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Factors Influencing the Preservation of the Periimplant Marginal Bone

Frederic Hermann, DDS*, Henriette Lerner, DDS,† and Ady Palti, DDS‡

Fabs

Numerous techniques within surgical hard-tissue and soft-tissue management are available today to assist in achieving an ideal aesthetic treatment result. The current view is that the long-term preservation of healthy periimplant tissues is of primary importance for ensuring function and esthetics over an extended period. The following parameters play a significant role: (a) considerations of biologic width; (b) the concept of platform switching; (c) implant design in the cervical region: (d) nanoroughness; (e) fine threads; (f) insertion depth; (g) abutment design; and (h) the avoidance of microlesions in the periimplant soft tissue created by the exchange of various secondary prosthetic components.

A stable bone level around the implant neck is a prerequisite for achieving support and, hence, long-term optimal and stable gingival contours. This is especially so with regard to the interdental papillae in the anterior region.[1] It is important to consider all the possible factors that may exert an influence within this sensitive region when designing an implant treatment plan to achieve an optimized functional/esthetic treatment outcome.

Esthetic outcomes cannot be attributed to a single parameter. Rather, as this article shows, they are the result of a number of important factors, especially in the esthetic zone. An understanding of the meaning of biologic width, of the integration of the platform-switching concept into implant treatment facilitates the preservation of a stable marginal bone level around the implant neck. This stable bone then serves to support the soft tissue, determining the long-term esthetic and functional treatment outcomes stability.

The following points should be noted: (1) A prefabricated post that can be used both as a temporary post and as the definitive abutment helps to avoid a frequent replacement of secondary components, provided that the 3-dimensional position of the implant is correct. It prevents a repeated destruction of the connective-tissue attachment on the biologic width, which would carry with it the risk of bone resorption. (2) A special implant and abutment design (a ledge and integration of the biologic width/tapered shape of the post) facilitates nonsurgical lengthening and thickening of the periimplant soft tissue. This leads to the establishment of a wider and more resistant zone of connective tissue. (3) A microrough and nanorough titanium surface extending to the implant shoulder in conjunction with the platform-switching concept provides osseous integration along the entire length of the implant. A fine thread optimally distributes the masticatory forces in the region of the implant neck, avoiding further bone loss in this region. (Implant Dent 2007;16:1–●●●)

Key Words: biologic width, platform-switching, implant macro, micro- and nanodesign

Biologic Width

The clinical term *biologic width* denotes the dimensions of periodontal and periimplant soft-tissue structures such as the gingival sulcus, the junctional epithelium, and the supracrestal connective tissues. According to Tarnow *et al*,[2] the bone facing the oral cavity is invariably covered by periosteal tissue, connective tissue, and epithelial tissue, all of which may vary in thickness. The original studies of the "dentogingival complex" can be traced back to Gottlieb,[3] to which Orban and Kohler[4] returned many years later. Gargiulo *et al*[5] examined the dimensions of these tissues in dead human bodies. One year later, in 1962, Cohen[6] defined the clinical concept of biologic width to include the dimensions of the epithelial and connective tissue attachments. The definition of the dentogingival complex additionally includes the vertical dimension of the gingival sulcus.

According to measurements conducted by Gargiulo *et al*,[5] the average biologic width (from the base of the sulcus to the alveolar bone margin) is 2.04 mm, of which 0.97 mm is epithelial attachment and 1.07 mm is connective tissue attachment. These dimensions, however, are in no way static but subject to interindividual variation (from tooth to tooth and from patient to patient)[6] and will also vary according to gingival types and implant concepts.

Numerous studies have shown that bone resorption around the implant neck does not start until the implant is uncovered and exposed to the oral cavity. This invariably leads to

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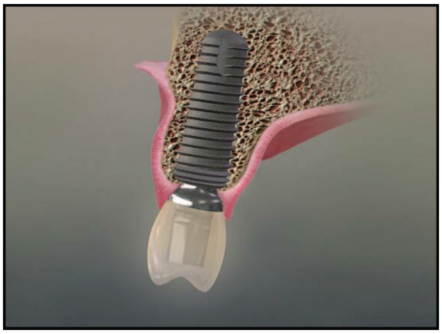


Fig. 1. Attachment of hemidesmosomal fibers to the nanorough abutment surface. Stabilization and nonsurgical soft-tissue augmentation thanks to the abutment's tapered shape.

bacterial contamination of the gap between the implant and the superstructure.[7–10] Bone remodeling will progress until the biologic width has been created and stabilized. Not only does this width progress apically, along the vertical axis, but according to studies conducted by Tarnow *et al*,[2] there is also a horizontal component amounting to 1–1.5 mm. This is the reason to maintain a minimum distance of 3 mm between 2 implants and platform switching in the esthetic reconstruction zone in order to obtain intact papillae and stable interimplant
F1 bone. Fig. 1 is a schematic representation of the principle of integrating the biologic width and platform switching into the surgical/prosthetic treatment concept.

