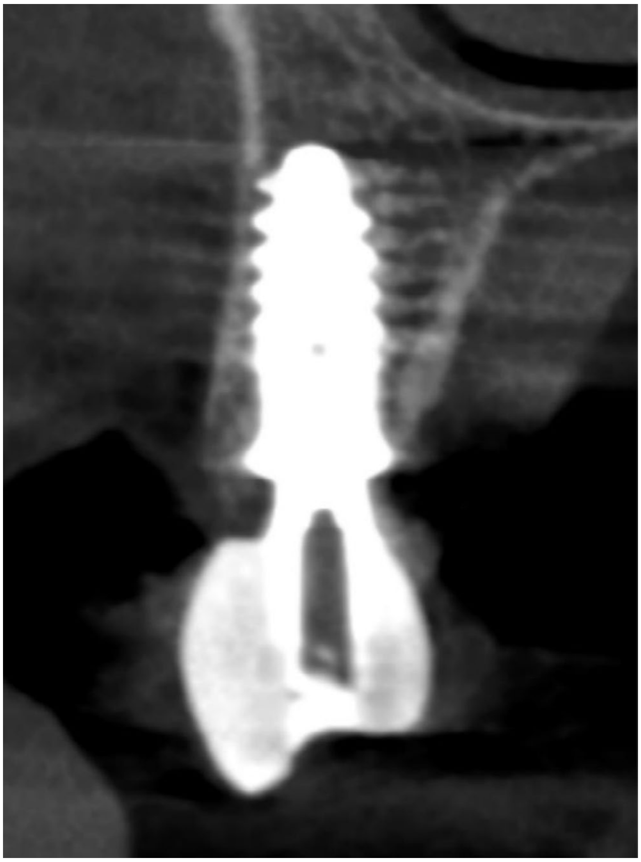

FIGURE 12 | Bucco-oral cross-section of implant regio upper right second premolar at 3-year follow-up after implant placement.

an implant without a tulip; if an implant with a tulip is used as presented in the case report, a profile drill can be used if needed to reduce bone compression.

Additionally, as a further factor, the literature states that a short supracrestal tissue height was associated with marginal bone loss due to the physiological establishment of the peri-implant soft tissues, independently of the implant design (bone level versus tissue level implants) or restorative design (matching versus non-matching) [20].

Dental implants that incorporate the same implant-abutment connection for both bone- and tissue-level implants enable the restoration of a tissue-level implant with either a matching or non-matching implant abutment. The use of a non-matching abutment type on a tissue-level implant in the presented case and the thereby created wide horizontal offset might potentially explain the stable marginal bone levels observed during the follow-up. This horizontal offset might allow more space for the soft tissues to establish a biological seal around the implant, reducing the extent of bone remodeling [6, 7]. In this context, in the presented case report this horizontal offset could have been already incorporated in the utilized healing abutments during the healing period.

The abutment used in the presented case had a gingival height of 2.5 and 3.5 mm (first molar and second premolar, respectively). Studies suggest that the height of the abutment and the thereby changed position of the cement junction might influence the peri-implant tissues. Even though this interaction still needs to be further evaluated in in vivo studies, it was recommended to select an abutment height that allows an abutment-restorative material interface location sufficiently distanced from the bone but still in a submucosal position generating sufficient space for an optimal emergence profile [39, 40]. Furthermore, studies have reported a positive impact of narrow abutment designs on peri-implant tissue stability compared to wider abutment design [6, 7, 41–43]. The selected abutment design (width and height) in the presented case might have positively influences the outcome in regard to peri-implant tissue preservation.

