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Customized Healing Abutments for Peri-Implant Soft Tissue Stability: Biological Rationale and Clinical Outcomes: A Narrative Review

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Abstract

Background: In implant dentistry, long-term success is no longer judged by osseointegration alone. The stability and contour of peri-implant soft tissues play an equally important role, particularly in esthetically demanding regions. Conventional healing abutments, due to their standardized shape, may not always support ideal soft tissue architecture during healing.

Aim: To evaluate the biological rationale and clinical outcomes of customized healing abutments in achieving and maintaining peri-implant soft tissue stability.

Materials and methods: Relevant literature was reviewed from databases such as PubMed, Scopus, and Google Scholar. Studies focusing on customized healing abutments, soft tissue response, and emergence profile management were considered, including clinical reports and in vitro investigations.

Results: Available evidence suggests that customized healing abutments can better guide soft tissue healing, leading to improved contour, papilla fill, and emergence profile. They also appear to reduce the need for repeated manipulation of peri-implant tissues. With the integration of digital workflows, customization has become more precise and clinically feasible.

Conclusion: Customized healing abutments represent a promising approach for improving peri-implant soft tissue outcomes. However, the current evidence is limited by variability in study design, and further well-designed clinical trials are needed.

Keywords: CAD-CAM dentistry, Customized healing abutments, Emergence profile, Implant esthetics, Peri-implant soft tissue, Soft tissue stability.

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1. Introduction

Over the past few decades, dental implant therapy has undergone a significant shift from a purely functional approach to one that also emphasizes esthetics and long-term tissue stability. Among the various factors that influence implant success, the condition and stability of peri-implant soft tissues have gained considerable attention [1,2]. Well-contoured and stable soft tissues not only contribute to a natural appearance but also play a role in maintaining peri-implant health [1-3].

Traditionally, healing abutments supplied by implant systems have been used to support soft tissue healing following implant placement. While these components are convenient, their uniform, circular design does not always reflect the natural

contours of teeth. As a result, the surrounding soft tissues may heal in a way that is not ideal for achieving a natural emergence profile, especially in the esthetic zone [4,5].

To address these limitations, customized healing abutments have been introduced as an alternative approach. These abutments can be modified or fabricated to mimic the shape of the final restoration, thereby guiding the peri-implant tissues during the healing phase itself [6-8]. Materials such as composite resin and PMMA, together with CAD-CAM technologies, have improved the feasibility of customized healing-abutment fabrication in routine clinical practice.

Another important consideration is the biological response of peri-implant tissues to repeated abutment disconnection and reconnection. It has been suggested that minimizing such manipulation may help preserve the soft tissue seal around implants [9,10]. In this context, customized healing abutments support a more stable healing environment by maintaining consistent tissue contours from an early stage.

With the growing interest in digital dentistry, clinicians now have the ability to design and fabricate customized components with greater precision [11,12]. Despite these advancements, the literature presents a wide range of techniques and outcomes, making it necessary to critically evaluate their clinical relevance. This narrative review therefore aims to examine the role of customized healing abutments in promoting peri-implant soft tissue stability, with a focus on their biological basis and clinical performance.

2. Materials and methods

This review was conducted to evaluate the role of customized healing abutments in peri-implant soft tissue stability, with a focus on their biological basis and clinical outcomes.

A literature search was performed using electronic databases, including PubMed, Scopus, and Google Scholar. The search was carried out using combinations of keywords such as “customized healing abutments,” “peri-implant soft tissue,” “emergence profile,” “implant esthetics,” and “CAD-CAM dentistry.” Relevant articles published in English up to recent years were considered.

Both clinical and in vitro studies, along with review articles that addressed soft tissue healing around implants and the use of customized healing abutments, were included. Articles focusing on emergence profile management, soft tissue contouring, and digital workflows in implant dentistry were also reviewed.

