

Defining the Biologic and Restorative Rooms for Implant Emergence Profile: A Concept for Clinical Implications and Its Impact on Hard and Soft Tissue Integration

Giacomo Fabbri, DDS¹ /Francesco Mintrone, DDS² /Fabiana Aellos, DDS³ /Joseph Lee, DDS⁴

¹ Adjunct faculty Tuft University School of Dental Medicine, Boston, Massachusetts, USA; Private Practice, Cattolica, Rimini, Italy.

² Private Practice, Sassuolo, Modena, Italy.

³ Department of Surgery, Stanford University School of Medicine, Stanford, California, USA.

⁴ Advanced Dental Education Program in Implant Dentistry, Loma Linda University, School of Dentistry, Loma Linda, California, USA; Private Practice, Whittier, California, USA.

Submitted May 7, 2025; accepted October 8, 2025.

Abstract

The long-term success of implant-supported restorations depends on achieving both esthetic and biologic stability through proper management of the transmucosal space. This article introduces a novel concept for comprehensive surgical, restorative, and laboratory interpretation of the subgingival implant complex by dividing it into two functional compartments: the Biological Room (BR) and the Restorative Room (RR). The BR, located immediately coronal from the bone-to-implant contact, is responsible for peri-implant tissue integration which serves as a biologic barrier. This biologic barrier is achieved by the connective tissue and apical peri-implant epithelium which is populated by hemidesmosomal attachments. It must be managed using biocompatible materials (eg, titanium or zirconia) with specific surface properties (roughness 0.1–0.2 microns) to promote stable mucointegration. A minimum height of 2.0 mm is

recommended for optimal hemidesmosomal function. The RR, located coronal to the BR, supports soft tissue architecture and esthetics and extends up to 3.0 mm. The prosthetic component in the RR is shaped to accommodate restorative needs and optimize the esthetic interface. Materials used here must balance esthetics, cleanability, and biocompatibility with highly polished surfaces to minimize plaque accumulation. This biologically driven framework enables clinicians and dental technicians to provide implant restorations that respect both esthetic and biologic principles, while promoting long-term peri-implant tissue health and clinical success. Previously, these concepts were described separately, but the Biological Room and Restorative Room concept serves as a guideline for all team members to achieve a desirable implant therapy. *Int J Periodontics Restorative Dent* 2025. doi: 10.11607/prd.7779

Introduction

Long-term success in implant dentistry can be described by two phases: early phase of osseointegration and mucointegration, and late phase of an implant restoration with healthy peri-implant tissue.¹ While the focus in earlier decades was optimizing the bone-to-implant interface, growing evidence highlights that the integrity of the soft tissue seal is just as critical for protecting peri-implant structures long-term.² One of the early concepts for describing implant prosthetic design is the “running room”, the distance between the implant platform and free gingival margin.¹⁻³ This was further classified into “critical” and “subcritical” contours to describe how prosthetic components are shaped within the transmucosal tunnel.³ These concepts provide a restorative guideline on developing an ideal emergence profile that supports soft tissue. However, they focus primarily on geometry and esthetics, without accounting for the biological events occurring in the same region. For example, Gomez-Meda et al describe the types of tissue

that are correlated to the restoration within this transmucosal space.⁴ However, detailed description of biology, hygienic maintenance, and laboratory involvement is not emphasized.^{5,6} It has become clear that the restorative surface in the transmucosal zone is not only for esthetics but also a biologically sensitive interface. Tissues in this region, connective tissue and epithelium, interacts with the prosthetic surface to play a critical role in maintaining the mucosal seal and protecting the underlying bone.⁷ Around natural teeth, the “biologic width” comprises the junctional epithelium (JE) and connective tissue that provides a protective barrier against microbial insult.⁸ Around implants, a similar supracrestal tissue complex exists although it differs in both structure and resilience.⁹ Studies have demonstrated that the peri-implant epithelium (PIE), while histologically like the junctional epithelium in natural teeth, lacks in regenerative capacity due to the absence of a stem cell population.^{10,11} Therefore, the biologic seal around implants is inherently more vulnerable. This has led to the concept of “mucointegration,” the integration of hemidesmosomal attachment from soft tissue to prosthetic surface, which has an added element to implant success.¹¹ On human subjects, the presence of hemidesmosomes attached to the surface of titanium abutment was originally described by Gould in 1984.¹² Subsequently, several studies using animal models have investigated this phenomenon.^{10–11} These findings, despite being derived from in vivo animal models, provide valuable insights of hemidesmosomal attachments. The clinical importance of this tissue–material interface in restorative protocols is often secondary to prosthetic or surgical priorities. Therefore, many restorative protocols underemphasize the biological requirements of this interface. This requires a unified framework or guideline that integrates biologic, prosthetic, and surgical principles into the implant therapy for placement and design of subgingival portion of implant restorations. The clinical model divides the subgingival implant restorative interface into two distinct functional

compartments: the Biological Room (BR) and Restorative Room (RR). The Biological Room refers to the apical portion of the transmucosal zone, which is the bone-to-implant contact to approximately 2 mm coronally. This region is responsible for establishing a protective soft tissue barrier. It must be managed with careful attention to material selection, surface properties, and restorative protocols that avoid disruption of tissue healing. The Restorative Room is located coronal from the BR and extends to the gingival margin. This compartment is where the restoration is shaped to support soft tissue contours, create a natural esthetic transition, and allow for effective hygiene access. Materials in this zone should be highly polished, biocompatible, and esthetically appropriate. While the BR is biologically sensitive and protected from mechanical disruption, the RR is shaped during provisionalization and final restoration for optimized esthetics and cleanability. This BR/RR guideline offers clinicians and dental technicians a structured approach for managing the biologic and restorative priorities of implant-supported restorations. It helps clarify how deep the implant is placed, how to select and position abutments, what materials to use, and how to shape restorations in a way that respects soft tissue biology. In the sections that follow, we will provide the rationale, clinical applications, and design principles of the Biological Room and Restorative Room model. Our goal is to provide a biologically driven restorative guideline that improves peri-implant tissue outcomes and long-term implant success. The Biological Room (BR) refers to the most apical portion of the subgingival implant contour—extending from the implant platform or bone-to-implant contact to the beginning of the Restorative Room. This is the region where mucointegration occurs and forms a soft tissue seal that protects the underlying bone. In most cases, the total vertical height from the free gingival margin to the bone-to-implant contact is approximately 4.0 mm. The BR typically occupies the lower 2.0 mm of this distance, and it can extend further in situations of

deeper implant placement for esthetic or anatomical reasons.^{13–15} Anatomically, the BR comprises of supracrestal connective tissue and the apical portion of the peri-implant epithelium (PIE)—the zone of densely concentrated hemidesmosomal attachments¹¹ (Figs 1, 2). Hence, this biologically active region plays a critical role in soft tissue adhesion and long-term implant stability. This description is based on available in vivo evidence, and further human studies are still needed to confirm these findings.

