The Implant Supracrestal Complex and Its Significance for Long-Term Successful Clinical Outcomes

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Emerging evidence implies significant interrelations between the condition of the peri-implant tissues and the implant-abutment-prosthesis complex. A new paradigm for studying the peri-implant tissues in close interrelation with the implant-abutment-prosthesis complex in the presence of the oral biofilm is essential.

The aims of this paper are to introduce the concept of the “implant supracrestal complex” (ISC) and to describe the critical elements that define it as a unique anatomical and functional system of human tissues, mechanical components, and oral bacteria/biofilm. This paper reviews recent evidence to identify the impact of design features on short-term clinical outcomes and long-term health of the peri-implant bone and soft tissues. Prosthetic-driven implant placement is a prerequisite for proper ISC design, which in turn can indirectly influence the structure and dimensions of the peri-implant soft tissues. Design features of the implant-prosthesis-abutment complex, such as the emergence profile, emergence angle, and cervical margin, as well as the design of the implant-abutment and abutment-prosthesis junctions and their locations in relation to the tissues of the ISC, can have a significant impact on the maintenance of stable and healthy peri-implant tissues in the long term. Int J Prosthodont 2021;34:88–100. doi: 10.11607/ijp.7201

A multitude of terms have been used to describe the peri-implant tissue coronal to the marginal bone. Initial terms were a direct extrapolation of periodontal terms, from the concept of the “biologic width”1 to the recently introduced “supracrestal tissue attachment.”2 However, the significant anatomical and structural differences between periodontal and peri-implant tissues (with the latter displaying “attachment” only at the level of the junctional epithelium [JE]) do not allow for a direct extrapolation of terms from the periodontium. Consequently, the terms “peri-implant soft tissue barrier,”3 “peri-implant mucosa,”4 “implant mucosal tunnel,”5 and, most recently, the specific “peri-implant phenotype,”6 have been suggested to describe peri-implant tissues.

Although such definitions appear adequate for describing the peri-implant soft tissues, there is an increasing body of evidence pointing toward significant interrelations between the condition of the peri-implant tissue and the implant-abutment-prosthesis (IAP) complex, all in the constant presence of oral bacteria. Emerging evidence suggests that factors such as the type of implant-abutment junction (IAJ) and prosthesis design and retention can have a significant influence on the short-term clinical outcomes and long-term health of the peri-implant bone and soft tissues.7,8

Consequently, a new paradigm is essential by which peri-implant tissues will be studied in close interrelation with the IAP complex under the presence of oral biofilm as one multi-element anatomical and functional unit. In such a system of close...
anatomical and functional interaction of the mechanical components and the human tissues, deficiencies or problems in one of the parts might manifest problems clinically through complications in any of the other. Such a paradigm is well aligned with the emerging concept of health and chronic disease being perceived as symbiosis or dysbiosis; ie, the outcome of complex interactions between human tissues and medical devices (such as dental implants) and bacteria.9–11

The aim of this paper is to introduce the concept of the “implant supracrestal complex” (ISC) and to describe the critical elements that define it as a unique anatomical and functional system of human tissues, mechanical components, and oral bacteria/biofilm. Furthermore, this paper aims to review the current evidence on critical design features of the ISC that can contribute to long-term sustainable and healthy outcomes or introduce risks.

ANATOMY AND COMPONENTS OF THE IMPLANT TRANSMUCOSAL COMPLEX

The anatomical structures of the human tissues, the mechanical components of the implant, abutment, and prosthetic, and the oral bacteria are closely interrelated toward maintaining health, as expressed through clinically stable long-term outcomes. In this capacity, the ISC displays elements of homeostatic regulation, and the tissues of the ISC are in close anatomical and functional relation with mechanical components through the interface of osseointegration and epithelial attachment. Homeostasis can be thought of as a dynamic equilibrium rather than a constant, unchanging state, as tissues and cells respond to constant internal and external changes in order to maintain long-term anatomical integrity and function.

Anatomical Structures of Human Tissues in the ISC

From apical to coronal in the vertical direction, the tissues of the ISC are defined by the marginal bone (MB), the connective tissue (CT), theJE, and the sulcus, along with the sulcular epithelium.