The process of osseointegration around different implant surfaces has been evaluated in multiple studies. The results showed an optimal bone response and the highest level of bone-to-implant contact for moderately rough implant surfaces with a Sa level of between 1 and 2 μm and an Sds of 50% [21–23]. Moderately rough and rough implant surfaces were associated with enhanced bone integration compared to smooth and minimally rough surfaces [23]. According to the manufacturer, the implants used in the presented case have a surface roughness of 1–2 μm at the rough surface and a surface roughness of 0.1–0.2 μm in the machined part. Histological analyses have shown lower bone-to-implant contact values on machined implants, and further studies have reported a bone remodeling at the machined part of tissue level implants [15, 24]. A previously mentioned clinical study comparing hybrid and fully etched implants over an observation period of 5 years showed similar bone regression for both groups in the first 6 months after loading; afterwards, they reported significantly different marginal bone level changes between the groups. However, these bone level changes were self-limiting and did not exceed a change from baseline of 1.2 mm [32]. Although the radiographic examination in the presented case report showed marginal bone levels exceeding the machined parts of the implants, the histological osseointegration in the machined part of the implant placed in the presented case is questionable based on the literature [15, 23]. Nevertheless, some studies showed osseointegration around machined surfaces [25]. However, the results still question the widespread opinion suggesting that subcrestally placed tissue-level implants are inevitably associated with marginal bone remodeling due to the machined implant neck. As observed in Figures 7 and 8, the peri-implant bone level was located of at the implant shoulder or coronally in the presented case.

Bone remodeling is further influenced by the implant placement and loading protocol and the possible use of bone graft materials. In the presented case, an immediate implant placement in combination with a xenogeneic bone graft material was performed. Immediate implants placement should only be performed after careful case selection since it can carry an additional risk for early implant loss and complications. It was reported that immediate implant placement should be avoided in extraction sites with severely damaged sockets with more than 50% loss of one or more walls, since this could result in inferior clinical, radiographic and patient-reported outcomes [46].

Furthmore, it was stated that grafting procedure at immediate implant placement are integral component of the procedure [46].

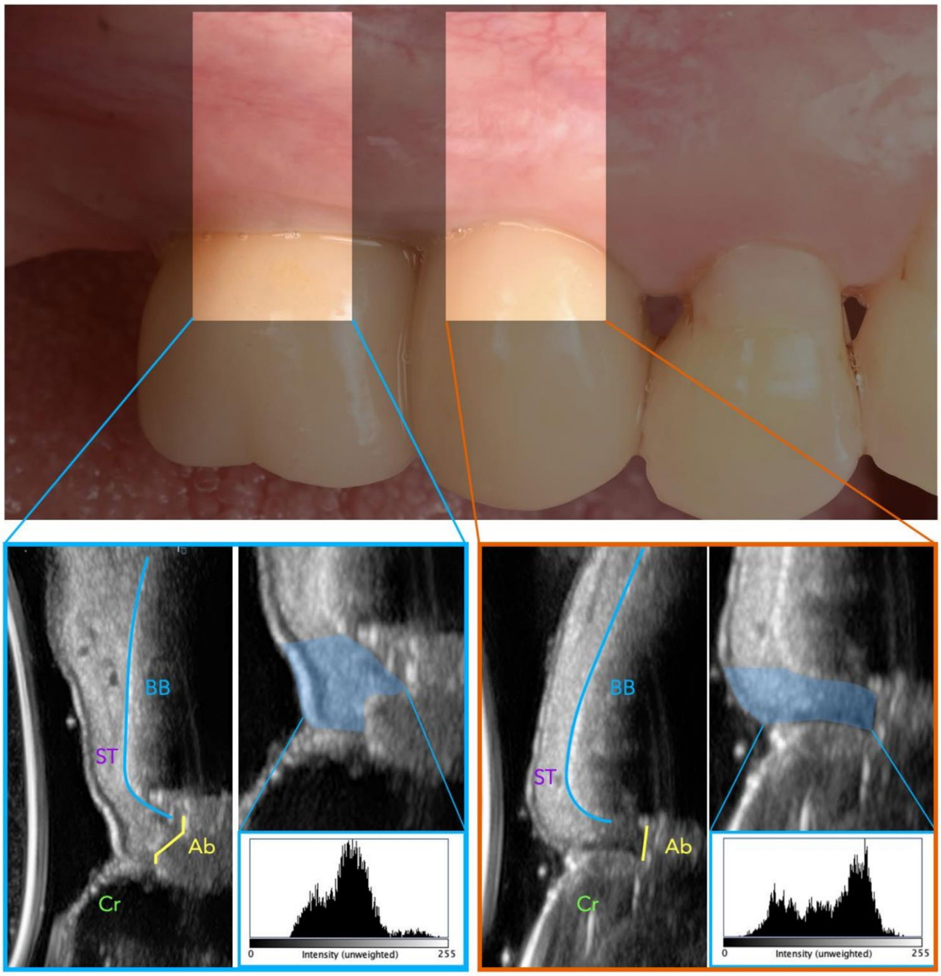

FIGURE 13 | High-frequency ultrasonographic examination and echo-intensity analysis of the supracrestal soft tissue compartment. "Cr" identifies the implant-supported crown, "Ab" the abutment, "ST" the soft tissue, and "BB" the buccal bone.