Studies that did not specifically address peri-implant soft tissue outcomes or lacked sufficient methodological detail were excluded. Case reports with limited clinical relevance and articles not available in full text were also omitted.

2.1 Biological basis of peri-implant soft tissue

The stability of peri-implant soft tissues is a key determinant in the long-term success of implant therapy. Unlike natural teeth, implants lack a periodontal ligament and have a different pattern of soft tissue attachment. Around implants, the soft tissue forms a peri-implant mucosal seal, which serves as a protective barrier against microbial invasion [1,2]. The quality and stability of this seal are essential for maintaining both tissue health and marginal bone levels [1,3].

Several studies have highlighted that the peri-implant soft tissue attachment is structurally different from those around natural teeth. The connective tissue fibers around implants are oriented parallel or circular to the implant surface, rather than inserting perpendicularly as seen in natural dentition. This difference makes the peri-implant tissues more susceptible to mechanical and bacterial challenges, emphasizing the importance of careful tissue management during all phases of implant therapy [2,3].

Another important concept is the establishment of a stable supracrestal tissue dimension, often compared to the “biological width” around teeth. Around implants, this dimension is formed by the junctional epithelium and connective tissue attachment, and it plays a crucial role in maintaining tissue stability [9]. Any repeated disruption of this soft tissue seal—such as frequent abutment disconnection and reconnection—may lead to apical migration of the epithelial attachment and subsequent marginal bone loss [9,10]. In this context, the concept of minimizing abutment manipulation has gained importance. It has been suggested that maintaining a stable transmucosal component during the healing phase can help preserve the integrity of the soft tissue seal [9,13]. Customized healing abutments support this approach by allowing the peri-implant tissues to adapt to a consistent contour early in the healing process, thereby reducing tissue trauma.

Additionally, soft tissue thickness and biotype have been shown to influence peri-implant stability. Thicker mucosal tissues are generally associated with better resistance to recession and improved esthetic outcomes [7,14]. By shaping the soft tissue profile during healing, customized healing abutments may contribute to more favourable tissue architecture and long-term stability. In immediate implant placement following tooth extraction, a customized healing abutment can be designed to approximate the contour of the extracted tooth and support the peri-implant soft tissues during healing. By providing a prosthetically oriented transmucosal contour from the early healing phase, the customized abutment may help limit soft-tissue collapse and facilitate development of a more stable peri-implant architecture, as illustrated in Figure 1.

2.2 Emergence profile and soft tissue contouring

The concept of emergence profile is central to achieving a natural and harmonious implant restoration [4,5]. It refers to the contour of the restoration as it transitions from the implant platform through the soft tissues into the oral cavity. Unlike natural teeth, where the cervical anatomy gradually shapes the surrounding gingiva, implants require deliberate planning to recreate a similar contour. In clinical practice, the absence of a proper emergence profile can result in flattened or over-contoured soft tissues, leading to compromised esthetics and difficulty in maintaining oral hygiene. This becomes particularly critical in the anterior region, where even minor discrepancies in gingival contour or papilla height can affect the overall smile appearance [4,14].

Traditionally, soft tissue shaping has been performed at later stages using provisional restorations. While this approach can achieve acceptable results, it often requires multiple adjustments and repeated manipulation of the peri-implant tissues. Such repeated intervention may disrupt the healing soft tissue seal and potentially influence marginal tissue stability [9,13].

Recent approaches emphasize early soft tissue conditioning, beginning at the healing phase itself. Customized healing abutments play a key role in this strategy by guiding the soft tissue contour immediately after implant placement or during second-stage surgery. By replicating the cervical contours of the intended final restoration, these abutments help in developing a more natural emergence profile from the outset [4,6,12]. Clinical observations have suggested that early contouring of soft tissues may facilitate better papilla formation and more stable gingival margins [3,5]. In addition, when tissues are shaped progressively and maintained without repeated disruption, the need for extensive prosthetic adjustments at later stages can be reduced. Another important consideration is the relationship between the emergence profile and cleansability. An excessively contoured restoration may create plaque-retentive areas that are difficult to access during routine oral hygiene, thereby potentially increasing the risk of peri-implant inflammation.