In implants, CT appears with no vascular supply close to the abutment and very few fibroblasts, more resembling a scar tissue. This is likely attributed to lack of the PDL vascular complex.3 Blood vessels originating from the suprapapioseal complex are located in the lateral borders of the CT/JE zone. These blood vessels are the origin of the immune response to bacteria in the sulcus.12,13 In a process similar to that of teeth, peri-implant crevicular fluid (PICF) is produced and flows into the sulcus through the JE. Analysis of PICF for protein biomarkers such as proinflammatory cytokines, chemokines, and bone turnover markers can reveal clinical and subclinical inflammation.14

Although the great majority of histomorphometry studies available are animal studies, human studies point to the zone of the CT and the JE occupying between 3 and 4.5 mm3,15 in a vertical dimension. This zone, previously called the “biologic zone” or “biologic width,”3 might be genetically determined. Although individual studies have suggested small differences in the JE and CT dimensions when different surfaces were used3,16 or when two-piece were compared to one-piece implants,17 at present, no intervention, surface, or implant design has been shown to predictably achieve any morphologic or structural changes in these tissues.18,19 As with all anatomical structures, it is reasonable to assume that the dimensions of the CT and JE could present with natural, limited variations between different individuals, different anatomical locations,20 or different peri-implant tissue sites.

In contrast to the JE/CT zone, the peri-implant sulcus varies significantly in depth depending on the local anatomy, the implant position, or the different sites around the same implant, especially in the anterior maxilla.21,22 Unlike natural teeth, where the healthy sulcus extends between 0.5 and 1.5 mm in depth, peri-implant sites might present with a much deeper sulcus. The natural scalloping of the gingival tissues observed around teeth is a result of the corresponding scalloping of the underlying bone and the corresponding shape of the cementoenamel junction (Fig 1). Such scalloping of the tissues has not been possible to maintain around implants, and the use of scalloped dental implants has resulted in increased bone loss.23 Consequently, the scalloping of peri-implant soft tissues—pronounced primarily in the esthetic zone—is only possible with a peri-implant sulcus depth of 3 to 5 mm at interproximal sites, while the sulcus depth in the buccal sites of the implant could be as little as 0.5 to 1.5 mm. It is therefore evident that the concept of supracrestal attachment as described around natural teeth cannot be applied to peri-implant tissues. Similarly, a peri-implant sulcus deeper than 3 mm is not to be confused with a periodontal pocket. The former is the outcome of tissue healing around a clean biomaterial surface, while the latter is the result of slow apical migration of the JE due to a challenge from biofilm-induced chronic inflammation.

Taking into consideration the above information, it becomes important to establish a minimum peri-implant supracrestal vertical tissue height of about 3 to 4.5 mm that will adequately accommodate the biologic demands of sustainable health. In cases where the vertical height of the peri-implant tissue is less than 3 mm, marginal bone resorption has often been reported around the implant platform. This might be a physiologic remodeling that results in reestablishing the vertical dimensions required to accommodate the soft tissues at the expense of the crestal peri-implant bone. Several researchers have correlated this pattern of early bone resorption and preoperative supracrestal gingival tissue height.24,25
Characteristics of the IAP Interface

The critical design characteristics of the IAP complex that have been shown to impact the configuration of the peri-implant marginal bone and soft tissues will be discussed separately for bone-level and tissue-level implants. The authors consider all implants with a smooth transmucosal collar that varies from 0.5 to 3 mm in vertical height to be tissue-level implants, whereas bone-level implants are implants without a transmucosal part that are intended to be placed with bone contact for their entire length, while the transmucosal part is facilitated through a detachable abutment. Platform switching is defined as a horizontal discrepancy between the diameter of the implant shoulder of bone-level implants and the diameter of the corresponding abutment.26

Two critical design features of the IAP intended to be in close contact with the peri-implant soft tissues are the EP and the CM. The shape, position, and dimensions of both the EP and CM could significantly influence the short- and long-term outcomes of implant treatment. Furthermore, the IAP contains two important interfaces: the implant-abutment junction (IAJ) and the abutment-prosthesis junction (APJ).

Understanding the influence of such design choices on the healing and long-term configuration of the bone and soft tissues is essential for successful clinical outcomes.