The used grafting material was shown to have a slow resorption rate leading to volume-stable results [47, 48].

The presented dual-hybrid approach offers an array of possible combinations among implant, abutment, and implant placement options. Additionally, hybrid-surface implants when placed subcrestally and restored using a non-matching implant abutment may result in an optimized peri-implant tissue preservation by incorporating the advantages of a horizontal offset at the implant-abutment interface (known from bone-level implants) to the treatment with tissue-level implants. Hereby, a stable implant–abutment connection is essential, as subcrestal placement of tissue-level implants effectively converts them into a bone-level configuration, thereby potentially negating a key advantage: the relocation of the implant–abutment inflammatory infiltrate away from the crestal bone. Furthermore, in contrast to classic hybrid implants [28] that retain threads in the machined part, this design offers improved conditions for reintervention in case of peri-implant disease with marginal bone loss; the presence of a thread-free machined part facilitates peri-implantitis treatments to resolve the peri-implant inflammation and allows for adequate hygiene without the need for implantoplastic procedures. Since this part is machined and does not involve any threads, patients would be able to clean this area properly in case of exposure due to peri-implant diseases without any implantoplastic procedures. Additionally, in cases of tissue loss and exposure of the implant-abutment interface, a new restoration using a matching abutment type can be delivered, thereby facilitating oral hygiene measures in this clinical scenario. A further advantage of this concept lies in the reduced diameter of prosthetic components. Often, particularly in premolar areas, the mesiodistal distance at the crestal bone level is significantly wider than the mesiodistal distance dimension of the edentulous gap. In cases where there is optimal bone available, this concept would also allow for placing a larger implant and then reducing the diameter of prosthetic components to match the mesiodistal prosthetic space.

The exploration of this approach and the outcomes from the presented case undoubtedly provoke contemplation on whether this design could serve as a preventive measure against implant biological and esthetic complications. Moreover, it prompts a broader inquiry into whether all implant variations should accommodate both matching and non-matching connection options.

Limitations of the presented case include its case-report nature, the rather short follow-up period and the lack of a histological evaluation of the osseointegration in the coronal part. Additional research and clinical trials are needed to validate the presented approach.