F2–3 Figs. 2 and 3 demonstrate the intraoperative inclusion of biologic width considerations during implant surgery. The implant used (Revois; Curasan AG, Kleinostheim Germany) has a microrough and nanorough surface extending to the implant shoulder, accommodating biologic width by featuring a prepared margin 1.9 mm above the shoulder (Fig. 3). This integrated distance takes into account the average formation of biologic width around implants. The special paralleling post available for this implant assists in ascertaining the optimal insertion depth and the correct distance from adjacent teeth or implants. The diameter of this paralleling post is the same as that of the definitive abutment; its height is 1.9 mm (Fig. 2). Equally important is the distance between the implant and the tooth, as first defined by Tarnow *et al*[11] in 1992 and modified in 2003,[12] and the distance between the bony base of the papilla and the contact point of the superstructure. Only if all these points are observed can we expect the interdental space to be filled in completely, leading to an optimal esthetic outcome.

The Platform-Switching Concept

The platform switching effect was first observed in the mid-1980s. At the time, larger-diameter implants were often restored with narrower abutments (Ankylos Densply, Friadent, Germany; Astra-Zeneca, Sweden; Bicon, Boston), as congruent abutments were often still unavailable. As it later turned out, this was a remarkable coincidence.

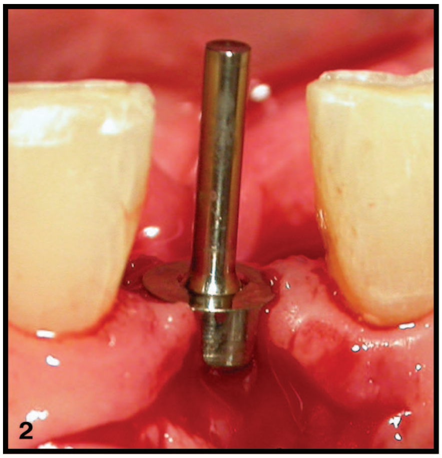
The abutments used with conventional implant types are generally flush with the implant shoulder in the contact zone. With many implant systems, this results in the formation of microcracks between the implant and the abutment. Numerous studies[13–15] have shown that bacterial contamination of the gap between the implant and the abutment adversely affects the stability of the periimplant tissue. If above-average axial forces are exerted on the implant, a pumping effect may ensue (depending on the positive internal/external connection at the interface) that may then result in a flow of bacteria from the gap, provoking the formation of inflammatory connective tissue in the region of the implant neck. Ericsson *et al*[9] coined the term *distance-sleeve-associated infiltrated connective tissue* to describe this phenomenon. They interpreted this to be a biological protective mechanism against the bacteria residing in the microcrack, explaining the plaque-independent bone loss of approximately 1 mm during the first year. This bone loss may result in a reduction of the marginal bone level in both the vertical and the horizontal dimensions. The entire process must be seen as a bacterial infection occurring naturally on transgingival implants and on submucosally placed implants as they are exposed, in both cases as a result of the communication with the oral cavity.[7–10] If the microcrack is located close to the bone, the creation of the biologic width will occur at the expense of the bone.[5,16–18]

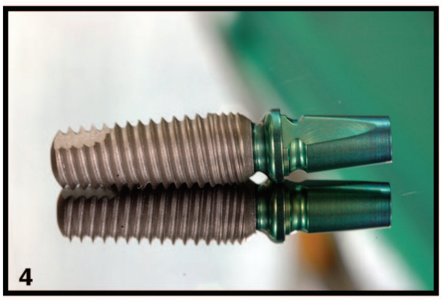
The platform-switching concept requires that this microcrack be placed away from the implant shoulder and closer toward the axis in order to increase the distance of this microcrack from the bone.[19–21] This generally implies the use of a reduced-diameter abutment (Figs. 1 and 4). The implant F4
used has a standard abutment diameter of 3.05 mm. With implant diameters of 3.8, 4.3, and 5.0 mm, the abutment margin runs between 0.375 and 0.975 farther axially than the circumference of the implant. According to the microbiological considerations outlined above, this delivers a measure of protection for the marginal bone.