Emergence profile

The EP is defined in the ninth edition of the Glossary of Prosthodontic Terms as “the contour of a tooth or restoration, such as the crown on a natural tooth, dental implant, or dental implant abutment, as it relates to the emergence from circumscribed soft tissues.” In this definition, no differentiation is being made related to implants vs teeth; rather, the emphasis is placed on its interrelation with the “circumscribed soft tissues.” For the purpose of this paper and based on the implant literature so far, the EP could be further defined as the entire transmucosal part of the IAP that extends from the most coronal part of the peri-implant mucosa to the implant platform for a bone-level implant, or as the most coronal intraosseous segment for a tissue-level implant (Fig 1). In the case of tissue-level implants, the soft tissue collar of the implant constitutes the apical end of the EP. The function of the EP is to ensure a proper transition from the implant to the CM while allowing for adequate space for the peri-implant tissues.

The emergence angle (EA), likewise, was defined as “the angle between the average tangent of the transitional contour relative to the long axis of a tooth, dental implant, or dental implant abutment.” The EA has been initially defined on natural teeth and was calculated by bringing the tangent line on the crown to the point corresponding to the gingival margin. Thus, as defined on natural teeth, the EA represents the angle of the tooth or prosthesis crown at the exact “point of emergence” through the gingival tissues.27,28

Two recent studies7,29 have measured the EA mesial and distal of implant restorations using periapical radiographs. The major limitation of radiographs is that they do not allow for estimation of the soft tissue margin; thus, calculation of the EA was conducted without any relevance to the actual “point of emergence,” which was invisible in the radiographs. Instead, two points were defined, one on the shoulder of the bone-level implant or the collar of the tissue-level implant and one on a selected point of the profile of the prosthesis, and the tangent line was drawn. The clinical relevance of defining the EA in this manner and what it actually represents remain to be further clarified. Such measurements include a significant risk of subjective judgment, as the convexity or concavity of the EP might influence the position of the second point and consequently the tangent line. Furthermore, the true emergence and level of the soft tissues are not considered in the calculation of the EA, which might reduce the clinical relevance. Finally, when a measurement is conducted on tissue-level implants, the first
point is placed in a different location of the supracrestal complex than when in bone-level implants, which could also seriously affect the calculation of the EA.

Bone-level implants allow for the design of the EP in its entirety, and the angle of the emergence can be determined by the prosthetic abutment. Although “prefabricated” or “catalogue” abutments offer very little variation in EP, current CAD/CAM custom-made abutments allow for individual design of critical elements such as the EA and convexity/concavity. Even prefabricated abutments in many implant systems today come with different cuff heights, thus allowing the selection of different angles for the EP. The additional ability of platform switching in bone-level implants facilitates further customization of the EP.

The EP of tissue-level implants starts with the smooth implant collar, which corresponds to the apical part of the abutment in bone-level implants. This smooth collar provides the surface for CT adhesion and, depending on the height of the collar, possibly the whole or part of the JE attachment. Both the angle and height of the soft tissue collar vary significantly between different implant systems and even in implants of different types within the same system. Consequently, the design of the EP is predetermined for the most apical couple of millimeters, as height and angle are defined by the design and dimension of the soft tissue collar. This prefabricated microgeometry, together with the lack of platform switching, could limit the options when designing the EP in such implants. Two studies27,29 investigating the impact of the EP in peri-implantitis prevalence have, however, excluded the transmucosal collar when calculating the EA in tissue-level implant restorations. This might lead to inconsistencies when attempting to assess the impact of the EP between bone- and tissue-level implants.

**Cervical margin**

The CM of a prosthesis refers to the circumferential margin, where the most coronal border of the peri-implant mucosa receives the most apical visible portion of the prosthesis or “cervix.” Terms such as “restoration contour” or “soft tissue contour” have been used interchangeably in the past to describe this margin. The present authors, however, would like to emphasize that the CM is a feature of the implant prosthesis that is subject to the planning and design of the clinician, while the peri-implant soft tissue margin is the respective feature of the peri-implant mucosa formed in response to the CM. Around natural teeth, the CM will coincide with the most coronal part of the periodontal sulcus. In implant-supported prostheses, the CM is a prosthetic concept that is defined by the visible portion of the implant crown (Fig 2). Again, the CM ideally coincides with the most coronal part of the peri-implant sulcus.