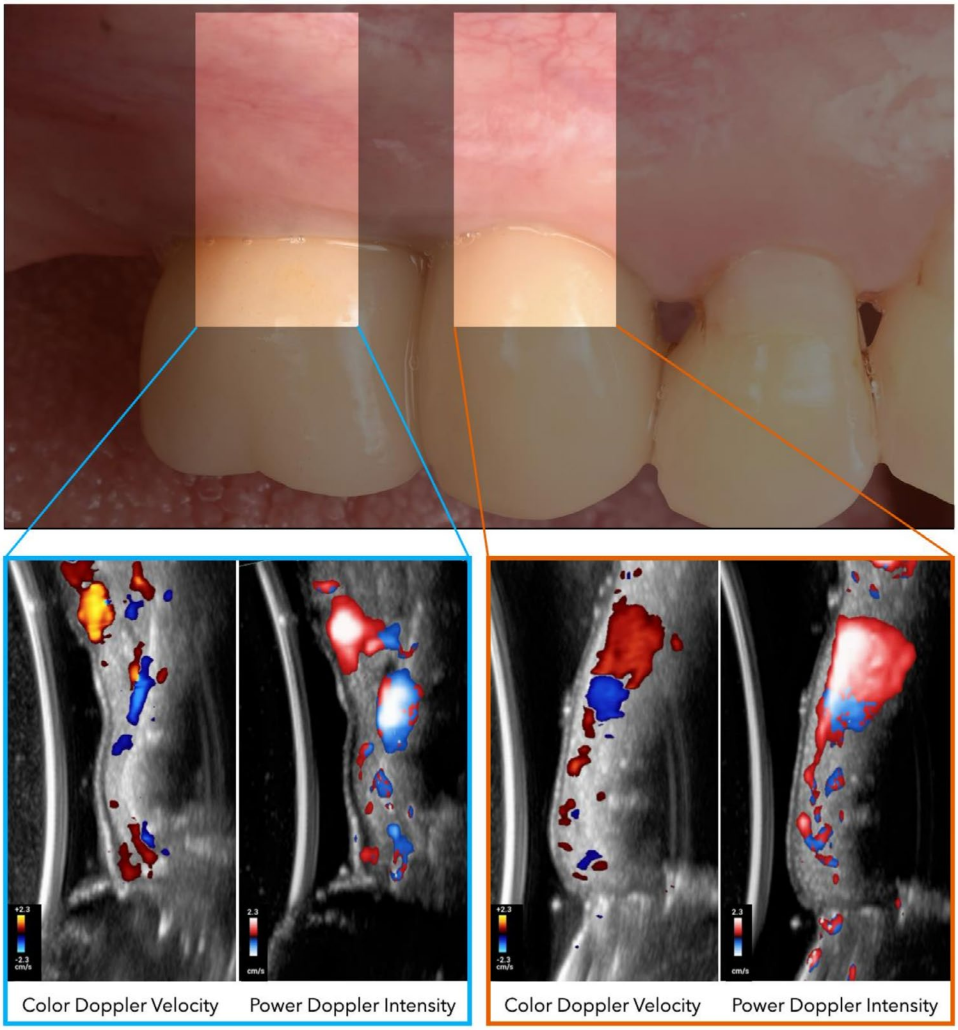

FIGURE 14 | Color and power Doppler ultrasonographic assessment at the midfacial aspect of the implants.

TABLE 1 | Ultrasonographic outcomes obtained at the last follow-up visit.

Ultrasonographic outcomes	Implant upper right first molar	Implant upper right second premolar
STH (mm)	2.59	1.43
MT (mm)	2.46	3.27
EI (mean ± SD) (GL)	121.75 ± 27.61	131.82 ± 39.42
CDV (cm/s)	0.31	0.28
PD Int (cm/s)	0.11	0.09

Abbreviations: CDV, color Doppler velocity; EI, echointensity; GL, gray levels; MT, mucosal thickness, measured at the level of the dual-hybrid compartment; PD Int, power Doppler intensity; SD, standard deviation; STH, supracrestal tissue height, measured from the bone to the soft tissue margin.

4 | Summary

This case report describes soft tissue level implants that were clinically restored using non-matching abutment types. Importantly, the shared connection design between tissue- and bone-level implants allows for future conversion to matching abutments if clinically indicated, offering enhanced restorative flexibility. The results show very positive tissue contours and stable marginal bone levels up to 3 years. Further studies are needed to validate the presented approach. This offers an alternative approach that may complement existing strategies for maintaining peri-implant tissue stability and suggests that further investigation into the implant-abutment connection is warranted. These connections should be versatile enough to accommodate not only the most effective tissue-preserving configuration but also the potential need for subsequent intervention without jeopardizing the implant itself.

Author Contributions

German O. Gallucci: conceptualization, patient treatment, investigation, methodology, supervision, visualization, writing – review and editing. **Lorenzo Tavelli:** patient treatment, investigation, writing – review and editing. **Daniel Buser:** writing – review and editing. **Ignacio Pedrinaci:** writing – review and editing. **Ronald E. Jung:** writing – review and editing. **Kevser Pala:** investigation, writing – original draft, writing – review and editing.

Funding

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this report are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

1. P. Galindo-Moreno, A. León-Cano, I. Ortega-Oller, A. Monje, F. O'Valle, and A. Catena, "Marginal Bone Loss as Success Criterion in Implant Dentistry: Beyond 2 mm," *Clinical Oral Implants Research* 26 (2015): e28–e34, https://doi.org/10.1111/clr.12324.