In contrast, an appropriately designed emergence profile facilitates effective plaque control while providing adequate support to the surrounding soft tissues, thereby contributing to both peri-implant tissue health and favorable esthetic and functional outcomes [5,14], as shown in Figure 2.

With the integration of digital workflows, clinicians can now design customized healing abutments and provisional restorations with greater precision. This has improved the predictability of soft tissue contouring and allowed better communication between surgical and prosthetic phases of treatment [11,12]. Overall, shaping the emergence profile at an early stage using customized healing abutments appears to offer a more controlled and biologically favourable approach to peri-implant tissue management.

2.3 Customized vs conventional healing abutments

Healing abutments are routinely used during the healing phase of implant therapy to maintain access to the implant and support soft tissue healing. Conventional healing abutments are typically prefabricated, available in standard shapes and sizes, and are designed primarily for convenience and ease of use. Their standardized cross-sectional geometry may not reproduce the individualized cervical and emergence contours of natural teeth, whereas customized healing abutments can be shaped according to the desired prosthetic and soft-tissue architecture (Figure 3) [1,2].

In contrast, customized healing abutments are specifically shaped to replicate the cervical and emergence profile of the intended final restoration. This customization allows the surrounding soft tissues to adapt more naturally and in a more controlled manner during healing [3,4]. As a result, clinicians can achieve better soft tissue architecture even before the prosthetic phase begins.