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*Fig 2* Tissues surrounding the emergence profile in a typical implant-abutment-prosthesis complex in the esthetic zone. Subcrestal placement of this bone-level implant (in relation to the mesial and distal bone levels of neighboring teeth) has allowed for maintaining the desired scalloping of the soft tissues, but resulted in an increased sulcus depth in the mesial and distal areas. Observe that implant position and the design of the emergence profile allow for the cervical margin (CM) to coincide with the most coronal part of the sulcus, as in natural teeth. JE = junctional epithelium; CT = connective tissue.
Implant-abutment junction

The interface between the implant and the abutment is probably the most studied and best documented junction, and knowledge in this area has evolved significantly as a result. The original configuration of an external hex, flat-to-flat connection of Brånemark implants has been followed by a wide array of designs, with the most notable changes being the internal tapered connections and the concept of platform switching. The original flat-to-flat external connection was reported to allow wider micromovement and also potential microleakage. The fact that in this configuration the IAJ was placed at bone level might have been the reason for the marginal bone resorption or remodeling observed during the first months postsurgery, which might have led to the wide acceptance of 1.5 mm of marginal bone loss during the first year postsurgery as a biologic consequence of bone remodeling. Bacterial and fluid microleakage has been related to oral malodor, inflammation, and marginal bone loss, apart from the potential technical implications it could have for the long-term tight fit of the connection. On the other hand, implants with an internal tapered connection and platform switching have been shown to increase connection fit and stability and effectively prevent microleakage, while interface gaps are found to be no more than 1 to 2 μm (Fig 3). Although implants with such configurations have demonstrated clinically less marginal bone remodeling during the first and consecutive years postsurgery, microbiologic investigations have shown bacterial contamination of the IAJ in both external and internal connection types after 5 years in function. Seen collectively, such results suggest that although the connection design might influence bacterial activity levels qualitatively and quantitatively, no design has been shown to be completely immune clinically to effects of microleakage in the long term. At the same time, it should be noted that not all implant configurations might achieve very tight fit of the IAJ, in particular when third-party prosthetic components are used (Fig 4).

Fig 3 Implant-abutment junction under scanning electron microscopy of bone-level implants. (a and b) Astra Tech Morse Taper internal connection at ×32 and ×120 magnification, respectively. (c and d) Straumann Bone Level CrossFit connection at ×20 and ×55 magnification, respectively. The tight fit at the implant shoulder in both cases allows for a gap of less than 2 μm.
Tissue-level implants are not designed to have an IAJ at bone level, but rather more coronally in the ISC, depending on the height of the implant soft tissue collar. In the time of flat-to-flat external hex connections, the absence of an IAJ on tissue-level implants was considered by many a “safer” configuration, as it eliminated the risks associated with the junction being close to the marginal bone. Nevertheless, the height of the soft tissue collar is an important parameter, seen under the light of the current understanding of essential vertical dimensions of soft tissues. A soft tissue collar of less than 2 mm might be too short to properly accommodate the adequate soft tissue vertical dimensions. Furthermore, the IAJ on tissue-level implants is less precise, even if it is tight. As the abutment sits externally on the implant collar, minor vertical discrepancies are shown to result in a significant “undercut” of 50 to 100 μm (Fig 5), which might turn into a plaque-retentive point if populated with biofilm. As this junction is almost always located in the apical section of the sulcus, continuous apical migration of the biofilm reaching this point could exacerbate the vicious circle of peri-implant tissue inflammation. This might reduce the ability to disinfect the implant after being affected by mucositis if this junction is placed deep in the ISC.

**Abutment-prosthesis junction**

The APJ can be present in both bone- and tissue-level implants, but varies significantly between implant systems and types of restoration. In certain one-piece API configurations (eg, precious alloy abutments where the prosthesis is being cast on the abutment), this junction might not be detectable clinically, as the abutment and the prosthesis are fused. When present, the APJ is intended to be within the sulcus and is thus of high clinical significance.