2. P. Papaspyridakos, C. J. Chen, M. Singh, H. P. Weber, and G. O. Gallucci, "Success Criteria in Implant Dentistry: A Systematic Review," *Journal of Dental Research* 91 (2012): 242–248, https://doi.org/10.1177/0022034511431252.

3. I. Laleman and F. Lambert, "Implant Connection and Abutment Selection as a Predisposing and/or Precipitating Factor for Peri-Implant Diseases: A Review," *Clinical Implant Dentistry and Related Research* 25 (2023): 723–733, https://doi.org/10.1111/cid.13185.

4. F. Schwarz, A. Hegewald, and J. Becker, "Impact of Implant-Abutment Connection and Positioning of the Machined Collar/Microgap on Crestal Bone Level Changes: A Systematic Review," *Clinical Oral Implants Research* 25 (2014): 417–425, https://doi.org/10.1111/clr.12215.

5. D. D. Bosshardt, V. Chappuis, and D. Buser, "Osseointegration of Titanium, Titanium Alloy and Zirconia Dental Implants: Current Knowledge and Open Questions," *Periodontology 2000* 73 (2017): 22–40, https://doi.org/10.1111/prd.12179.

6. G. Finelle, D. E. V. Papadimitriou, A. B. Souza, N. Katebi, G. O. Gallucci, and M. G. Araújo, "Peri-Implant Soft Tissue and Marginal Bone Adaptation on Implant With Non-Matching Healing Abutments: Micro-CT Analysis," *Clinical Oral Implants Research* 26 (2015): e42-e46, https://doi.org/10.1111/clr.12328.

7. A. B. Souza, A. Alshihri, P. W. Kammerer, M. G. Araujo, and G. O. Gallucci, "Histological and Micro-CT Analysis of Peri-Implant Soft and Hard Tissue Healing on Implants With Different Healing Abutments Configurations," *Clinical Oral Implants Research* 29 (2018): 1007–1015, https://doi.org/10.1111/clr.13367.

8. P. Galindo-Moreno, A. León-Cano, I. Ortega-Oller, et al., "Prosthetic Abutment Height Is a Key Factor in Peri-Implant Marginal Bone Loss," *Journal of Dental Research* 93 (2014): 80S-85S, https://doi.org/10.1177/0022034513519800.

9. A. Monje, O. Gonzalez-Martin, and G. Avila-Ortiz, "Impact of Peri-Implant Soft Tissue Characteristics on Health and Esthetics," *Journal of Esthetic and Restorative Dentistry* 35 (2023): 183–196, https://doi.org/10.1111/jerd.13003.

10. R. Gomez-Meda, J. Esquivel, and M. B. Blatz, "The Esthetic Biological Contour Concept for Implant Restoration Emergence Profile Design," *Journal of Esthetic and Restorative Dentistry* 33 (2021): 173–184, https://doi.org/10.1111/jerd.12714.

11. M. Siegenthaler, F. J. Strauss, F. Gamper, C. H. F. Hämmerle, R. E. Jung, and D. S. Thoma, "Anterior Implant Restorations With a Convex Emergence Profile Increase the Frequency of Recession: 12-Month Results of a Randomized Controlled Clinical Trial," *Journal of Clinical Periodontology* 49 (2022): 1145–1157, https://doi.org/10.1111/jcpe.13696.

12. J. Majzoub, Z. Chen, I. Saleh, H. Askar, and H. L. Wang, "Influence of Restorative Design on the Progression of Peri-Implant Bone Loss: A Retrospective Study," *Journal of Periodontology* 92 (2021): 536–546, https://doi.org/10.1002/JPER.20-0327.

13. I. Pedrinaci, A. Hamilton, A. Lanis, M. Sanz, and G. O. Gallucci, "The Bio-Restorative Concept for Implant-Supported Restorations," *Journal of Esthetic and Restorative Dentistry: Official Publication of the American Academy of Esthetic Dentistry* 36 (2024): 1516–1527, https://doi.org/10.1111/jerd.13306.

14. R. J. Lazzara and S. S. Porter, "Platform Switching: A New Concept in Implant Dentistry for Controlling Postrestorative Crestal Bone Levels," *International Journal of Periodontics & Restorative Dentistry* 26 (2006): 9–17.

