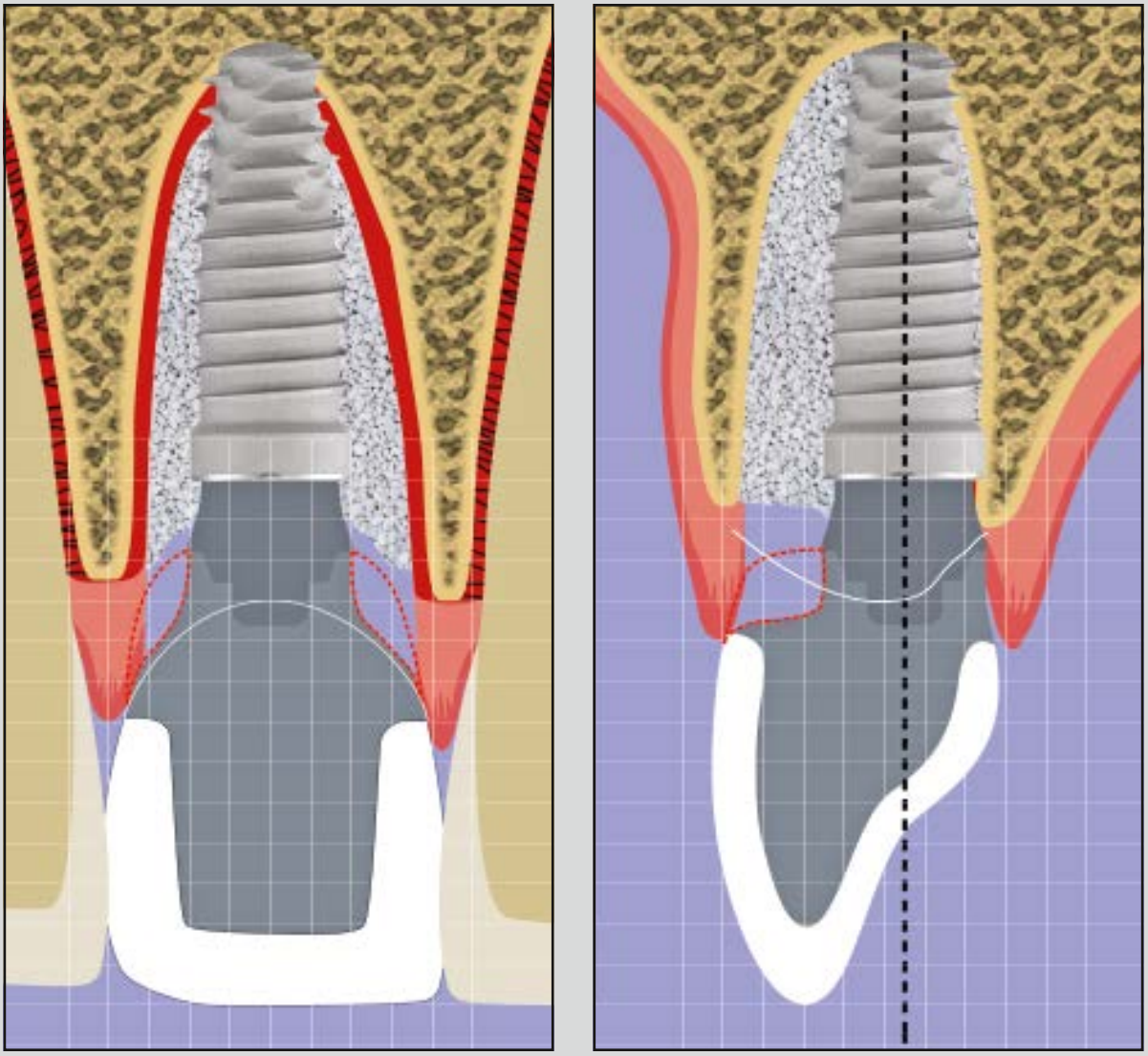


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Immediate One-Time Low-Profile Abutment to Enhance Peri-implant Soft and Hard Tissue Stability in the Esthetic Zone