The interface between the implant and prosthesis is commonly structured in one of four different ways (Figs 6 to 9):

- Prosthesis cemented on an extraorally cementable screw-retained abutment, such as a titanium base. In this configuration, the often milled or CAD/CAM prosthesis will be cemented outside the mouth. The prosthesis-abutment complex is then polished and placed in the mouth as a one-piece, screw-retained restoration. The extraoral cementation eliminates the risk of cement rests, but a thin layer of cement is very likely to be exposed in the API, even in ideal conditions (Fig 10). Even when tight, the interface between the abutment and prosthesis in such cases can result in some discrepancies that can act as plaque retention points. An alternative configuration is a prosthesis cast on top of a base abutment, which will result in a one-piece restoration without any clinically detectable interface between the abutment and prosthesis.
Prosthesis cemented on an intraorally cementable screw-retained abutment. In this configuration, the prosthesis will be cemented in the mouth typically due to esthetic requirements when the implant angle is not optimal. In such cases, the APJ coincides with the cementation level, so it is important to place it as close to the sulcus opening as possible. The risk of cement rests increases significantly when this junction is placed deeper in the sulcus.\textsuperscript{44} Cement rests can constitute a major long-term risk by being pushed under the JE, jeopardizing the integrity of the ISC, and/or acting as plaque retention points.\textsuperscript{45}

Prosthesis retained by a screw on an intermediate abutment. This configuration will result in a restoration with one or two screws for every implant. Tight fit of both the IAJ and APJ is paramount for preventing microleakage and plaque retention.

Prosthesis attached directly to the implant (without an intermediate abutment). A typical example of this configuration would be a milled partial denture at the implant level. This will result in one screw retaining the prosthesis on each implant. Studies have shown prostheses of this type on bone-level implants to present with increased risk of bone resorption,\textsuperscript{46} possibly related to increased risk of misfit. The tight fit of this junction, as well as the absence of misfit, discrepancies, and gaps, is of paramount importance, since otherwise bacterial products will directly affect the sulcus through

Fig 5  Implant-abutment junction under scanning electron microscopy of tissue-level implants. (a and b) Straumann Tissue Level synOcta connection with gold abutment at ×30 and ×100 magnification, respectively. (c and d) Straumann Tissue Level synOcta connection with third-party titanium abutment at ×13 and ×100 magnification, respectively. Observe the tight fit between the implant and abutment at the shoulder, which in both cases allows for a gap of less than 2 μm. However, the horizontal discrepancy in both cases creates an “undercut” exceeding 50 μm.
Fig 6  Schematic representation of common types of implant-abutment-prosthesis configurations for bone-level implants. (a) Prosthesis cemented on an extraorally cementable abutment, such as a titanium base. (b) Prosthesis cemented on an intraorally cementable abutment. (c) Prosthesis retained by a screw on an intermediate abutment. (d) Prosthesis attached directly to the implant (without an intermediate abutment).

Fig 7  Details of the implant-abutment-prosthesis interfaces of (a) a prosthesis cemented extraorally on the abutment; (b) a prosthesis cemented on an intraorally cementable abutment; (c) a prosthesis retained by a screw on an intermediate abutment; and (d) a prosthesis attached directly to the implant (without an intermediate abutment) in bone-level implants. Red line = peri-implant soft tissues and emergence profile; blue line = prosthesis-abutment junction; yellow line = implant-abutment junction.
Fig 8: Schematic representation of common types of implant-abutment-prosthesis configurations for tissue-level implants. (a) Prosthesis cemented on an extraorally cementable abutment such as a titanium base. (b) Prosthesis cemented on an intraorally cementable abutment. (c) Prosthesis retained by a screw on an intermediate abutment. (d) One-piece prosthesis cast on abutment.