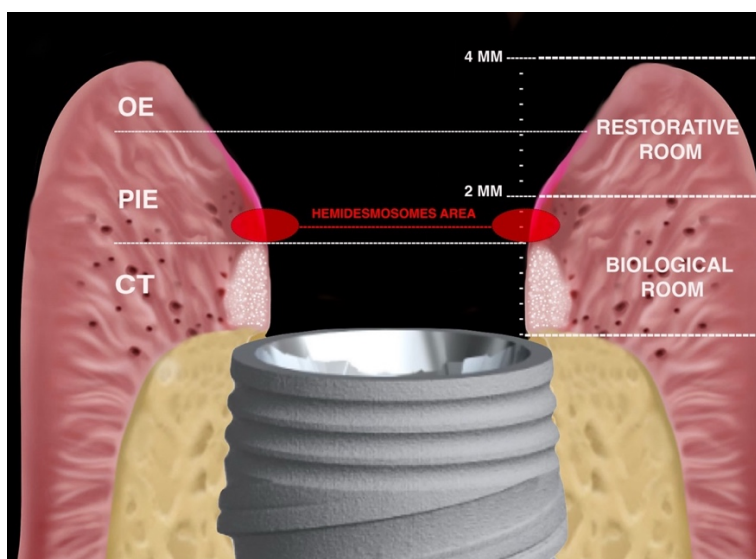


Fig 1 The illustration shows the supracrestal soft tissue of a bone-level implant. Within this thickness, moving from apical to coronal, we observe the connective tissue (CT), the peri-implant epithelium (PIE), and the oral epithelium. The boundary between CT and PIE is the area where hemidesmosomes are predominantly found—these are responsible for mucosal attachment to the prosthetic components. The Biological Room (BR) extends into the most apical part of the mucosal pathway, occupying the space of the CT and the apical portion of the PIE. The BR extends for at least 2 mm, but it can be even larger when the implant’s running room exceeds 4 mm or when dealing with cases where aesthetics is of lower priority. The Restorative Room, on the other hand, defines the more coronal portion of the emergence profile. The maximum vertical space this area can reach is 3 mm.

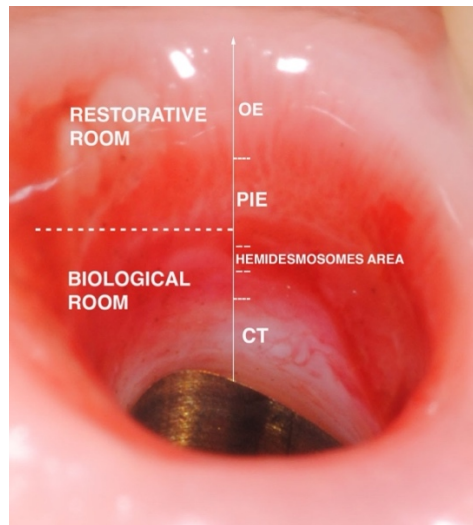


Fig 2 Clinical image shows the implant trans-mucosal tunnel, where the connective tissue (CT) and the peri-implant epithelium (PIE) can be identified.

Details and Guidelines of the Biologic Room

The Biological Room (BR) in tissue-level implants, which includes a built-in transmucosal collar, is typically located within this prefabricated supracrestal collar. In contrast, the BR in bone-level implant corresponds to the prosthetic–implant interface, where the abutment emerges from the implant body. In bone-level cases, two restorative strategies can be used to manage the BR:

- (a) A one-piece implant-level abutment that is designed and placed at the time of restoration, or
- (b) A two-piece concept, where a definitive intermediate abutment is placed at the time of surgery and never removed, following the “One Abutment, One Time” (OAOT) protocol (16) (Fig 3).

The primary objective of the BR is to promote muointegration—a stable soft tissue attachment to the transmucosal component. This attachment helps protect the underlying bone by resisting

bacterial infiltration and preserving peri-implant health. The three critical factors that influence BR performance are:

- Morphology
- Material and Surface Properties
- Restorative Approach

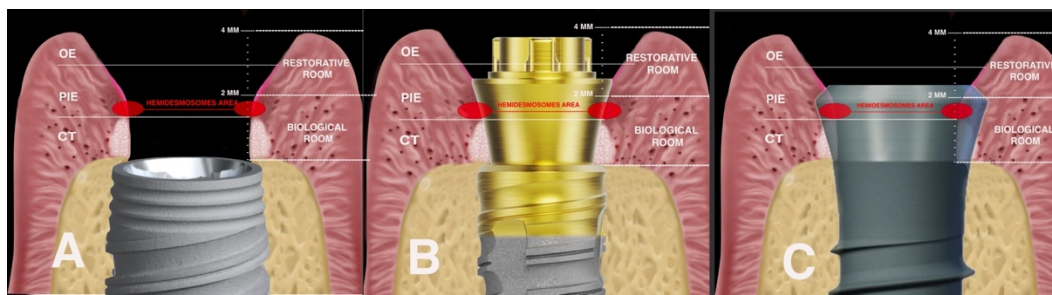


Fig 3 Illustration of three common restorative approaches in implant dentistry:

(A) Bone-level implant with a one-piece abutment; (B) Bone-level implant with an intermediate, definitive abutment (two-piece system); (C) Tissue-level implant with a built-in transmucosal collar. Among these, options B and C are generally preferred for maintaining the mucosal seal, as they minimize disruption during restorative procedures by avoiding repeated disconnection and reconnection of healing abutments at the implant level.

Morphology

The shape and contour of the implant collar or abutment within the Biological Room (BR) plays a crucial role in establishing the supracrestal tissue complex and supporting hemidesmosomal attachments—both essential to forming a stable “biologic width”. Abutments with a wide, deep, or significantly divergent emergence angle can displace soft tissues apically, which may lead to bone resorption as the biologic width is reestablished apically. Clinical studies has shown that emergence angles greater than 30°, particularly when combined with convex profiles, are

associated with increased marginal bone loss and higher rates of peri-implantitis.^{17,18} In contrast, smaller angles ($<30^\circ$) with straight or concave profiles correlate to better tissue stability.^{17–20} Hence, the BR should be designed with a straight-to-concave contour and narrow emergence angle to minimize interference with surrounding tissues and preserve the crestal bone. This provides space for soft tissue accommodation that allows for more stable soft tissue integration and reduces bone remodeling. Given the delicate nature of this zone, components used in the BR should be fabricated from materials with high biomechanical strength to maintain structural integrity with narrow diameters.