The preservation of the periimplant bone is particularly important in the esthetic zone and in areas with a limited bone supply. Here the objective is to avoid provoking an additional postprosthetic bone loss and to preserve the long-term stability of the bone and soft tissue alike.

Implant Design in the Cervical Region: Nanoroughness, Fine Threads, and Insertion Depth

Conventional implant types generally feature a smoothly polished cervical region that may vary in width. As a result of the radiologic and histologic studies conducted by Hermann *et al*,[13,22] there is awareness of the implications of the position of the implant shoulder on crestal bone resorption. The relative positions of the interface between the implant shoulder and the abutment and the transition zone from the smooth to the rough implant surface, respectively, to the alveolar ridge are of eminent importance. The literature mentions a distance of 3.6 mm in the mandible and 4.1 mm in the maxilla between the point of first bone-to-implant contact and the implant shoulder for ITI (Straumann, Switzerland) standard implants (2.8 mm) with this neck configuration.[23] Current trends in implant design favor a reduction or elimination of the smoothly polished segment. In newer implants, the rough segment was extended 1 mm coronally. Here the biologic width created was reduced to an average of 2.19 mm after 32 months.[24] Therefore, it is to be ex-





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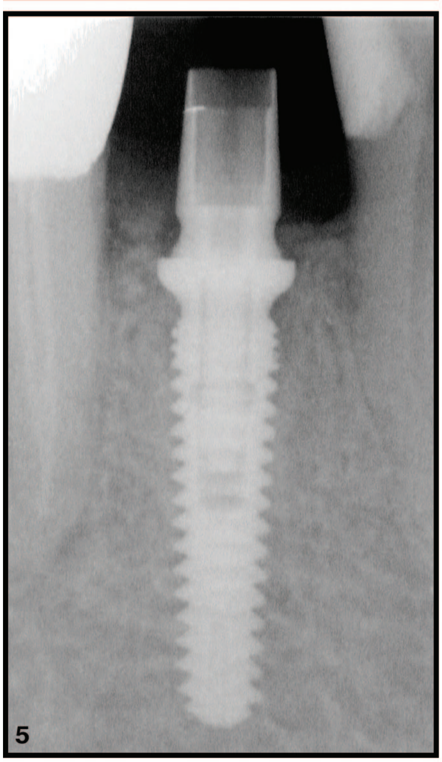


Fig. 2. Checking the 3-dimensional position, using parallelizing posts.
Fig. 3. Macrodesign of an implant and the integrated platform-switching concept.
Fig. 4. Revois implant with a rough titanium surface extending to the implant shoulder, integrated platform switching, and a fine thread around the implant neck.
Fig. 5. Radiological situation at the 1-year follow-up. The marginal bone level is preserved.
AQ: 5 **Fig. 6.** Radiological control prior to impression-taking showing the multifunctional precision post.

pected that the biologic width will be reduced by limiting the width of the smoothly polished cervical region. However, if the smooth segment is inserted below the bone level, the bone will resorb all the way down to the rough-to-smooth transition line.[25] Moreover, it was shown that the amount of bone loss also depends on the nature of the adjacent structures (cantilever situation, implant, natural dentition). The biologic width in 2-piece implant systems invariably starts at the implant-abutment interface. Depending on the positive fit of the internal or external connective interface, this microcrack might provoke bone loss to an extent that will vary, depending on the insertion depth of the implant.[13]

Our experience with an implant design of the most recent generation that has continuous microrough and nanorough surface extending to the implant neck and a fine thread in the cervical region (Fig. 5) has shown that the crestal bone level was stabilized in numerous clinical cases. Integrating the platform-switching concept in the presence of a completely rough implant surface played a central role in moving the microcrack on the implant platform more closely to the implant axis, counteracting bone resorption tendencies.

Implants with a continuous microrough and nanorough titanium surface extending to the implant neck facilitate osseointegration along the entire length of the implant, involving the entire implant surface. A fine thread in the cervical region results in functional loads being transmitted to the adjacent bony structures, supporting the formation of trabecular bony structures and stabilizing the region in question. Complete bony coverage of the entire implant surface can be attained upon successful osseointegration if the platform-switching concept is implemented.