Fig 9: Details of the implant-abutment-prosthesis interfaces of (a) a prosthesis cemented extraorally on the abutment; (b) a prosthesis cemented on an intraorally cementable abutment; (c) a prosthesis retained by a screw on an intermediate abutment; and (d) a prosthesis cast on the abutment in tissue-level implants. Red line = peri-implant soft tissues and emergence profile; blue line = prosthesis-abutment junction; yellow line = implant-abutment junction.
microleakage and/or plaque retention. In vitro studies have also documented that even small misfit in partial dentures with this configuration can have detrimental effects on the veneer as well.\textsuperscript{46,47} Certain laboratory manufacturing processes resulting in an oxidation layer on the surface of the prosthesis might affect the tight fit, as the oxidation layer has to be removed often with airborne-particle abrasion, thus altering the surface of the prosthesis that connects to the implant.\textsuperscript{41}

**Bacteria: Oral Biofilm**

Plaque accumulation is detrimental for the health of peri-implant tissues. Studies of experimental peri-implant mucositis in humans have shown that undisturbed plaque accumulation will lead to inflammation of the peri-implant tissues within 3 weeks without any exceptions.\textsuperscript{5,48–50} At this point it is important to emphasize that detrimental peri-implant inflammation is not caused by the presence of bacteria in the sulcus in planktonic status, but is rather the result of accumulation of mature pathogenic biofilm. Biofilm formation requires a solid hard surface and a liquid environment infected with bacteria. As both conditions are met on the prosthesis surface, the biofilm forms first on the part of the prosthesis that is exposed in the oral cavity and first interacts with the soft tissues at the CM. Establishment of a mature, pathogenic biofilm at the CM will require at least 7 to 14 days, after which it will provoke the immune response and lead to inflammation of the oral mucosa.\textsuperscript{5,48–50} In the case of oral mucosa not in proximity to implants, the inflammation remains limited superficially in the mucosa; as, for example, under an uncleannable prosthesis pontic or a denture. However, biofilm accumulation in close proximity to the peri-implant sulcus leads to an inflammatory response from the peri-implant soft tissue margins and the sulcular epithelium, leading to peri-implant mucositis and kickstarting a vicious circle that eventually results in apical migration of the JE, peri-implantitis, and formation of a peri-implant pocket. There is at present no evidence that sulcus depth influences the initiation of peri-implant mucositis. On the contrary, a study of experimental mucositis\textsuperscript{5} showed that peri-implant tissues around shallow and deep sulci remained equally healthy with the application of professional maintenance care and self-performed oral hygiene, thus maintaining a biofilm-free CM. The same study, however, also suggested a less favorable pattern of resolution when peri-implant mucositis was initiated in tissue-level implants with a deeper sulcus.

**Clinical Implications for Design of the ISC**

**The ISC and plaque-induced peri-implant inflammation**

Recent evidence has demonstrated that peri-implant tissues in particular mount a greater host-inflammatory response to plaque accumulation than at teeth,\textsuperscript{51} suggesting that plaque control around implants may be of critical importance in averting the cascade of destructive inflammatory peri-implant disease. There are two main factors that can expose the peri-implant sulcus to the detriments of biofilm accumulation: deficient oral hygiene and improper design of the CM. The former requires proper training and motivation from the patient, while the latter is an iatrogenic condition. When the CM coincides with the coronal margin of the peri-implant sulcus, oral hygiene can efficiently remove the biofilm from the proximity of the sulcus (Fig 2). On the contrary, a nonanatomical cervical margin, as created by the commonly used stock abutments that are cylindrical in shape, can be located away from the sulcus, resulting in a horizontal discrepancy between the CM and sulcus (or a “ridge lap”). Plaque accumulation in proximity of the sulcus can then proceed with little or no inhibition from oral hygiene, posing a significant risk and increasing the prevalence of peri-implantitis.\textsuperscript{52} The wider the prosthesis, the bigger this ridge lap becomes;
in particular as the restoration location moves anterior to posterior, since the lateral size of the prosthesis increases. An improper CM could further inhibit monitoring of the health of peri-implant tissues, preventing efficient probing or resulting in a false negative probing depth and thus underestimating the extent of bone loss. An improper CM could further inhibit monitoring of the health of peri-implant tissues, preventing efficient probing or resulting in a false negative probing depth and thus underestimating the extent of bone loss. As the design of the CM is key for access to oral hygiene and sustainability, calculation of the EA in an implant prosthesis for exactly this location might be a much more clinically relevant measurement, as if it was conducted on natural teeth. A tangent line to the CM of the implant prosthesis might reflect the ability to maintain oral hygiene much more precisely than a line drawn for the whole EP. A wide EA there would approximate a ridge lap and inhibit oral hygiene, while a narrow one would resemble the EA reported for natural teeth. To do such a calculation on implants, however, would require a precise location of the mucosal margin, which cannot be done through radiographs.