Material and Surface Properties

The materials and surface characteristics within the Biological Room (BR) are critical for establishing stable soft tissue adhesion through hemidesmosomal attachments. For effective mucointegration, the prosthetic surface characteristics must be biocompatible, clean, sterile, and hydrophilic, all of which promote epithelial and connective tissue cell adhesion.²¹ Key surface parameters influencing tissue response include chemistry, nanostructure, topography, surface charge, and wettability.^{21,22} Evidence suggests that a surface roughness between 0.1 and 0.2 microns is optimal for promoting cellular attachment in the BR.^{17,21,23} Among available materials, titanium and zirconia are best suited for this region due to their excellent biocompatibility and mechanical strength.^{16,23,24} These materials support both biological integration and structural performance, even within narrow transmucosal contours.

Restorative Approach

From a restorative standpoint, the “One Abutment, One Time” technique which uses two-piece abutment or tissue-level system is preferred when managing the BR.

These approaches minimize disruption to the soft tissue seal by avoiding repeated abutment disconnection and reconnection, thus supporting the uninterrupted bone and soft tissue healing.^{16,25,26}

In both systems, the micro- and macro-designs of the transmucosal component with surface properties are essential to ensuring soft tissue integration within the BR^{27,28} (Fig 3). In cases of one-piece implant-level abutment, it is recommended that the abutment have a minimum height of 2 mm. This ensures that the BR is entirely supported by a pristine, uninterrupted surface of titanium or zirconia to reduce contamination risk and optimize soft tissue adherence.²⁹

Details and guidelines of the Restorative Room

The Restorative Room (RR) refers to the coronal portion of the running room, which extends from the Biological Room (BR) to the free gingival margin. In a scenario with 4.0 mm distance between implant platform to the buccal gingival margin, the BR occupies the apical 2.0 mm, and the RR makes up the remaining coronal 2.0 mm. Unlike the BR, the RR varies in vertical dimension depending on the anatomical location. On the buccal and palatal/lingual sides, the RR has a different height than in the interproximal zones because the papillae and crestal bone peaks increases vertical soft tissue height (Fig 4). This anatomic variation resembles the natural form of the cementoenamel junction (CEJ), which follows the scalloped contour of the interproximal tissues in healthy dentition. The emergence profile within the RR should progressively flare to support the soft tissue and help shape a natural gingival contour. However, excessive vertical

extension or more than 3 mm on the buccal/facial side does not provide additional esthetic benefit and can compromise biologic space. Profiles that are over convex in this region can reduce the space needed for the supracrestal tissue complex. This over convexity can apply soft tissue tension and can initiate crestal bone remodeling.¹⁷⁻²⁰ This is especially relevant when using narrow or regular-diameter implant platforms, since the emergence profile can appear exaggerated.^{3,20,30} The main purpose of the RR is to create a seamlessly esthetic transition between the restoration and soft tissue. This includes supporting gingival architecture, enhancing pink esthetics, simplifying hygiene access, promoting soft tissue health, and providing adequate space for technicians to finalize the restoration.

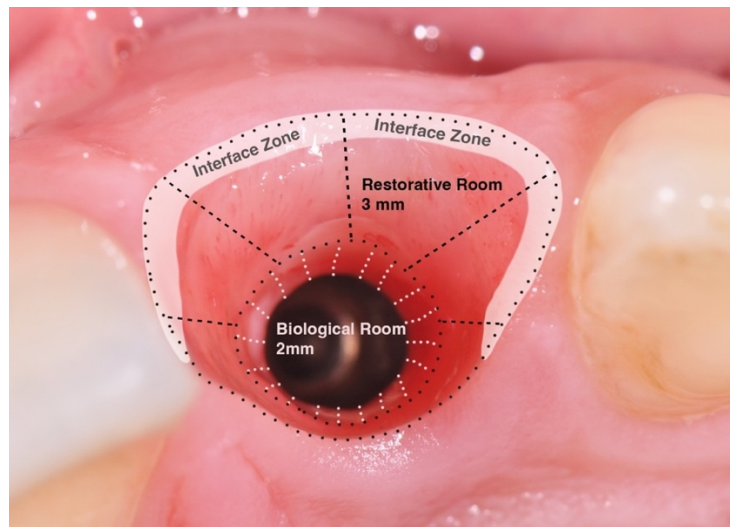


Fig 4 Emergence profile of an implant placed in the aesthetic zone of the upper arch. The Biological Room can be seen in the most apical portion, characterized by a very straight anatomy. Moving coronally, we observe the Restorative Room, which has a convex morphology as it needs to support the surrounding soft tissues. The final 1 mm of the RR identifies the Interface Zone, this is the sulcus area where the restoration must compenetrates with the soft tissues optimizing the aesthetic outcome. The area with the highest concentration of hemidesmosomes is clinically visible as a red band, sometimes slightly bleeding, since the removal of the healing abutment compromises

the adhesion between the soft tissues and the abutment itself. This area should always belong to the Biological Room to reinforce and protect the peri-implant mucosal seal.

The esthetic and spatial demands of the RR vary by region:

- In the anterior zone, careful design of the RR is essential to achieving a lifelike, natural esthetic result.
- In posterior areas, esthetic demands are lower, and a vertical RR height of 1.0 to 2.0 mm is usually sufficient.
- In anterior regions, the RR may range from 2.0 to 3.0 mm, depending on tissue thickness and implant depth.

Key factors in RR design include:

- Morphology – to guide soft tissue contour and esthetics
- Material selection – to optimize biocompatibility and visual harmony
- Cleanability – to support long-term soft tissue health and patient maintenance

Morphology

The morphology of the Restorative Room (RR) plays a key role in shaping soft tissue architecture and determining the gingival margin. In this zone, prosthetic designs directly influence esthetic outcomes. A concave emergence profile can lead to reduced soft tissue support, which may require compensation through connective tissue grafting or recontouring the provisional restoration.^{1,3,31} Conversely, a convex profile provides support to the gingival tissues, which mimics the natural shape of a tooth and contributing to esthetic gingival contours.³¹

Provisional restorations are critical tools for soft tissue management especially in the esthetic

zone. Adding or reducing restorative contour in the RR can guide the soft tissue into a desired position:

- Adding volume can push gingival tissue apically, helping define the gingival zenith.
- Reducing volume can allow for coronal migration of the soft tissue.³¹

In most definitive restorations, a convex RR profile is preferred to achieve optimal and harmonious pink esthetics. The coronal 1.0 mm of the RR is referred to as the Interface Zone (IZ), and this is where the prosthetic material meets the soft tissue. This zone is critical for achieving natural-looking transitions in color, volume, and morphology and ultimately shapes the Esthetic Interface (EI) (Figs 5–7).