When inserting implants in a reduced-bone environment, an additional advantage of the fine thread around the implant neck becomes manifest: the thread stabilizes the implant in the presence of an underprepared osteotomy (implant bed preparation), contributing to the achievement of primary stability. This

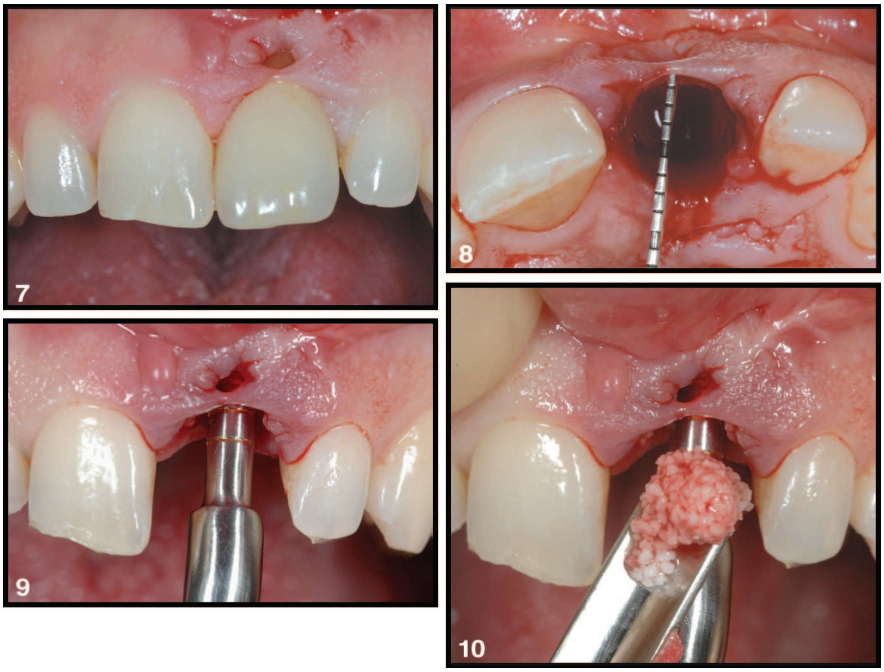


Fig. 7. Planned immediate implementation, with immediate restoration in the region of tooth 21. Multiple apical resections have been performed. Note the perforation of the soft tissue.
Fig. 8. Determining the alveolar dimensions and showing the thin soft tissue on the buccal area.
Fig. 9. After using a pilot drill 2-mm Ø, a nonablative cavity preparation using the osteotome technique to increase primary stability has been performed.
Fig. 10. Inserted osteotome to keep the prepared implant bed clear; bone augmentation using β-TCP (Cerasorb M; Curasan AG, Kleinostheim, Germany).

in turn may help reduce the length of time for the healing phase.

Abutment Design and the Avoidance of Microlesions: Radiologic Follow-Up

The radiologic follow-up images in
F6 Figs. 5 and 6 impressively demonstrate the effect of platform switching. Following immediate placement of an implant (Revois 3.8/13 mm; Curasan AG) in the region of tooth 45, a transgingival healing mode using a narrower healing cap was selected. Following a healing phase of 4 months, an impression was taken using a multifunctional precision post that, if the 3-dimensional position of the implant is correct, doubles as a definitive post, *i.e.*, it will not be removed (Fig. 6). The 1-year follow-up radiograph shows that the periimplant marginal bone has clearly been preserved (Fig. 5).

By analogy with the results of Abrahamsson *et al*,[26] an additional replacement of secondary components at the time of insertion of the prosthetic superstructure, which would carry a risk of additional marginal bone loss, can therefore be avoided. Studies have shown that micromovements associated with the replacement of the secondary components (violation of the established biologic width) may result in an apical migration of the epithelial tissue around the implant neck, with more bone resorption and a reduction of the marginal bone level as a consequence.