Avoiding the need for a ridge lap design necessitates placement of the implant in the optimal restorative position, angle, and depth (Fig 11). Katafuchi et al showed a correlation between the depth of placement of bone-level implants and the EA, with the latter being more favorable when implants were placed subcrestally. This indicates that although subcrestal placement of bone-level implants should not be seen as the norm, it might be essential if directed by the need to create the desired prosthesis contour, CM, and EP.

The ISC and implant-abutment/prosthesis junctions

Attention must be paid to the risks presented by any gaps within the supracrestal complex, such as those that might be created in the IAJ or IPJ. If not tight enough, such interfaces might facilitate microleakage and circulation of bacterial products into the ISC, while micromobility of the components might also contribute to problems. Furthermore, gaps within the ISC might act as retention points when infected with biofilm, possibly inhibiting disinfection efforts with professional means and oral hygiene and complicating the resolution of inflammation. Modern bone-level implant systems with internal connection can achieve a very tight fit in the IAJ, which can be at the level of 1 to 2 μm. In addition, in the case of bone-level implants with platform switching, the IAJ remains well apical of the JE, and is thus potentially protected by direct plaque contamination in the early stages of mucositis. Nevertheless, screw loosening of the healing, temporary, or prosthetic abutment at the bone-level implant could potentially be more detrimental to the bone margins and tissue health than in the case of a tissue-level implant.

The IAJ of tissue-level implants presents with a different configuration; however, the fit of the components can be equally tight in the range of 1 to 2 μm (Fig 5). Depending on the height of the smooth collar, this junction is in most cases exposed in the sulcus coronal of the JE or close to the sulcus opening and is thus more easily
accessible through oral hygiene. Abutment loosening in this case might be less detrimental than in the case of bone-level implants. Nevertheless, if this interface is deep in the sulcus, as in the case of increased vertical dimension of the soft tissues or in subcrestal placement, this area could act as a difficult-to-disinfect retention point if colonized with biofilm. It is therefore advisable to avoid the placement of tissue-level implants in sites with increased vertical soft tissue height, which would result in placing the IAP several millimeters under the CM. Subcrestal implant placement is well documented in the case of platform-switching bone-level implants, but should be avoided with tissue-level implants, as it would result in less precise placement of the IAP junction (Fig 5) deep under the supracrestal complex tissues.

Limitations
The present authors accept that the use of these terms and the definitions of the respective anatomical and morphologic structures correspond to a configuration in ideal conditions. For example, in the case of subcrestal placement of a bone-level implant, the supracrestal complex will be established from below the implant crest, thus seemingly contradicting the term. The term “supraplatform implant complex” was thus proposed to address such a configuration, but the authors acknowledge that such a term would be confusing in the case of tissue-level implants, where the “platform” is already some millimeters coronal of the bone crest. Consequently, the authors have decided to describe the anatomical and morphologic landmarks of importance that will be present in most common IAP configurations while acknowledging that some very specific implant systems or configurations might not fall exactly within this term. The terms have thus been described for bone- and tissue-level two-piece implants being placed for axial loading. Even within this category of implants, significant diversity of design persists; for example, in the height and angle of the transmucosal collar of tissue-level implants, or the presence and extent of platform switching in bone-level implants. The authors also acknowledge that there is a significant diversity of implant systems, connections, and combinations with potentially different levels of precision and fit of components. The samples that have been used for discussion in this paper originate from specific published research in peer-reviewed journals and only address the conditions and results of these investigations. The use of different materials for the submucosal components, such as titanium, gold alloys, and ceramics, and also the use of nonoriginal prosthetic components and screws, might also impact the tissues and configuration of the supracrestal complex.

Furthermore, the authors believe that, as with any anatomical feature, the dimensions and structure of the peri-implant tissues can present with significant physiologic variation between individuals or different anatomical sites in the same person. Histologic studies in humans are scarce and typically based on very few samples. Even so, the means describing the dimensions are accompanied by high standard deviations, which is suggestive of significant variation.

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