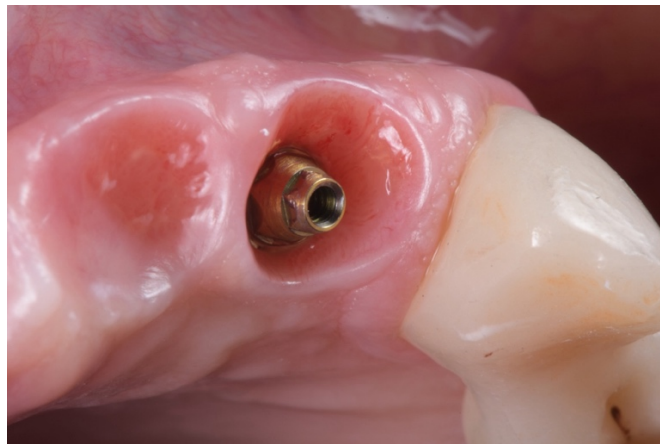


Fig 5 Soft tissue morphology and health in a anterior implant supported screw-retained rehabilitation at abutment level. The prosthesis is placed at the level of a final intermediate abutments; therefore, the prosthesis occupies just the restorative room (RR) of the emergence profile preserving the hemidesmosomes seal, soft tissue health and stability. In Figs 5 and 6 the prosthesis and the final results are shown.



Fig 6 Anterior implant-supported restoration in zirconia, screw-retained on intermediate final abutments placed on the day of surgery using the “one abutment, one time” technique. In this case, the Biological Room is entirely managed by the intermediate abutments positioned on the implants, and within the prosthetic restoration we identify only the Restorative Room its most coronal 1mm called the interface Zone (IZ).



Fig 7 Restoration placed in situ. The pic shows the soft tissue integration of the prosthesis in the interface zone (IZ).



Fig 8 Full-zirconia anterior rehabilitation on natural teeth and implants. Implant supported rehabilitations were managed with full-zirconia screw-retained crown at abutment level. The abutments were placed at the day of the surgery with “One abutment One time “approach. The picture show how the implant retained crowns aren’t cemented to any metal titanium universal abutment.



Fig 9 Final restorations in situ. The picture was taken 5-year follow-up since prosthetic insertions.



Fig 10 X-ray evaluation of the result 5-year follow-up since prosthetic insertions.

Material

Material selection in the RR is crucial for achieving natural esthetics especially within the Interface Zone. The visual properties of the restorative material directly influence how well the restoration blends with the surrounding soft tissues. In thin tissue phenotypes, metal components (e.g., titanium bases) can create visible shadows or discoloration that compromise esthetics.³² For this reason, monolithic zirconia restorations especially screw-retained full-zirconia crowns without titanium bases are highly recommended in the RR (Fig 11–16). All common restorative materials can be used within the RR for both temporary and definitive restorations. These include:

- PMMA (polymethyl methacrylate)
- Composites
- Lithium disilicate
- Zirconia
- Glass ceramics

Unlike the Biological Room, the primary objective in the RR is not mucointegration but rather esthetic harmony and hygienic maintainability. Therefore, the ideal materials for this zone must combine high esthetic performance with excellent polishability and cleanability to support long-term tissue health and ease of maintenance.

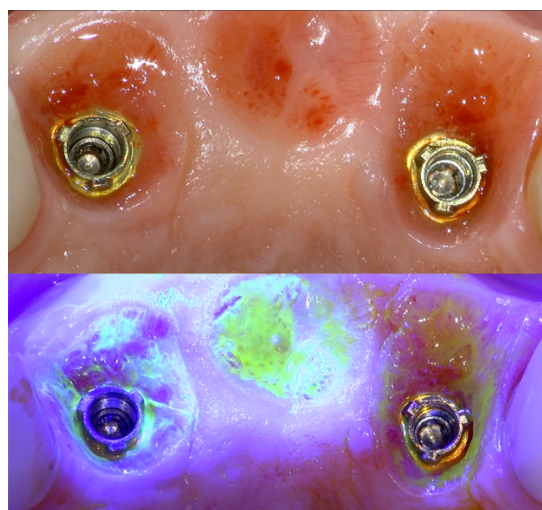


Fig 11 in this image, we observe the peri-implant soft tissues treated with a specific dye for epithelial cells (Sodium Fluorescein, that highlights areas where epithelium is damaged or absent), and it is evident that in many areas along the emergence profiles and in the pontic region, there is a lack of stable epithelial protection. This is visible in both images, the untreated one as well as the one treated with the dye. This may be due to mechanical action caused by the prosthesis disconnection or by hygiene procedures for maintenance. This area makes the peri-implant tissue more vulnerable, and it is therefore necessary to optimize its maintenance and stability through accurate prosthetic design, the selection of suitable materials, and a clinical protocol that preserves tissue maturation as much as possible.

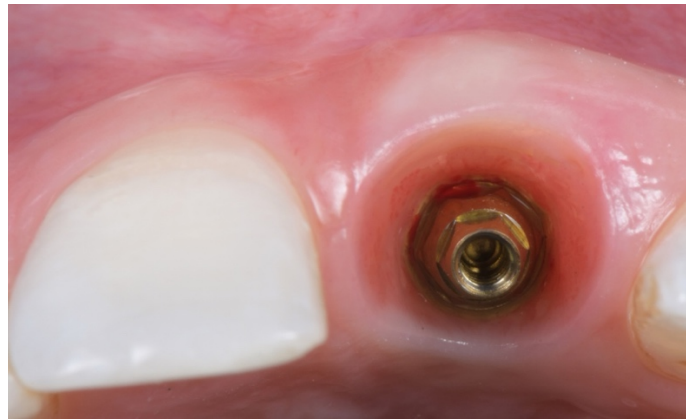


Fig 12 The image shows an implant placed in the area of the upper central incisor, combined with a definitive intermediate abutment. Through the provisional phase, excellent soft tissue conditioning was achieved by working exclusively within the Restorative Room. In such cases, the repeated disconnections of the provisional restoration or healing abutments may compromise the hemidesmosomal adhesion; however, with the use of the intermediate abutment it can optimize the soft tissue contouring without compromising the integrity of the mucosal seal.



Fig 13 The frontal view shows the excellent soft tissue architecture achieved.



Fig 14 Final Screw-Retained Zirconia Restoration. This image shows how the layering approach with felspathic porcelain involves the overall esthetics of the buccal and interproximal sites including the 1 mm Interface Zone (IZ). Apically to the IZ, the restoration was managed by hand polished zirconia for a mirror-like appearance to optimize the cleanability and the maintenance of the implant restoration.

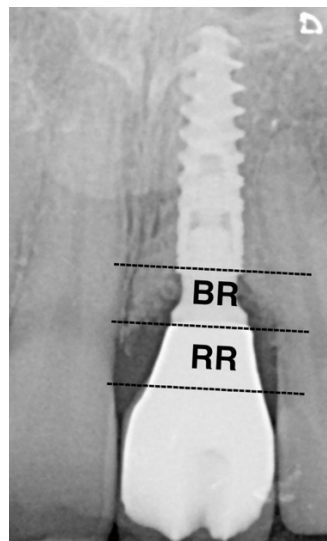


Fig 15 Radiographic evaluation of the restoration in situ, 2-year follow-up from the prosthetic insertion. The image shows how the level of the final intermediate abutment, representing the Biological Room, has a concave design to optimize biological response. In the Restorative Room the morphology is convex because it must support the soft tissue in the ideal position and gingival contour.