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Reductions in peri-implant bone height have been acknowledged as a normal consequence of implant therapy. Various restorative factors contribute to this phenomenon. One is repeated abutment retightening, which causes a mechanical disruption at the implant-abutment interface, leading to soft tissue recession. Several investigators proposed placement of the definitive abutment after implant placement as a solution to the problem. The definitive use of an intermediate abutment after implant placement seems to positively affect the soft tissue response. This article aims to present a prosthetic sequence for achieving peri-implant tissue stability in the esthetic zone.
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Reductions in peri-implant bone height[1,2] are reported following implant placement even in the first year of loading. A 1-year prospective clinical trial recorded 0.7 mm of vertical bone loss after second-stage surgery and a 0.6-mm apical displacement of the soft tissues 1 year after placing the final prosthesis.[2] Vertical repositioning of peri-implant tissue occurs when an implant is exposed to the oral environment. This is believed to be caused by bone remodeling and biologic width reestablishment as well as an inflammatory cell infiltrate at the implant-abutment (IA) junction.[2,3] Restorative factors contributing to this phenomenon are the IA connection, micromovement, the interface seal, repeated disconnection and reconnection of the abutment, the shape and size of the abutment, the abutment material, and the abutment configuration (screw- versus cement-retained).

Although the IA interface acts as a reservoir for bacteria, resulting in bacterial leakage and an inflammatory response around the peri-implant tissues, its impact on crestal bone levels is still unknown.[4] Bacterial leakage occurs irrespective of the type of connection.[5,6] Repeated abutment disconnection and reconnection is also thought to increase the intensity of the leakage because of the misfit at the IA interface caused by repeated screw tightening.[7]

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Continual abutment disconnection and reconnection cause a mechanical disruption at the junction, followed by soft tissue recession as the soft tissue attempts to establish a proper transmucosal attachment.[8,9] Several investigators proposed placing the definitive abutment at the time of implant placement or second-stage surgery to minimize soft tissue recession.[8,10] According to the one abutment, one time concept,[10] definitive insertion of the final abutment without the interference of a provisional abutment results in undisturbed healing of the peri-implant tissue and establishment of a stable transmucosal barrier.[8–12]

Applying this concept in the esthetic zone is problematic. The osseous crest has a scalloped shape that is more apical in the facial and lingual aspects and approximately 3.0 mm more coronal interproximally.[13,14] According to Kois and Kan,[13] in a normal gingival-to-osseous relationship, the gingival margin is placed about 3.0 mm above the osseous crest facially and 4.5 mm interproximally. To establish an appropriate emergence profile, implants with flat connections should be placed subcrestally and about 3.0 to 4.0 mm below the free gingival margin of the adjacent natural tooth, which corresponds to the zenith of the future crown.[13,14] This scalloped morphology complicates treatment sequencing and makes selecting the final abutment at the early stage of implant placement problematic. Inevitably, the margin of the final crown is placed subgingivally, making difficult the complete removal of cement remnants and jeopardizing peri-implant health.[15,16]

One possible solution is placement of the final prefabricated intermediate abutment for screw-type restorations without any further removal. This eliminates cement remnants and facilitates treatment sequencing.

The aim of the present article is to describe a prosthetic sequence, the immediate two-piece abutment concept, as a means to enhance peri-implant soft- and hard-tissue stability in the esthetic zone.

Clinical Case 1

A 26-year-old woman's chief complaint was the continuous decementation of a resin composite restoration on her maxillary left central incisor. Clinical and radiographic evaluations (Figs 1a and 1b) showed that the incisor had an oblique fracture and an insufficient sound tooth structure. The incisor was extracted, and an implant was immediately placed (3i T3 Non-Platform Switched 3.25 × 11. 5 mm, Biomet 3i) with an initial stability of 30 Ncm. An immediate screw-retained low-profile final abutment (Low Profile Abutment, Biomet 3i) was placed, and a screw-retained provisional restoration was fabricated (Fig 1c). Following osseointegration, the contour of the provisional was relined to obtain a natural emergence profile. After achieving the ideal emergence profile, the provisional remained in place for 2 months to stabilize the soft tissue (Fig 1d). Final impression and fabrication of the final, screw-retained all-ceramic crown followed. Final clinical and radiographic evaluations showed optimal soft tissue integration and bone stability (Figs 1e and 1f).