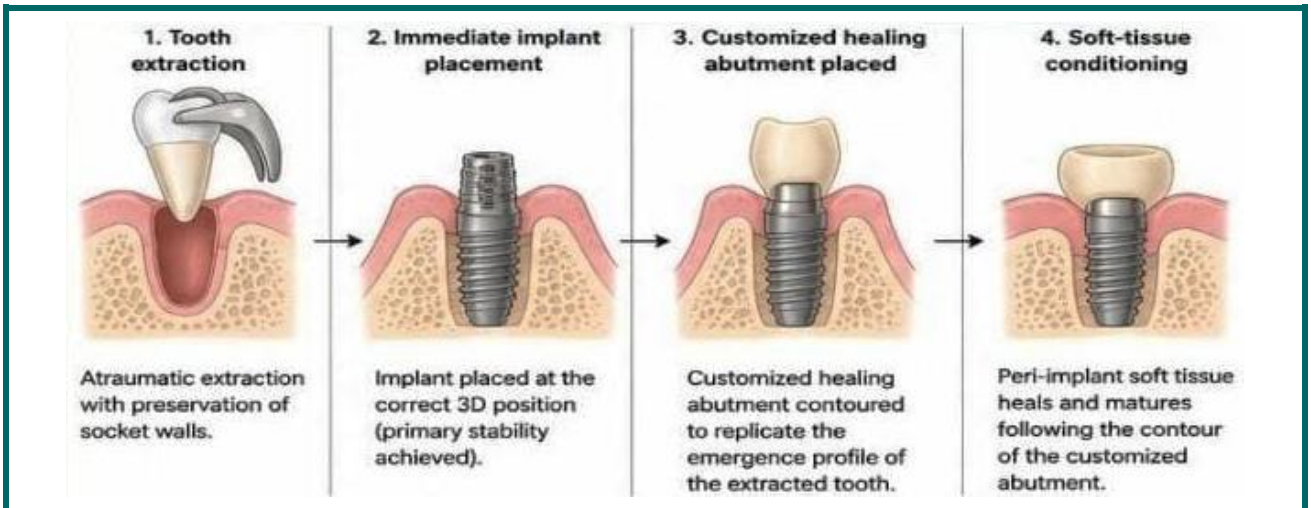

Figure 1. Immediate implant placement and peri-implant soft-tissue contour

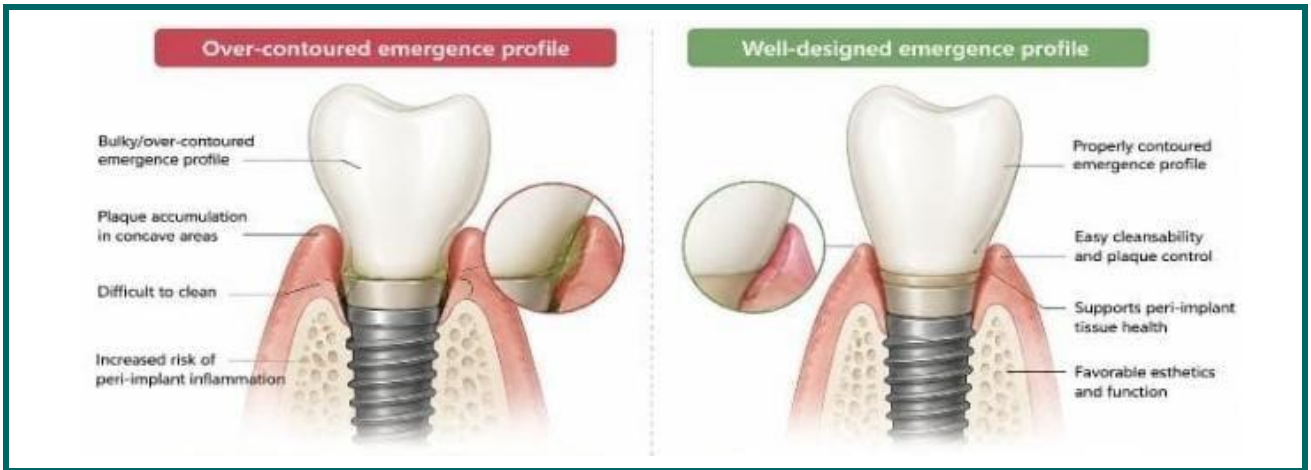

Figure 2. Emergence profile and cleansability: conceptual representation

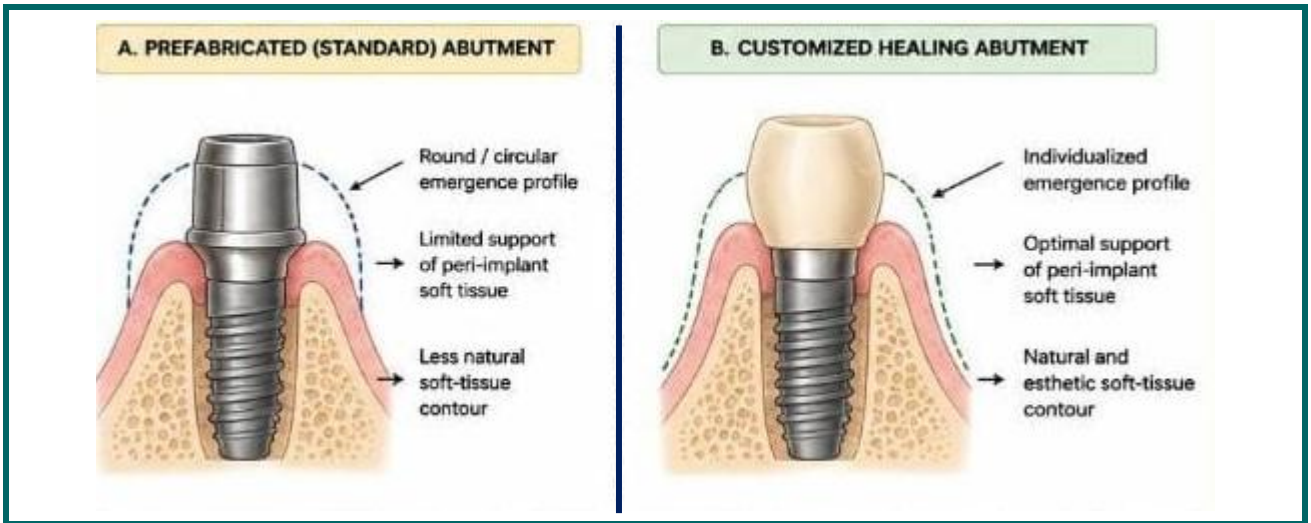

Figure 3. Prefabricated versus customized healing abutment

One of the main limitations of conventional healing abutments is their inability to preserve interdental papilla and gingival contours, particularly in esthetically demanding areas. The mismatch between the circular abutment and the often oval or triangular tooth form can lead to flattened soft

tissue profiles. This may subsequently require additional soft tissue conditioning using provisional restorations, increasing chairside time and patient visits [4,5].

Customized healing abutments, on the other hand, aim to minimize these issues by providing an anatomically appropriate scaffold for tissue healing. Clinical reports have indicated improved papilla fill, better maintenance of gingival margins, and enhanced emergence profiles when customized abutments are used [2,3,5]. Additionally, because the soft tissues are shaped early in the healing phase, the need for repeated abutment removal and modification is reduced.

Another important consideration is the biological impact of abutment manipulation. Repeated disconnection and reconnection of conventional healing abutments and provisional components may disturb the peri-implant soft tissue seal [9,13]. In contrast, customized healing abutments can support a more stable healing environment by maintaining consistent contours, aligning with the concept of minimizing tissue disturbance.

From a practical standpoint, conventional healing abutments are simple, cost-effective, and widely available, making them suitable for routine cases where esthetic demands are limited. However, in situations where soft tissue contour and esthetics are critical, customized healing abutments offer clear advantages despite requiring additional time, materials, and technical expertise.

Although customized healing abutments may require additional clinical time, materials, and technical expertise, their ability to provide individualized emergence profiles may offer important advantages in cases where peri-implant soft-tissue architecture and esthetic demands are critical [1,4].

2.4 Materials and fabrication techniques