Fig 16 Final result, frontal view shows the ideal prosthetic and soft tissue integration 1-year follow-up from prosthetic delivery.

Cleanability

The Restorative Room (RR) is the only zone within the subgingival implant interface that is accessible for oral hygiene and professional maintenance. In contrast, the Biological Room (BR) cannot be cleaned manually due limited access and visibility because of its apical position and tight prosthetic interface. Attempting to clean the BR with instruments such as curettes or ultrasonic scalers may disrupt the mucosal seal, which can potentially compromise the soft tissue integration. Therefore, material selection in the RR must balance between esthetics, biocompatibility, and surface polishability to facilitate long-term maintenance. Materials with smooth, mirror-like, or hand-polished finishes are ideal, as they reduce plaque accumulation and promote soft tissue health.^{20,24} Among available options, hand-polished zirconia offers an excellent combination of esthetic appearance, cleanability, and mechanical strength.² Maintenance of optimal esthetics at the visible tissue interface, layering materials such as feldspathic porcelain, glazes, or stains may be applied, but these should be restricted to the Interface Zone (IZ) to enhance the Esthetic Interface (EI). In the apical portion of the RR, ultra-smooth and highly polished restorative surfaces should be used to ensure minimal biofilm

retention and maximize oral hygiene access (Figs 17–23). In posterior regions, cleanability becomes even more critical due to its limited visibility and access. In such cases, polished zirconia contours may extend slightly supra-gingival to further support hygiene and tissue health.³³



Fig 17 Final result: lateral view shows the ideal prosthetic and soft tissue integration, 1-year follow-up from the prosthetic insertion.

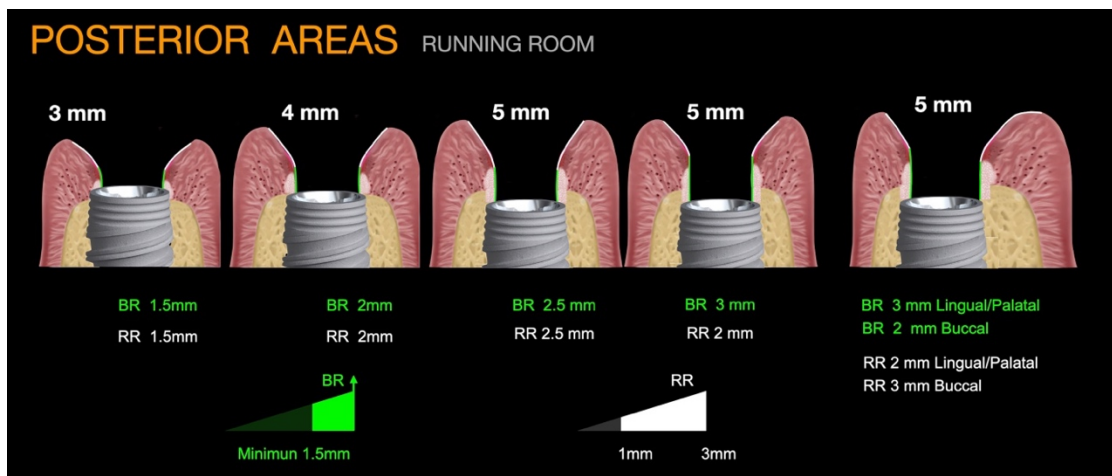


Fig 18 This diagram shows the Biologic Room (BR) and Restorative Room (RR) in the posterior area in relation to implant depth. Ideally, the BR should be about 2 mm, but in cases of limited running room, it must be reduced to 1.5 mm to provide more space for the RR. This helps achieve a better emergence profile and soft tissue conditioning. In

scenarios where the running room is 3 mm or less, the connective tissue often migrates apically, leading to subsequent bone loss. This process also results in a downward migration of the BR, aligning it with the implant collar. When an ideal running room of 4 to 5 mm is achieved, the BR should be at least 2 mm. In the posterior area, the RR can range from 1 mm to 3 mm, but in the molar region, an RR of 1.5 to 2 mm is typically ideal for achieving both optimal esthetics and biological integration; this is typical the scenario that happens with tissue level implant in the posterior segments. Extending the BR in these cases helps to enhance tissue integration and stability. In certain situations, the height of the BR may vary between the buccal and lingual sides. For instance, when an implant is placed more palatally or lingually, the buccal BR can be slightly reduced (not less than 1.5–2 mm) to optimize the emergence profile and soft tissue support.

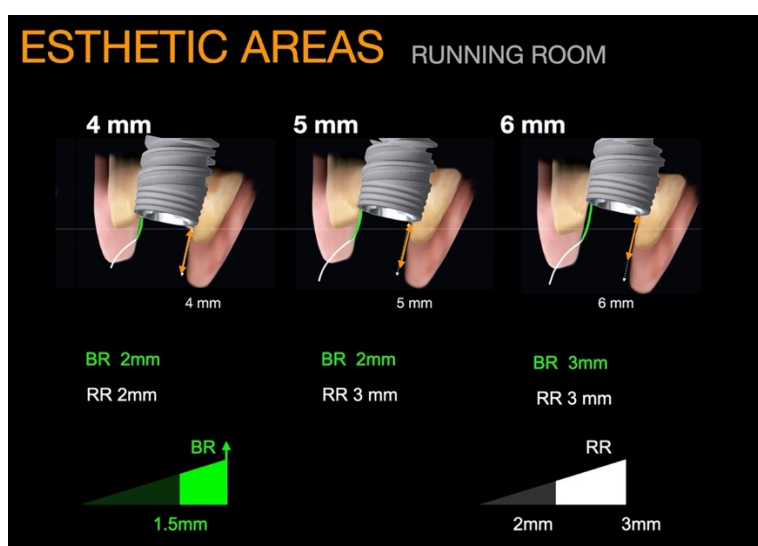


Fig 19 The running room in the anterior areas should range from 4 to 6 mm. However, the Restorative Room (RR) itself should not exceed 3 mm. Within this space, it is possible to achieve ideal soft tissue conditioning without disturbing or compromising biological integration and the soft tissue seal. In cases when deeper running room is needed, it is the Biological Room (BR) that increases, while the RR remains at a maximum of 3 mm.

BIOLOGICAL ROOM Minimum 2 mm	1 MATERIALS TITANIUM & Zirconia <ul style="list-style-type: none">● DECONTAMINATED & STERILIZED● BIOCOMPATIBLE● SURFACE CHEMISTRY	2 MORPHOLOGY NARROW / CONCAVE PROFILE 	3 CLINICAL APPROACH 1) ONE ABUTMENT ONE TIME 2) TISSUE LEVEL IMPLANT
RESTORATIVE ROOM Max 3 mm	ZI -GLASS CERAM-POLYMER <ul style="list-style-type: none">● CLEANABILITY● ESTHETICS● MAINTAINANCE	ANATOMICAL / CONVEX PROFILE 	Healing abutment Screw Retained Temporary

Fig 20 Comparison in the management of RR and BR. The image illustrates how BR and RR differ in terms of morphology, materials, and clinical approach. These two compartments have very different goals, which require very different characteristics in terms of materials, morphologies, and clinical strategies. The goal of BR is mucosal integration and the preservation of a mucosal seal, while the goal of RR is esthetics integration.