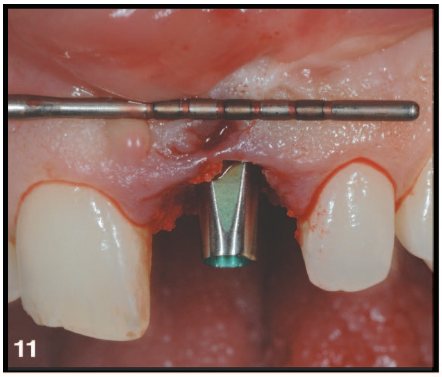
Berglundh *et al*[27] concluded from the results of their studies that a reaction takes place between the connective tissue and the titanium-oxide surface of the abutment, a reaction that they termed *connective-tissue integration*. Cochran *et al*[28] demonstrated the adhesion of epithelial cells and fibroblasts to rough and smooth titanium surfaces. The results indicated that a connective-tissue attachment could help avoid the apical proliferation of the epithelial tissue on titanium surfaces.

The results from periodontal structural biology, regarding the formation of a long junctional epithelium after root planing, whose apical proliferation is limited by connective-tissue fibers inserting on the surface, can also be applied to the periimplant situation. A good connective-tissue attachment to the titanium surface of the implant/abutment could prevent apical proliferation of the epithelial tissue. However, if the connective-tissue attachment process is disturbed by plaque accumulations or by exchanging secondary components (healing caps, posts, etc), this will facilitate apical migration of the epithelial tissue all the way down to the bone, with the concomitant risk of additional bone resorption.

Consequently, a surgical/aesthetic concept should be devised that facilitates the creation of a permanent connective-tissue attachment to limit the proliferation of epithelial tissue. The first step would be a reduction in the number of traumatic events, such as surgical procedures or the replacement of secondary components, and implementation of an efficient mode of plaque control.

The multi-functional precision post of the implant system used (Revois; Curasan AG) has a reduced diameter of 3.05 mm (compared to the implant diameter of 3.8 mm), which relocates the biologic microcrack inward toward the implant axis and reduces the amount of distance-sleeve-associated infiltrated connective tissue formed. Additional nonsurgical thickening of the soft tissue is caused by the tapered shape of the post and its tulip profile as the prepared ledge 1.9 mm above the implant shoulder is approached (Figs. 1, 4, 5, and 6). Fig. 6 shows the situation directly before the impression was taken, whereas Fig. 5 shows the situation 1 year after insertion of the prosthetic reconstruction. The standardized radiologic follow-ups clearly show the preservation of the interdental bone, which is located at the level of the prosthetic platform. It should be noted that this effect is not created by platform switching alone but is the result of the combination of all the factors previously described.

The influence of additional parameters on the functional and esthetic long-term results of implant therapy will be discussed in the next installation of this series of articles titled "Parameters of Esthetics." This is intended be able to integrate many criteria and documented results into im-



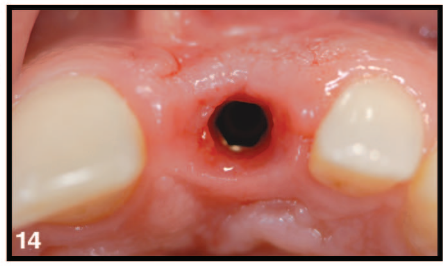


Fig. 11. Final position of the Revois implant with final abutment. Checking the insertion position.
Fig. 12. Preparation of an absorbable membrane (Epi-Guide; Curasan AG, Kleinostheim, Germany) to cover the soft-tissue perforation.
Fig. 13. Postoperative situation after suture adaptation. The soft-tissue perforation has been closed. Note the patient's crown, which is in nonocclusion (−50 μm).
Fig. 14. Soft tissue situation after 12 months: compared to the initial thickness, an addition of 3 mm.
Fig. 15. Patient situation after 12 months, with the natural tooth.

plant therapy in the esthetically sensitive anterior region to achieve optimal long-term treatment outcomes. These criteria include:

1. Anatomy: bone volume/bone quality[29]
2. Mucosal quality: type/thickness[30,31]
3. Condition of the adjacent teeth: classification of Palacci[32]
4. Distances to the adjacent teeth: Tarnow relations[2,11,12]
5. Biologic width and the platform-switching concept[33–36]
6. Implant design: macro-/micro-/nanolevel design and implant dimensions[37]
7. Abutment design: macro-/micro-/nanolevel[38]
8. Augmentation procedures: type/materials/membranes[39]
9. Surgical procedure: soft-tissue management/ton of insertion[40–42]; implant insertion depth[13,22,25,43]; time of loading/time of restoration AQ: 1
10. Prosthetic procedure: frequency of secondary-component replacement[26]
11. Suturing techniques: materials
12. Provisional restorations: abutment materials/abutment shapes; crown materials/crown shapes
13. Definitive restorations: abutment materials/abutment shapes; crown materials/crown shapes
14. Patient compliance: oral hygiene/smoking/nutrition/recall intervals

Conclusion

For long-term esthetic results with implant restorations, the following parameters are important:

- Implant position following the literature concerning distance between implants or implants and natural teeth.
- Implant design and macro-, micro-, and nanostructures play an important role in maintaining the bone and soft tissue in the initial positions.
- Platform switching in combination with a final abutment inserted the day of implant placement (nonocclusal restoration) can be useful to obtain and maintain the long-term result concerning the biological width.