Clinical Case 2

A 27-year-old woman presented for treatment, wishing to change the appearance of her smile (Fig 2a). The endodontic treatment of her maxillary right central incisor and the resin composite restorations of her left central incisor both were failing (Figs 2a and 2b). The treatment plan included extraction of the right central incisor, second-stage implant placement, and fabrication of an implant-supported zirconia all-ceramic crown, and composite resin restorations for the left central incisor and both maxillary lateral incisors.

The right central incisor was atraumatically extracted, and socket preservation was performed using a collagen sponge (Collacone, Botiss Biomaterials). After 3 months, an implant was placed (3i T3 4/3 × 10 mm, Biomet 3i) with sufficient initial stability (30 Ncm) and a screw-retained low-profile abutment (Low Profile Abutment, Biomet 3i) with a gingival height of 2.0 mm and a platform-switched design was placed (Fig 2c). This low-profile abutment remained in place throughout the treatment and continued to support the final crown restoration. The bone was regenerated using bovine bone xenograft (Cerabone, Botiss Biomaterials) and a resorbable membrane (Jason membrane, Botiss Biomaterials) to make up for a deficiency of the buccal plate.

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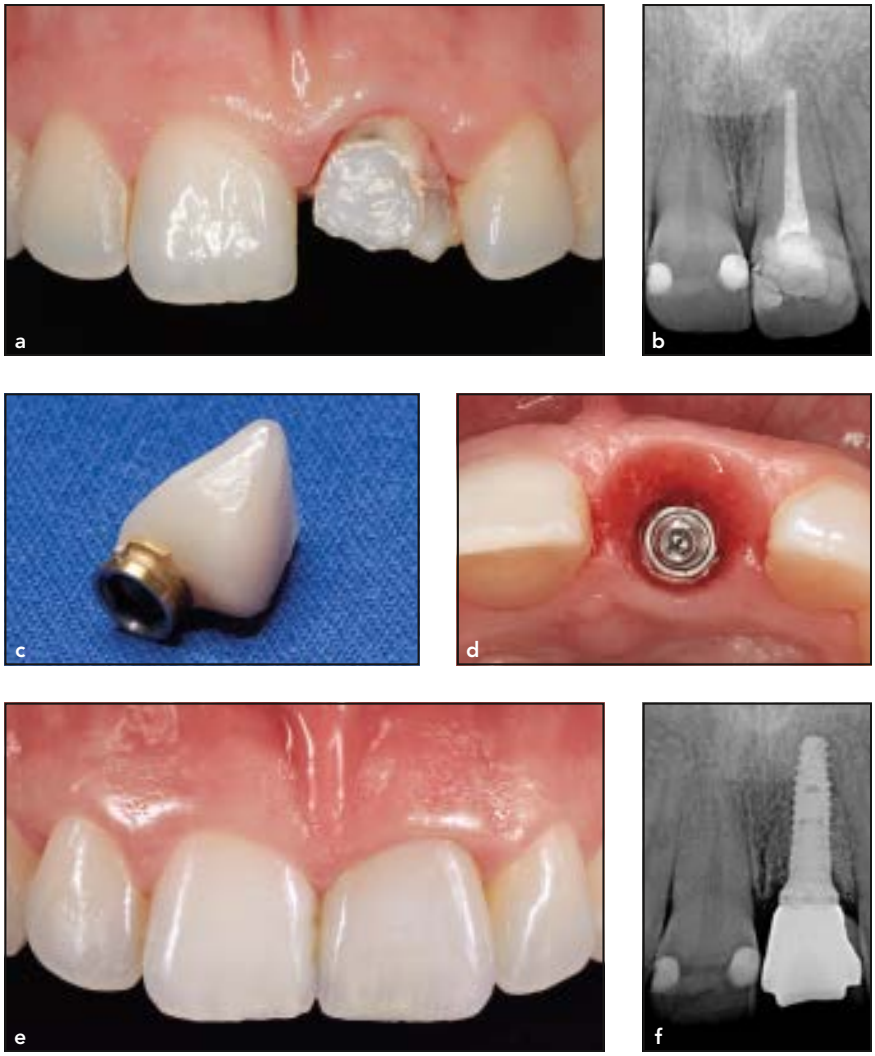