Discussion

The long-term success of implant-supported restorations depends not only on achieving osseointegration but also on preserving stable, healthy peri-implant soft tissue. Clinically, many complications such as peri-implant mucositis or peri-implantitis can be traced back to insufficient planning or disruption of the transmucosal soft tissue complex.^{1-4,34} Based on histologic evidence, the supracrestal tissue complex around implants has been shown to average around 3.6 mm in vertical height, consisting of 1.9 mm of epithelial barrier and 1.7 mm of connective tissue.^{3-5,8-10,30,35} A vertical distance of 4.0 to 5.0 mm from the implant platform to the pre-determined gingival margin is considered ideal to allow both biologic and prosthetic components to coexist predictably.^{3,4,8,33} Within this vertical dimension, we define two critical compartments: the Biological Room (BR) and the Restorative Room (RR). The BR primarily emphasizes the ideal soft tissue integration, which extends from the bone-to-implant interface to the end point of hemidesmosomes. Thereafter, the implant restoration interface transitions into the RR in the coronal direction. At least 2.0 mm extension of the BR, comprises of supracrestal

connective tissue and the most apical portion of the PIE. Within this is the highest concentration of hemidesmosomes, though evidence in humans is still limited.¹¹ A recent randomized clinical trial study has shown that disconnecting and reconnecting healing abutment was associated with significantly higher bone loss after 12 months as compared to the placement of the definitive abutment at implant installation.³⁶ This is the basis of “One Abutment, One Time” approach and describe similarly to a tissue-level implant. This treatment approach is essentially a customized healing abutment, which can be comparable to a tissue-level implant that with success rate.³⁷ It is the trauma or disturbance to the hemidesmosomal adherence that contributes to the jeopardy of crestal bone stability. However, there are successful implant restorations with no clinical significance to marginal bone loss. It is the suggestion by the authors to minimize the trauma to the hemidesmosomes for any positive tendencies for preservation of marginal bone. It is important to note that the void of space or room does not exist within this transmucosal tunnel unless the restorative component is removed to allow for visibility. The use of the word “room” helps explain the portion of the prosthetic contour that creates an interface for the transmucosa. The original introduction to these contours was explained by Zamzok and Potashnick as the “running room” or implant depth from gingival margin.^{38,39} Thereafter, the introduction of categorizing implant restoration by critical and subcritical contours provides clinicians guidance to optimize esthetics as described by Su et al.¹ Their scenarios describe more of the manipulation of the soft tissue architecture to achieve esthetic results. Chu et al addresses not only the influence of what critical and subcritical contours can do but also emphasizes the dominant factor of implant position that ultimately dictates the gingival architecture.⁶ This concept closely aligns with Gomez-Meda et al., highlighting the transmucosa's biological aspect.⁴ Unlike these publications, this concept is a compilation of recent studies that explains the restorative contours

into two. These two contours, BR and RR, describe the purpose they serve. The BR explains, optimizes, and compliments the hard-soft tissue complex surrounding the bone-to-implant contact. The RR does the same in relation to gingival-restorative esthetics and hygiene. This encompasses a guideline for clinicians to perform implant procedures in a biologically driven prosthetic approach with a technician that can follow a reference for more favorable restorations that supports the biological aspect. According to the authors, this is a team approach that may help minimize miscommunication within team members, peri-implant mucositis and peri-implantitis.

Clinical Implications of the Biological Room (BR)

The BR occupies the apical portion of the soft tissue pathway and is responsible for the biologic integration of the implant restoration. This region includes the supracrestal connective tissue and the apical peri-implant epithelium (PIE) which contains hemidesmosomal attachments.

Hemidesmosomal attachments form a seal that defends the peri-implant bone from bacterial and mechanical insults.¹¹ Although this protective role has been well demonstrated in experimental models, its extent in humans remains to be fully validated. The BR should remain undisturbed throughout the surgical and restorative phases to preserve this biologic interface. A minimum height of 2.0 mm is required to allow for adequate tissue attachment and biologic seal.^{11,18,22} This space should be restored using biocompatible materials such as titanium or zirconia with ideal surface properties, including micro-roughness in the range of 0.1–0.2 microns to promote cell adhesion.^{17,21,23–25} The “One Abutment, One Time” protocol is critical for the BR. Placing a final or intermediate abutment at the time of surgery and avoiding future disconnections significantly reduces the trauma the hemidesmosomal attachments. A recent randomized clinical trial

demonstrated that repeated disconnections of the healing abutment led to significantly higher bone resorption after 12 months, compared to cases where a final abutment was placed during surgery.³⁶ This suggests that early trauma to hemidesmosomal attachments destabilizes the biological seal. In bone-level implants, this strategy involves using a stock final intermediate abutment based on required tissue height, esthetic zone, and restoration dimension.¹⁶ This effectively converts a bone-level implant into a customized tissue-level restoration, which can maintain the BR interface while allowing for prosthetic flexibility. However, this approach should be reserved for implant systems with conical connections and platform switching, which ensures a tight seal and minimize microgap contamination.^{16,36} Despite the biological advantages, the use of a second restorative interface, an intermediate abutment, introduces potential mechanical vulnerabilities. If the system lacks a well-engineered, strong connection, this interface could become a failure point. Yet, in some cases, it may serve as a sacrificial joint that absorbs stress to prevent damage to the more critical bone–implant interface.^{16,26} An alternative use to this method is tissue-level implants, which inherently include a transmucosal collar that becomes the BR. Both systems avoid hemidesmosomal attachment disconnections altogether and come pre-sterilized with surfaces optimized for soft tissue integration. Evidence supports that concave or convergent transmucosal collars in tissue-level implants are associated with improved soft tissue health and marginal bone stability.⁴

Clinical implications of the Restorative Room (RR)