15. C. H. Hammerle, U. Bragger, W. Burgin, and N. P. Lang, "The Effect of Subcrestal Placement of the Polished Surface of ITI Implants on Marginal Soft and Hard Tissues," *Clinical Oral Implants Research* 7 (1996): 111–119, https://doi.org/10.1034/j.1600-0501.1996.070204.x.

16. M. H. A. Saleh, A. Ravida, F. S.-. L. del Amo, et al., "The Effect of Implant-Abutment Junction Position on Crestal Bone Loss: A Systematic Review and Meta-Analysis," *Clinical Implant Dentistry and Related Research* 20 (2018): 617–633, https://doi.org/10.1111/cid.12600.

17. C. Valles, X. Rodriguez-Ciurana, F. Muñoz, et al., "Influence of Implant Neck Surface and Placement Depth on Crestal Bone Changes Around Platform-Switched Implants: A Clinical and Radiographic Study in Dogs," *Journal of Periodontology* 88 (2017): 1200–1210, https://doi.org/10.1902/jop.2017.170192.

18. D. Weng, M. J. H. Nagata, M. Bell, et al., "Influence of Microgap Location and Configuration on the Periimplant Bone Morphology in Submerged Implants. An Experimental Study in Dogs," *Clinical Oral Implants Research* 19 (2008): 1141–1147, https://doi.org/10.1111/j.1600-0501.2008.01564.x.

19. C. Valles, X. Rodriguez-Ciurana, F. Muñoz, et al., "Influence of Implant Neck Surface and Placement Depth on Crestal Bone Changes and Soft Tissue Dimensions Around Platform-Switched Implants: A Histologic Study in Dogs," *Journal of Clinical Periodontology* 45 (2018): 869–883, https://doi.org/10.1111/jcpe.12887.

20. G. Avila-Ortiz, O. Gonzalez-Martin, E. Couso-Queiruga, and H. L. Wang, "The Peri-Implant Phenotype," *Journal of Periodontology* 91 (2020): 283–288, https://doi.org/10.1002/JPER.19-0566.

21. A. Wennerberg and T. Albrektsson, "Effects of Titanium Surface Topography on Bone Integration: A Systematic Review," *Clinical Oral Implants Research* 20, no. Suppl 4 (2009): 172–184, https://doi.org/10.1111/j.1600-0501.2009.01775.x.

22. T. Albrektsson and A. Wennerberg, "Oral Implant Surfaces: Part 1—Review Focusing on Topographic and Chemical Properties of Different Surfaces and In Vivo Responses to Them," *International Journal of Prosthodontics* 17 (2004): 536–543.

23. N. P. Lang, S. Jepsen, and G. Working, "Implant Surfaces and Design (Working Group 4)," *Clinical Oral Implants Research* 20, no. Suppl 4 (2009): 228–231, https://doi.org/10.1111/j.1600-0501.2009.01771.x.

24. I. Abrahamsson, T. Berglundh, E. Linder, N. P. Lang, and J. Lindhe, "Early Bone Formation Adjacent to Rough and Turned Endosseous Implant Surfaces. An Experimental Study in the Dog," *Clinical Oral Implants Research* 15 (2004): 381–392, https://doi.org/10.1111/j.1600-0501.2004.01082.x.

25. M. Simion, M. Benigni, K. Al-Hezaimi, and D. M. Kim, "Early Bone Formation Adjacent to Oxidized and Machined Implant Surfaces: A Histologic Study," *International Journal of Periodontics & Restorative Dentistry* 35 (2015): 9–17, https://doi.org/10.11607/prd.2217.

26. S. Spinato, F. Bernardello, P. Sassatelli, and D. Zaffe, "Hybrid Implants in Healthy and Periodontally Compromised Patients: A Preliminary Clinical and Radiographic Study," *International Journal of Periodontics & Restorative Dentistry* 37 (2017): 195–202, https://doi.org/10.11607/prd.3140.

27. F. Khoury, P. L. Keeve, A. Ramanauskaite, et al., "Surgical Treatment of Peri-Implantitis—Consensus Report of Working Group 4,"

International Dental Journal 69, no. Suppl 2 (2019): 18–22, https://doi.org/10.1111/idj.12505.