Fig 1 *Case 1.* (a) *Initial clinical situation. The maxillary left central incisor presented with a resin composite restoration that continuously decemented and an insufficient amount of sound tooth structure.* (b) *Initial periapical radiograph.* (c) *View of the provisional crown. Note the concave configuration.* (d) *Soft tissue integration 3 months after implant placement.* (e) *Final clinical situation. Soft tissue integration has been achieved.* (f) *Final periapical radiograph. Bone surrounding the entire implant surface up to the implant platform and extending beyond the implant-abutment junction onto the low-profile abutment surface.*

Since the initial implant stability was sufficient, an implant-retained provisional restoration was fabricated. The emergence profile of the provisional crown was divergent and consisted of a vertical and a horizontal part. The vertical part started at the abutment platform and extended 2.0 mm incisally. The horizontal part extended labially in an angle greater than 90 degrees (Fig 2d). After the osseointegration period, the emergence profile and therefore the angulation of the provisional profile could be changed according to the desired final result.

Finally, a natural emergence profile was established (Fig 2e) and left in place for an additional 2 months. The impression coping was customized for final impressions. An implant-retained zirconia all-ceramic crown was fabricated (Fig 2f).

The final radiograph suggests integration of the fixture with bone levels to the implant collar and partially extending over the intermediate abutment (Fig 2g). The platform-switched design of the prefabricated abutment might also have influenced the bone stability of the present case.

Discussion

Vertical repositioning of peri-implant tissue (ie, bone, connective tissue, and epithelium) after exposure to the

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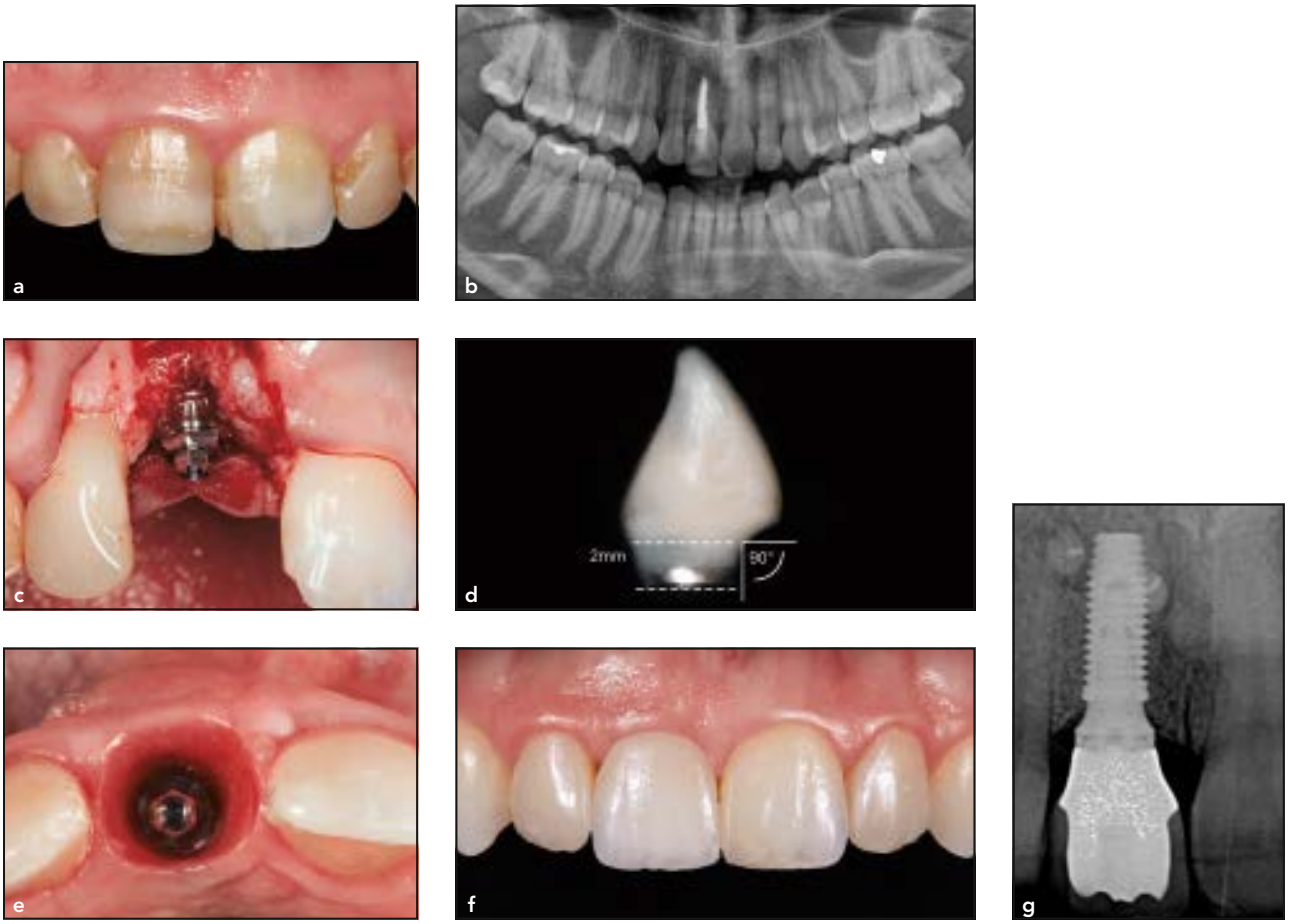