The RR occupies the coronal portion of the transmucosal pathway and plays a critical role in esthetics, soft tissue morphology, and oral hygiene maintenance. This is the zone where the dental technician sculpts the emergence profile and designs the esthetic interface.^{3,18–21,34} In the

anterior esthetic zone, deeper implant placement (up to 5.0 mm from the gingival margin) may be necessary to create sufficient space for tissue sculpting. However, the RR should not exceed 3.0 mm in vertical height. If it does, restorative contouring can compromise soft tissue health or impinge on the BR.^{18–21} In posterior regions, 1.0–2.0 mm of RR is typically adequate. To maintain long-term soft tissue stability and esthetics, the RR must be restored using smooth, highly polished materials. Polished zirconia is preferred due to its biocompatibility, mechanical properties, and ability to maintain a plaque-resistant surface.^{2,10,20} In the interface zone (IZ), the most coronal 1.0 mm of the RR, layered ceramics (feldspathic porcelain, glazes, or stains) may be used to enhance esthetics. However, in deeper areas of the RR, only ultra-smooth, hand-polished restorative materials should be used to minimize bacterial accumulation and support soft tissue health.^{10,20,32} The RR is also the only zone that is accessible for oral hygiene procedures. Any attempt to mechanically clean the BR can compromise the mucosal seal, particularly with ultrasonic or metal instruments.^{20,24} Therefore, restorative planning must ensure that prosthetic margins and emergence profiles in the RR are hygienically accessible and easily maintainable. There should be more emphasis of cleanability in posterior regions where visibility and access are limited.³³

Conclusion of Clinical Strategy

From a clinical standpoint, planning for long-term implant success requires:

- At least 4.0–5.0 mm vertical space from the implant platform to the buccal gingival margin.
- A minimum 2.0 mm BR to ensure stable soft tissue integration or mucointegration.
- A maximum 3.0 mm RR, allowing for esthetic contouring and hygiene maintenance.

Materials in the BR should be sterile, non-contaminated titanium or zirconia, with specific microtopography. The RR should feature polished, esthetic materials, with layering ceramics restricted to the coronal interface. Avoid excessive emergence angles or over-contouring, which are associated with increased bone loss.^{17–20,24}

Considering that a short distance from the prosthetic margin to crestal bone during implant placement may predispose peri-implantitis.⁴³ This would favor the concept of tissue-level implant design or the use of final transmucosal abutment.⁴³

Choose bone level implant systems that support platform switching, secure conical connections, and clean intermediate components.^{16,40–42,44,45}

Choose tissue level implant system that includes a transmucosal component of at least 2 mm, with a design that complies with the guidelines required for biological room (BR).

This biologically driven prosthetic approach allows clinicians and dental technicians to consistently improve peri-implant tissue outcomes, maintain long-term bone stability, and enhance esthetic results.

Conclusions

Dividing the subgingival implant contour into the Biological Room (BR) and Restorative Room (RR) offers a practical and biologically sound framework or guideline for clinicians and dental technicians. This concept supports more predictable soft tissue integration, esthetic outcomes, and long-term stability. The BR should remain undisturbed to preserve the mucosal seal, which can be ideally achieved with tissue-level implants or bone-level implants combined with an intermediate definitive abutment. When an intermediate abutment is not used, the clinician must design a 2.0 mm straight/concave BR using biocompatible materials that transitions into a

polished, convex RR that supports esthetics and hygiene with a maximum of 3.0 mm. The proposed approach streamlines prosthetic planning and promotes biologically respectful implant restorations by clearly distinguishing the running room into RR and BR.

Acknowledgments

The authors declare no conflicts of interest.

Author contributions: G.F.: writing, editing, photo editing; F.M.: editing, photo editing; F.A.: Substantive editing, proofreading; J.L.: Substantive editing, proofreading.

References

1. Su H, Gonzales-Martin O, Weisgold A, Lee E. Considerations of implant abutment and crown contour: Critical contour and subcritical contour. *Int J Periodontics Restorative Dent* 2010;30:335–343.
2. Klinge B, Meyle J, Working G. Soft Tissue integration of implants. Consensus report of working group 2. *Clin Oral Implant Res* 2006;17(suppl 2):93–96.
3. Chu SJ, Salama MA, Salama H, et al. The dual-zone therapeutic concept of managing immediate implant placement and provisional restoration in anterior extraction sockets. *Compend Contin Educ Dent* 2012;33:524-534.
4. Gomez-Meda R, Esquivel J, Blatz MB. The esthetic biological contour concept for implant restoration emergence profile design. *J Esthet Restor Dent* 2021;33:173-184.
5. González-Martín O, Lee E, Weisgold A, Veltri M, Su H. Contour management of implant restorations for optimal emergence profiles: guidelines for immediate and delayed provisional restorations. *Int J Periodontics Restorative Dent* 2020;40:61-70.
6. Chu SJ, Kan JY, Lee EA, et al. Restorative emergence profile for single-tooth implants in healthy periodontal patients: clinical guidelines and decision-making strategies. *Int J Periodontics Restorative Dent* 2019;40:19–29.
7. Zheng Zheng, Xiaogang Ao. Peng Xie, Fan Jiang, Wenchuan Chen. The biological width around implant. *J Prosthodont Res* 2021;65:11–18.

8. Gargiulo AW, Wentz FM, Orban B. Dimensions and relations of the dentogingival junction in humans. *J Periodontol* 1961;32:261–267.
9. Cochran DL, Hermann JS, Schenk RK, Higginbottom FL, Buser D. Biological width around titanium implants. A histometric analysis of the implanto-gingiva junction around loaded and unloaded non-submerged implants in the canine mandible. *J Periodontol* 1997;68:186–198.
10. Yuan X, Pei X, Chen J, Zhao Y, Brunski JB, Helms JA. Comparative analyses of the soft tissue interfaces around teeth and implants: insights from a pre-clinical implant model. *J Clin Periodontol* 2021;48:745-753.
11. Aellos F, Grauer JA, Harder KG, et al. Dynamic analyses of soft tissue-implant interface: Biological responses to immediate versus delayed dental implants. *J Clin Periodontol* 2024;51:806-817.
12. Gould TR, Westbury L, Brunette DM. Ultrastructural study of attachment of human gingiva to titanium in vivo. *J Prosthet Dent* 1984;52:418–420.
13. Groenendijk E, Staas TA, Bronkhorst EM, Raghoobar GM, Meijer GJ. Factors associated with esthetic outcomes of flapless immediate placed and loaded implants in the maxillary incisor region—Three-year results of prospective case series. *J Clin Med* 2023;12:2625.
14. Staas TA, Groenendijk E, Bronkhorst EM, Verhamme L, Raghoobar GM, Meijer GJ. Does initial buccal crest thickness affect final buccal crest thickness after flapless immediate implant placement and provisionalization: A prospective cone beam computed tomogram cohort study. *Clin Implant Dent Relat Res* 2022;24:24-33.
15. Gamborena I, Sasaki Y, Blatz MB. Updated clinical and technical protocols for predictable immediate implant placement. *J Cosmet Dent* 2020;35:36-51.
16. Fabbri G, Staas T, Linkevicius T, Valantiejene V, González-Martin O, Rompen E. Clinical performance of a novel two-piece abutment concept: Result from a prospective study with a 1-year follow-up. *J Clin Med* 2021;10:1594.
17. Soulami S, Slot DE, Van der Weijden F. Implant-abutment emergence angle and profile in relation to peri-implantitis: A systematic review. *Clin Exp Dent Res* 2022;8:795-806.
18. Strauss FJ, Park JY, Lee JS, et al. Wide restorative emergence angle increases marginal bone loss and impairs integrity of the junctional epithelium of implant supracrestal complex: A preclinical study. *J Clin Periodontol* 2024;51:1677-1687.