28. D. P. Tarnow, "Dental Implants in Periodontal Care," *Current Opinion in Periodontology* (1993): 157–162.

29. E. Bravo, B. Serrano, H. Ribeiro-Vidal, et al., "Biofilm Formation on Dental Implants With a Hybrid Surface Microtopography: An In Vitro Study in a Validated Multispecies Dynamic Biofilm Model," *Clinical Oral Implants Research* 34 (2023): 475–485, https://doi.org/10.1111/clr.14054.

30. D. Robles, A. Brizuela, M. Fernandez-Dominguez, and J. Gil, "Osteoblastic and Bacterial Response of Hybrid Dental Implants," *Journal of Functional Biomaterials* 14 (2023): 321, https://doi.org/10.3390/jfb14060321.

31. S. Spinato, F. Bernardello, P. Sassatelli, and D. Zaffe, "Hybrid and Fully-Etched Surface Implants in Periodontally Healthy Patients: A Comparative Retrospective Study on Marginal Bone Loss," *Clinical Implant Dentistry and Related Research* 19 (2017): 663–670, https://doi.org/10.1111/cid.12504.

32. L. Zetterqvist, S. Feldman, B. Rotter, et al., "A Prospective, Multicenter, Randomized-Controlled 5-Year Study of Hybrid and Fully Etched Implants for the Incidence of Peri-Implantitis," *Journal of Periodontology* 81 (2010): 493–501, https://doi.org/10.1902/jop.2009.090492.

33. B. Serrano, I. Sanz-Sanchez, K. Serrano, E. Montero, and M. Sanz, "One-Year Outcomes of Dental Implants With a Hybrid Surface Macro-Design Placed in Patients With History of Periodontitis: A Randomized Clinical Trial," *Journal of Clinical Periodontology* 49 (2022): 90–100, https://doi.org/10.1111/jcpe.13575.

34. F. Schwarz, I. Mihatovic, V. Golubovic, S. Eick, T. Iglhaut, and J. Becker, "Experimental Peri-Implant Mucositis at Different Implant Surfaces," *Journal of Clinical Periodontology* 41 (2014): 513–520, https://doi.org/10.1111/jcpe.12240.

35. M. E. Galarraga-Vinueza and L. Tavelli, "Soft Tissue Features of Peri-Implant Diseases and Related Treatment," *Clinical Implant Dentistry and Related Research* 25 (2023): 661–681, https://doi.org/10.1111/cid.13156.

36. T. Berglundh, K. Gotfredsen, N. U. Zitzmann, N. P. Lang, and J. Lindhe, "Spontaneous Progression of Ligature Induced Peri-Implantitis at Implants With Different Surface Roughness: An Experimental Study in Dogs," *Clinical Oral Implants Research* 18 (2007): 655–661, https://doi.org/10.1111/j.1600-0501.2007.01397.x.

37. R. Rossi, D. Capri, E. Risciotti, and P. Zeman, "Randomized Clinical Investigation of Titanium Implants With and Without Platform Switching: Six Months' Radiographic and Clinical Outcome," *Dentistry Journal* 3 (2015): 55–66, https://doi.org/10.3390/dj3020055.

38. R. Caricasulo, L. Malchiodi, P. Ghensi, G. Fantozzi, and A. Cucchi, "The Influence of Implant-Abutment Connection to Peri-Implant Bone Loss: A Systematic Review and Meta-Analysis," *Clinical Implant Dentistry and Related Research* 20 (2018): 653–664, https://doi.org/10.1111/cid.12620.

39. W. Derksen, T. Joda, J. Chantler, et al., "Group 2 ITI Consensus Report: Technological Developments in Implant Prosthetics," *Clinical Oral Implants Research* 34, no. Suppl 26 (2023): 104–111, https://doi.org/10.1111/clr.14148.

40. J. G. M. Chantler, C. D. J. Evans, N. U. Zitzmann, and W. Derksen, "Clinical Performance of Single Implant Prostheses Restored Using Titanium Base Abutments: A Systematic Review and Meta-Analysis," *Clinical Oral Implants Research* 34, no. Suppl 26 (2023): 64–85, https://doi.org/10.1111/clr.14128.