Fig 2 *Case 2.* (a) *Initial clinical situation.* (b) *Initial panoramic radiograph.* (c) *After implant placement, a low-profile abutment with a gingival height of 2.0 mm was definitively placed on the implant. Due to the deficiency of the buccal plate, bone regeneration was performed.* (d) *The emergence profile of the provisional crown consists of a horizontal and a vertical part that form an angle > 90 degrees.* (e) *The established transmucosal emergence profile.* (f) *Final clinical situation. With the aid of the proposed concept, soft tissue recession was averted and the final soft tissue integration is optimal.* (g) *Final periapical radiograph. Bony tissue covers the entire implant surface and part of the low-profile abutment.*

oral environment is caused by phenomena occurring at the IA interface. The removal of the abutment after initial healing and bacterial inflammation at the IA connection chronically irritate the interface. The bone resorbs in an attempt to create distance from this irritated area, leading to a new biologic width formation below the IA interface.[17]

As Abrahamsson et al[8] first reported, continuous IA disconnections and reconnections during the restorative process cause a mechanical wound at the IA junction,[8] seen as a disruption of the mucosal seal.[11] Bone resorption and soft tissue recession then occur.[8,11] Immediate placement of a final abutment allows undisturbed healing of the peri-implant tissue and formation of a stable transmucosal barrier. Placing the final prefabricated low-profile abutment at the time of implant placement, as proposed in the present article, is in agreement with this technique. Crestal bone resorption is minimized, leading to enhanced soft tissue stability.[9,12]

In the anterior area, the proximity of the teeth and limited mesiodistal space are problems for implant placement. A clinical and radiographic study found that a 2.0 mm minimum tooth-to-implant distance must be kept for the papilla to fill the

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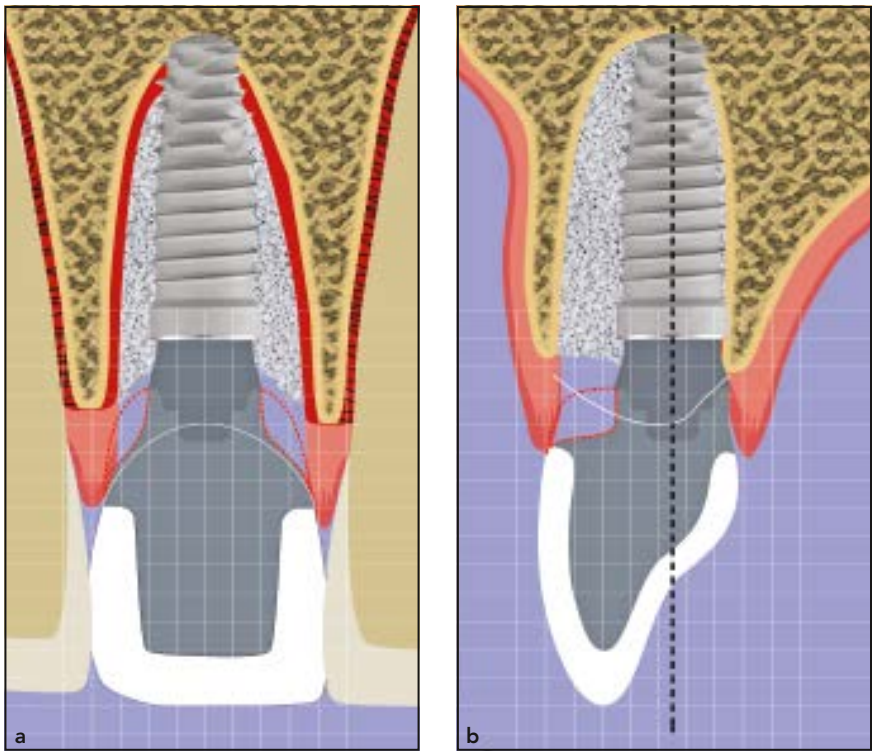