Clinical Case

Figs. 7 through 15 exemplify our procedure by showing a clinical case. F7–15

Disclosure

Each of the authors claims to have a financial interest in Curasan Company, whose product Revois Implant is mentioned in this article, inasmuch as each author lectures for Curasan.

References AQ: 2

1. Salama H, Salama MA, Garber D, et al. The interproximal height of bone: a guidepost to esthetic strategies and soft tissue contours in anterior tooth replacement. *J Pract Periodontics Aesthet Dent*. 2003;5:64-73.
2. 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.
3. Gottlieb B. Der Epithelansatz am Zahne. *Dtsch Monatsschr Zahnhk*. 1921;39:142-147.
4. Orban B, Kohler J. The physiologic gingival sulcus. *Z Stomatol*. 1924;22:353.
5. Gargiulo AW, Wentz FM, Orban B. Dimensions and relations of the dentogingival junction in humans. *J Periodontol*. 1961;32:111-119.
6. Cohen DW. Biologic width. Washington, DC. Presented at Walter Reed Army Medical Center; 1962. AQ: 3
7. Quirynen M, Van Steenberghe D. Bacterial colonization of the internal part of two-stage implants: an in vivo study. *Clin Oral Implants Res*. 1994;4:158-161.
8. Quirynen M, Bollen CM, Eyssen H, et al. Microbial penetration along the implant components of the Branemark system: an in vitro study. *Clin Oral Implants Res*. 1994;5:239-244.
9. Ericsson I, Persson LG, Berglundh T, et al. Different types of inflammatory reactions in periimplant soft tissues. *J Clin Periodontol*. 1995;22:255-261.
10. Persson LG, Lekholm U, Leonhardt A, et al. Bacterial colonization on internal surfaces of Branemark system implant components. *Clin Oral Implants Res*. 1996;7:90-95.

11. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of the bone on the presence or absence of the interproximal dental papilla. *J Periodontol*. 1992;63:995-996.

12. Tarnow DP, Elian N, Fletcher P, et al. Vertical distance from the crest of bone to the height of the interproximal papilla between adjacent implants. *J Periodontol*. 2003;74:1785-1788.

13. Hermann JS, Schoofield JD, Schenk RK, et al. Influence of the size of the microgap on crestal bone changes around titanium implants: a histometric evaluation of unloaded non-submerged implants in the canine mandible. *J Periodontol*. 2001;72:1372-1383.

14. Todescan FF, Pustiglioni FE, Imbronito AV, et al. Influence of the microgap in the peri-implant hard and soft tissues: a histomorphometric study in dogs. *Int J Oral Maxillofac Implants*. 2002;17:467-472.

15. Dibart S, Warbington M, Su MF, et al. In vitro evaluation of the implant- abutment bacterial seal: the locking taper system. *J Oral Maxillofac Surgery*. 2005;20:732-737.

16. Hermann JS, Buser D, Schenk RK, et al. Crestal bone changes around titanium implants: a histometric evaluation of unloaded non-submerged and submerged implants in the canine mandible. *J Periodontol*. 2000;71:1412-1424.

17. Maynard JG, Wilson RD. Physiologic dimensions of the periodontium significant to the restorative dentist. *J Periodontol*. 1979;50:170-174.

18. Carnevale G, Sterrantino SF, Di Febo G. Soft and hard tissue wound healing following tooth preparation to the alveolar crest. *Int J Periodontics Restorative Dent*. 1983;3:36-53.

19. Gardner DM. Platform switching as a means to achieving implant esthetics. *N Y State Dent J*. 2005;71:34-37.

20. Lazzara RJ, Porter SS. Platform switching: a new concept in implant dentistry for controlling postrestorative crestal bone levels. *Int J Periodontics Restorative Dent*. 2006;26:9-17.