19. Katafuchi M, Weinstein BF, Leroux BG, Chen YW, Daubert DM. Restoration contour is a risk indicator for peri-implantitis: A cross-sectional radiographic analysis. *J Clin Periodontol* 2018;45:225-232.
20. Souza AB, Alshihri A, Kämmerer PW, Araújo MG, Gallucci GO. Histological and Micro-CT Analysis of peri-implant soft and hard tissue healing on implants with different healing abutment configurations. *Clin Oral Implants Res* 2018;29:1007-1015.
21. Nothdurft FP, Fontana D, Ruppenthal S et al. Differential behavior of fibroblast and epithelium cells on structured implant abutment materials: A comparison of materials and surfacetopographies. *Clin Implant Dent Relat Res* 2015;17:1237-1249.
22. Sanz-Martin I, Sanz-Sanchez I, Carrillo de Albornoz A, Figuero E, Sanz M. Effects of modified abutment characteristics on peri-implant soft tissue health: A systematic review and meta-analysis. *Clin Oral Implants Res* 2018;29:118-129.
23. Canullo L, Tallarico M, Penarrocha M, Corrente G, Fiorellini J, Penarrocha D. Plasma of Aragon cleaning treatment on implant abutment in periodontally healthy patients: six years post loading results of a randomized controlled trial. *Int J Periodontics Restorative Dent* 2017;37:683-690.
24. Fabbri G, Sorrentino R. A Biologically Driven Concept to design emergence profile around dental implant: surgical and prosthetic considerations to optimize hard and soft tissue integration. *Int J Periodontics Restorative Dent* 2021 Nov-Dec;41(6):913-921.
25. Tallarico M, Caneva M, Meloni SM, Xhanari E, Covani U, Canullo L. Definitive abutments placed at implant insertion and never removed: Is it an effective approach? A systematic review and meta-analysis of randomized controlled trials. *J Oral Maxillofac Surg* 2018;76:316-324.
26. Vatėnas I, Linkevičius T. One abutment one time vs. Repeatable abutment disconnections in implants, restored with cemented/screw retained fixed partial dentures: Marginal bone level changes. A systematic review and meta-analysis. *Stomatologija* 2021;23:35-40.
27. Dworan J, Aellos F, Grauer JA, et al. Dynamics of mucosal integration of machined versus anodized titanium implants. *J Dent Res* 2025;104:270-279.

28. Happe A, Roling N, Schafer A, Rothamel D. Effects of different polishing protocols on the surface roughness of Y-TZP surfaces used for custom-made implant abutments: a controlled morphologic SEM and profilometric pilot study. *J Prosthet Dent*. 2015 May;113(5):440-7.
29. Galindo-Moreno P, León-Cano A, Ortega-Oller I, et al. Prosthetic abutment height is a key factor in peri-implant marginal bone loss. *J Dent Res* 2014;93(suppl 7):s80–s85.
30. Esquivel J, Gomez-Meda R, Blatz MB. The impact of 3D implant position on emergence profile design. *Int J Periodontics Restorative Dent*. 2021;41:79-86
31. Esquivel J, Gomez-Meda R, Villaroel M. Timing implant provisionalization: Decision-making and systematic workflow. *J Esthet Restor Dent* 2024;36:858–867.
32. Jung RE, Hammerle C, Attin T, Schmidlin P. In vitro color Changes of soft tissue caused by restorative materials. *Int J Periodontics Restorative Dent* 2007;27:251-257.
33. Bollen CM, W Papaioanno, J Van Eldere, E Schepers, M Quirynen, D van Steenberghe. The influence of abutment surface roughness on plaque accumulation and peri-implant mucositis. *Clin Oral Implants Res* 1996;7:201-211.
34. Steigmann M, Monje A, Chan HL, Wang HL. Emergence profile design based on implant position in the esthetic zone. *Int J Periodontics Restorative Dent* 2014;34:559-563.
35. Tomasi C, Tessarolo F, Caola I, Wennstrom J, Nollo G, Berglund T. Morphogenesis of peri-implant mucosa revisited: An experimental study in humans. *Clin Oral Implants Res* 2014;25:997-1003.
36. Calatrava J, Sanz-Sanchez I, Molina A, Bollain J, Martin C, Sanz M. Effect of one-time placement of the definitive abutment versus multiple healing abutment disconnection and reconnections during the prosthetic phase on radiographic and clinical outcomes: A 12-month randomized clinical trial. *Clin Implant Dent Relat Res* 2024;26:998–1011.
37. Buser D, Mericske-Stern R, Pierre Bernard JP, et al. Long-term evaluation of non-submerged ITI implants. Part 1: 8-year life table analysis of a prospective multi-center study with 235 implants. *Clin Oral Implants Res* 1997;8:161–172.
38. Zamzok J. Nonsurgical soft tissue sculpting. *Alpha Mohegan* 1997;90:65-9.

39. Potashnick SR. Soft tissue modeling for the esthetic single-tooth implant restoration. *J Esthet Dent*. 1998;10(3):121-31.
40. Baffone GM, Botticelli D, Canullo L, Scala A, Beolchini M, Lang NP. Effect of mismatching abutments on implants with wider platforms—an experimental study in dogs. *Clin Oral Impl Res* 2012. Mar;23(3):334-9.
41. Linkevicius T, Linkevicius R, alkimavicius J, Linkeviciene L, Andrijauskas P, Puisys A. Influence of titanium base, lithium disilicate restorations and vertical soft tissue thickness on bone stability around triangular-shape implants: A prospective clinical trial. *Clin Oral Implants Res* 2018;29:716-724.
42. Agustin-Panadero R, Martinez Martinez N, Fernandez-Estevan L, Faus-Lopez J, Sola-Ruiz MF. Influence of transmucosal Area Morphology on implant Bone Loss in Tissue-Level Implant. *Int J Oral Maxillofac Implants*. 2019 July/August: (34):947-952.
43. Derks J, Schaller D, Hakansson J, Wennstrom JL, Tomasi C, Berglundh T. Effectiveness of implant therapy analyzed in a Swedish population: prevalence of peri-implantitis. *J Dent Res*. 2016;95:43-49.
44. Monje A, Barootchi S, Rosen PS, Wang HL. Surgical and implant-retained factors and onset/progression of peri-implant diseases: An AO/AAP systematic review. *J Periodontol* 2025 Jun;96(6):542-561.
45. Mishra M, Ozawa S, Masuda T, Yoshioka F, Tanaka Y. Finite element study on the effect of abutment length and material on implant bone interface against dynamic loading. *J Adv Prosthodont*. 2011 Sep;38(3):140.