Fig 3 *Schematic view of the one-time immediate two-piece low-profile abutment. Each square is 1.0 × 1.0 mm.* (a) *The implant is placed 3.0–4.0 mm below the zenith of the future crown. The height of the low-profile abutment can be 1.0 or 2.0 mm, depending on the depth of implant placement (3.0 or 4.0 mm below the zenith of the crown, respectively).* (b) *The transmucosal part consists of a horizontal and a vertical part. The horizontal part is at least 2.0 mm long. When an immediate implant is ideally placed, these two parts diverge to an angle of approximately 90 degrees and the configuration is concave. In the case of late implant placement, pressure is applied to the soft tissue to establish a natural emergence profile and the configuration is convex. The amount of material one can add on the provisional to apply pressure to the soft tissues is restricted between the red dotted lines.*

entire interdental space.[18] When the distance is < 2.0 mm, bone remodeling and soft tissue recession lead to incomplete fill of the interdental space. To overcome this problem, Vela et al[19] showed that the use of platform-switched abutments reduces marginal bone loss to approximately half that documented around platform-matched implants.[17,19] Using a low-profile abutment with a diameter smaller than the implant might keep the inflammatory cell infiltrate of the IA junction away from the bone crest, minimizing bone resorption[12] (Fig 3).

The shape of the immediate provisional crown may also play a role in soft tissue stability. The transmucosal part of the crown consists of a vertical and a horizontal part. The vertical part starts at the low-profile abutment platform, while the horizontal extends to the crown zenith. As the neck of the implant should ideally be placed at least 2.0 mm more palatal than the expected marginal part of the future crown,[20] the horizontal part is at least 2.0 mm long. In the case of an extraction and immediate implant ideally placed, the two parts are divergent and form an angle of about 90 degrees. In more demanding clinical scenarios (eg, delayed implant placement or a thin gingival biotype), the transmucosal part of the provisional restoration is shaped accordingly to establish a natural emergence profile (Fig 3). The proposed concept is applicable for screw-retained restorations of implants placed in a prosthetically favorable position (4.0 mm below the clinical crown zenith and in a palatal position, with the screw access opening in the cingulum). If a cement-retained restoration were selected, the second abutment could be customized and the margins placed 1.0 mm subgingivally, following the scalloping of the soft tissue.

Rompen et al[21] previously reported that the delivery of a final abutment with a concave, inwardly narrowed transmucosal profile improved the stabilization of the soft tissue and even resulted in a vertical gain. The behavior of this abutment configuration was attributed to the void chamber that provided sufficient space for the blood clot and

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for the soft tissue to regenerate (Fig 3b). In addition, the curved profile created a bigger tissue-to-implant interface and a ring-like seal with enhanced mechanical stability that mimicked the effect of Sharpey fibers.[21] Several authors have studied the effects of abutment configuration on the stability of peri-implant mucosa,[22–24] but the results are conflicting.[23,24] Randomized controlled clinical trials comparing the effect of a concave versus a convex design should be performed to evaluate the effects of the design on peri-implant soft tissue stability.