41. A. Puisys, M. Janda, V. Auzbikaviciute, G. O. Gallucci, and N. Mattheos, "Contour Angle and Peri-Implant Tissue Height: Two Interrelated Features of the Implant Supracrestal Complex," *Clinical and Experimental Dental Research* 9 (2023): 418–424, https://doi.org/10.1002/cre2.731.

42. P. Rungtanakiat, N. Thitaphanich, M. Janda, F. J. Strauss, M. Arksornnukit, and N. Mattheos, "Association of Peri-Implant Mucosa Dimensions With Emergence Profile Angles of the Implant Prosthesis," *Clinical and Experimental Dental Research* 10 (2024): e939, https://doi.org/10.1002/cre2.939.

43. F. J. Strauss, J. Y. Park, J. S. Lee, et al., "Wide Restorative Emergence Angle Increases Marginal Bone Loss and Impairs Integrity of the Junctional Epithelium of the Implant Supracrestal Complex: A Preclinical Study," *Journal of Clinical Periodontology* 51 (2024): 1677–1687, https://doi.org/10.1111/jcpe.14070.

44. A. Jorba-Garcia, A. Pozzi, Z. Chen, et al., "Glossary of Computer-Assisted Implant Surgery and Related Terms. First Edition," *Clinical and Experimental Dental Research* 11 (2025): e70148, https://doi.org/10.1002/cre2.70148.

45. W. Zhou, G. O. Gallucci, S. Chen, D. Buser, and A. Hamilton, "Placement and Loading Protocols for Single Implants in Different Locations: A Systematic Review," *International Journal of Oral & Maxillofacial Implants* 36 (2021): e72–e89, https://doi.org/10.11607/jomi.8750.

46. M. S. Tonetti, R. E. Jung, G. Avila-Ortiz, et al., "Management of the Extraction Socket and Timing of Implant Placement: Consensus Report and Clinical Recommendations of Group 3 of the XV European Workshop in Periodontology," *Journal of Clinical Periodontology* 46, no. Suppl 21 (2019): 183–194, https://doi.org/10.1111/jcpe.13131.

47. V. Perrotti, B. M. Nicholls, M. A. Horton, and A. Piattelli, "Human Osteoclast Formation and Activity on a Xenogenous Bone Mineral," *Journal of Biomedical Materials Research. Part A* 90 (2009): 238–246, https://doi.org/10.1002/jbm.a.32079.

48. R. E. Jung, S. I. Windisch, A. M. Eggenschwiler, D. S. Thoma, F. E. Weber, and C. H. F. Hämmerle, "A Randomized-Controlled Clinical Trial Evaluating Clinical and Radiological Outcomes After 3 and 5 Years of Dental Implants Placed in Bone Regenerated by Means of GBR Techniques With or Without the Addition of BMP-2," *Clinical Oral Implants Research* 20 (2009): 660–666, https://doi.org/10.1111/j.1600-0501.2008.01648.x.

49. L. Tavelli, S. Barootchi, J. Majzoub, et al., "Prevalence and Risk Indicators of Midfacial Peri-Implant Soft Tissue Dehiscence at Single Site in the Esthetic Zone: A Cross-Sectional Clinical and Ultrasonographic Study," *Journal of Periodontology* 93 (2022): 857–866, https://doi.org/10.1002/JPER.21-0402.

50. L. Tavelli, O. D. Kripfgans, H. L. Chan, et al., "Doppler Ultrasonographic Evaluation of Tissue Revascularization Following Connective Tissue Graft at Implant Sites," *Journal of Clinical Periodontology* 52 (2023): 68–79, https://doi.org/10.1111/jcpe.13889.

51. L. Mancini, A. Khehra, T. Nguyen, S. Barootchi, and L. Tavelli, "Echo Intensity and Gray-Level Co-Occurrence Matrix Analysis of Soft Tissue Grafting Biomaterials and Dental Implants: An In Vitro Ultrasonographic Pilot Study," *Dento Maxillo Facial Radiology* 52 (2023): 20230033, https://doi.org/10.1259/dmfr.20230033.