21. Baumgarten H, Cocchetto R, Testori T, et al. A new implant design for crestal bone preservation: initial observations and case report. *Pract Proced Aesthet Dent*. 2005;17:735-740.

22. Hermann JS, Cochran DS, Nummikoski PV, et al. Crestal bone changes around titanium implants: a radiographic evaluation unloaded submerged and nonsubmerged and submerged implants in the canine mandible. *J Periodontol*. 1997;68:1117-1130.

23. Weber HP, Buser D, Fiorellini JP, et al. Radiographic evaluation of crestal bone levels adjacent to non-submerged titanium implants. *Clin Oral Implants Res*. 1992;3:181-188.

24. Gerber C, Hardt N, Von Arx T. Esthetic plus-ITI-Implantate (TPS): Eine prospektive klinische Studie. *Schweiz Monatsschr Zahnmed*. 2002;113:12-19.

25. Hämmerle CH, Bragger U, Burgin W, et al. The effect of subcrestal placement of the polished surface of ITI implants on marginal soft and hard tissues. *Clin Oral Implants Res*. 1996;7:111-119.

26. Abrahamsson I, Berglundh T, Lindhe J. The mucosal barrier following abutment dis/reconnection: an experimental study in dogs. *J Clin Periodontol*. 1997;24:569-557.

27. Berglundh T, Lindhe J, Ericsson I, et al. The soft tissue barrier at implants and teeth. *Clin Oral Implants Res*. 1991;2:81-90.

28. Cochran D, Simpson J, Weber H, et al. Attachment and growth of periodontal cells on smooth and rough titanium. *Int J Oral Maxillofac Implants*. 1994;9:289-296.

29. Misch CE. *Contemporary Implant Dentistry*. 2nd ed. Mosby; 1999.

30. Kois JC. Predictable single tooth peri-implant esthetics: five diagnostic keys. *Compend Contin Educ Dent*. 2001;22:199-206.

31. Kois JC. Altering gingival levels: the restorative connection: biological variables. *J Esthet Dent*. 1994;6:3-9.

32. Palacci P. *Esthetic Implant Dentistry*. Quintessence; 2001.

33. Nentwig GH. The Ankylos implant system: concept and clinical application. *J Oral Implantol*. 2004;30:171-177.

34. Nentwig GH, Mairgünther R. Reaktionen an der Knochen-Implantatgrenze bei Brückenversorgungen mit dem NM-System. 1992;8:251-253. AQ: 4

35. Blake A. *What Every Engineer Should Know about Threaded Fasteners Materials and Design*. New York, NY: Lawrence Livermore Laboratories, Marcel Dekker, Inc; 1986.

36. Driskell TD. *The DB Precision Implant System 1000 Series: Evolution and Rationale*. Galena, OH: Driskell Bioengineering; 1985.

37. Davies JE. Mechanisms of endosseous integration. *Int J Prosthodont*. 1998;11:391-401.

38. Daftary F. The bio-esthetic abutment system: an evolution in implant prosthetics. *Int J Dent Symp*. 1995;3:10-17.

39. Buser D, Ruskin J, Higginbottom F, et al. Osseointegration of titanium implants in bone regenerated membrane-protected defects: a histologic study in the canine mandible. *Int J Oral Maxillofac Implants*. 1995;10:666.

40. Branemark PI, Adell R, Breine U, et al. Intra-osseous anchorage of dental prostheses, I: experimental studies. *Scand J Plast Reconstr Surg*. 1969;3:81-100.

41. Adell R, Lekholm U, Rockler B, et al. Marginal tissue reactions at osseointegrated titanium fixtures: a 3-year longitudinal prospective study. *Int J Oral Maxillofac Surgery*. 1986;15:39-52.

42. Cochran DL, Hermann JS, Schenk RK, et al. Biologic width around titanium implants: a histometric analysis of the implanto-gingival junction around unloaded and loaded nonsubmerged implants in the canine mandible. *J Periodontol*. 1997;68:186-198.

43. Davaparnah M, Martinez H, Tecucianu JF. Apical-coronal implant position: recent surgical proposals: technical note. *Int J Oral Maxillofac Implants*. 2000;15:865-872.

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ID Abstract Translations

GERMAN / DEUTSCH

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Maßgebliche Parameter für ein ästhetisches Ergebnis: Teil I Die die Erhaltung des randständigen Knochengewebes im das Implantat umlagernden Bereich beeinflussenden Faktoren