Since the introduction of osseointegrated implants, many attempts have been made to maintain mucosal integration at the abutment and prevent tissue recession. Various materials have been studied, including titanium, aluminum oxide, gold alloys, and zirconium dioxide.[25,26] No distinct differences in peri-implant mucosal health have been found between titanium and zirconium dioxide abutments in animal[25] and human[26] studies. Further, modifying the surface roughness of titanium abutments caused tight integration of soft tissue.[27]

However, the white color of zirconium dioxide abutments makes it favorable compared to titanium or gold for the maxillary anterior area, especially in patients with thin periodontal biotypes.[26] In the highly scalloped anterior region, customized zirconia abutments are shaped to follow the contours of the desired crown shape. The abutment is fabricated using computer-aided design/computer-assisted manufacturing technology and is cemented extraorally on a metal sleeve that fits on the implant platform. One possible drawback is the cementation gap at the interface between the zirconia abutment and the metal sleeve, which is placed deep inside the peri-implant mucosal sulcus, although the drawbacks have not been fully determined.

The technique described uses a prefabricated component and not a custom-made final abutment. Optimal fit between the implant platform and the abutment and consequently an improved interface seal are ensured. As mentioned earlier, the IA interface is a bacterial reservoir[4] where bacterial leakage occurs irrespective of the type of connection[5,6] and is influenced by a variety of factors, such as dynamic loading[6] and repeated abutment tightening.[7] Micromovement of the low-profile abutment is therefore unavoidable. However, this interface is a tight mechanical seal with a prefabricated component produced by the same implant company.

The proposed concept is applicable for screw retention. Screw-retained restorations do not require cement, they provide a smoother surface inside the gingival sulcus, and they decrease the risk of plaque accumulation and peri-implantitis.[19,20] They also make it easier to customize the provisional crown, which is of particular benefit in the highly scalloped anterior area (Fig 3). Prefabricated components for screw-type, multiple-unit restorations have been used for many years. The presented concept describes the use of these components for single-unit restorations in the esthetic zone with the goal of achieving a hermetic seal at the implant level and less bone resorption in a scalloped bony situation.

Conclusions

Factors that determine soft and hard tissue stability can be surgical or restorative. Factors involved in the restorative process include the I/A connection, micromovement, and/or interface seal; repeated disconnection and reconnection of the abutment; the shape and size of the abutment; the abutment material; and the abutment configuration (screw- versus cement-retained). Most of these factors are strongly related to the IA interface. The technique described aims to control these factors and enhance soft and hard tissue stability in single implants in the esthetic zone.

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References

1. Hürzeler M, Fickl Z, Zuhr O, Wachtel HC. Peri-implant bone level around implants with platform-switched abutments: Preliminary data from a prospective study. J Oral Maxillofac Surg 2007;65(suppl): s33–s39.
2. Cardaropoli G, Lekholm U, Wennström JL. Tissue alterations at implant-supported single-tooth replacements: A 1-year prospective clinical study. Clin Oral Implants Res 2006;17:165–171.

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3. Canullo L, Iurlano G, Iannello G. Double-blind randomized controlled trial study on post-extraction immediately restored implants using the switching platform concept: Softtissueresponse. Preliminary report. Clin Oral Implants Res 2009;20: 414–420.
4. Passos SP, Gressler May L, Faria R, Özcan M, Bottino MA. Implant-abutment gap versus microbial colonization: Clinical significance based on a literature review. J Biomed Mater Res B Appl Biomater 2013;101:1321–1328.
5. Canullo L, Penarrocha-Oltra D, Soldnini C, Mazzocco F, Penarrocha M, Covani U. Microbiological assessment of the implant-abutment interface in different connections: cross sectional study after 5 years of functional loading. Clin Oral Implants Res 2015;26:426–434.
6. Koutouzis T, Mesia R, Calderon N, Wong F, Wallet S. The effect of dynamic loading on bacterial colonization of the dental implant fixture-abutment interface: An in vitro study. J Oral Implantol 2014;40:432–437.
7. Do Nascimento C, Oedrazzi V, Miani PK, Moreira LD, de Albuquerque RF Jr. Influence of repeated screw tightening on bacterial leakage along the implant-abutment interface. Clin Oral Implants Res 2009;20:1394–1397.
8. Abrahamsson I, Berglundh T, Lindhe J. The mucosal barrier following abutment dis/reconnection. An experimental study in dogs. J Clin Periodontol 1997;24: 568–572.
9. Degidi M, Nardi D, Piatteli A. One abutment at one time: Non-removal of an immediate abutment and its effect on bone healing around subcretal tapered implants. Clin Oral Implants Res 2011;22:1303–1307.
10. Pelekanos S, Ntounis A, Jovanovic S, Euwe E. Definitive abutment-driven stage-two surgery as a means to reduce peri-implant soft tissue changes: Introduction of a new concept. Int J Periodontics Restorative Dent 2013;33: 193–199.
11. Becker K, Mihatovic I, Golubovic V, Schwarz F. Impact of abutment material and dis-/re-connection on soft and hard tissue changes at implants with platform-switching. J Clin Periodontol 2012; 39:774–780.
12. Canullo L, Bignozzi I, Cocchetto R, Cristalli MP, Iannello G. Immediate positioning of a definitive abutment versus repeated abutment replacements in post-extractive implants: 3-year follow-up of a randomized multicenter clinical trial. Eur J Oral Implantol 2010;3: 285–296.
13. Kois J, Kan J. Predictable peri-implant gingival aesthetics: Surgical and prosthodontic rationales. Pract Proced Aesthet Dent 2001;13:691–698.
14. Zetu L, Wang H. Management of interdental/inter-implant papilla. J Clin Periodontol 2005;32:831–839.
15. Agar JR, Cameron SM, Hughbanks JC, Parker MH. Cement removal from restorations luted to titanium abutments with simulated subgingival margins. J Prosthet Dent 1997;78:43–47.
16. Wilson T. The positive relationship between excess cement and peri-implant disease: A prospective clinical endoscopic study. J Periodontol 2009;80: 1388–1392.
17. Tarnow DP, Cho SC, Wallace SS. The effect of inter-implant distance on the height of inter-implant bone crest. J Periodontol 2000;71:546–549.
18. Perez F, Segalla JC, Marcantonio E Jr, Lauris JR, Ribeiro JG, Ferreira LP. Gingival papilla dimensions in anterosuperior regions adjacent to single-tooth implants. Int J Periodontics Restorative Dent 2012; 32:93–100.
19. Vela X, Méndez V, Rodriguez X, Segala M, Tarnow DP. Crestal bone changes on platform-switched implants and adjacent teeth when the tooth-implant distance is less than 1.5 mm. Int J Periodontics Restorative Dent 2012;32: 149–155.
20. Grunder U, Gracis S, Capelli M. Influence of the 3-D bone-to-implant relationship on esthetics. Int J Periodontics Restorative Dent 2005;25:113–119.
21. Rompen E, Raepsaet N, Domken O, Touati B, Van Dooren E. Soft tissue stability at the facial aspect of gingivally converging abutments in the esthetic zone: A pilot clinical study. J Prosthet Dent 2007;97(suppl):s119–s125.
22. López-López PJ, Mareque-Bueno J, Boquete-Castro A, Aguilar-Salvatierra Raya A, Martínez-González JM, Calvo-Guirado JL. The effects of healing abutments of different size and anatomic shape placed immediately in extraction sockets on peri-implant hard and soft tissues. A pilot study in foxhound dogs. Clin Oral Implants Res 2016; 27:90–96.
23. Gamborena I, Lee J, Fiorini T, et al. Effect of platform shift/switch and concave abutments on crestal bone levels and mucosal profile following flap and flapless implant surgery. Clin Implant Dent Relat Res 2015;17:908–916.
24. Patil R, den Hartog L, Dilbaghi A, de Jong B, Kerdijk W, Cune MS. Papillary fill response in single-tooth implants using abutments of different geometry. Clin Oral Implants Res 2016;27:1506–1510.
25. Abrahamsson I, Berglundh T, Glantz PO, Lindhe J. The mucosal attachment at different abutments. An experimental study in dogs. J Clin Periodontol 1998; 25:721–727.
26. Van Brakel R, Meijer GJ, Verhoeven JW, Jansen J, de Putter C, Cune MS. Soft tissue response to zirconia and titanium implant abutments: An in vivo within-subject comparison. J Clin Periodontol 2012;39:995–1001.
27. Nevins M, Kim DM, Guze K, Schupbach P, Nevins ML. Histologic evidence of a connective tissue attachment to laser microgrooved abutments: A canine study. Int J Periodontics Restorative Dent 2010;30:245–255.

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