The success of customized healing abutments depends not only on their design but also on the materials used and the method of fabrication. Over time, a variety of materials and techniques have been introduced, each offering specific advantages in terms of adaptability, precision, and clinical convenience. One of the most commonly used materials for chairside customization is composite resin. It allows direct intraoral modification of prefabricated healing abutments, enabling clinicians to shape the desired emergence profile in a relatively simple and cost-effective manner [11,12]. Composite materials are easy to handle and can be adjusted incrementally, making them suitable for immediate contouring during the healing phase. However, concerns related to surface roughness and plaque accumulation need to be considered, especially if polishing is inadequate [10,12].

Polymethyl methacrylate (PMMA) is another material frequently used, particularly in laboratory or digitally fabricated customized abutments. PMMA offers better control over contour and finish when compared to chairside composite techniques. It is commonly used in CAD-CAM workflows, where the abutment is designed digitally and milled to achieve a precise and reproducible shape [11,12]. This approach reduces operator variability and enhances consistency in outcomes.

With the advancement of digital dentistry, CAD-CAM technology has become increasingly important in the fabrication of customized healing abutments. Conventional and digital impression techniques can be used to record the peri-implant soft-tissue architecture, including the gingival cuff contour, and transfer this information to the working cast or digital model for fabrication of the customized component [15]. Additionally, digital workflows can reduce chairside time and improve overall efficiency.

More recently, additive manufacturing techniques such as 3D printing have also been explored. These methods offer flexibility in design and the potential for rapid fabrication. Although still evolving, 3D printing may provide cost-effective solutions in the future, especially for complex or multiple-unit cases [12].

Another aspect to consider is the choice between direct and indirect fabrication techniques. Chairside (direct) methods are quicker and require minimal laboratory support, making them suitable for immediate clinical use. Indirect methods, on the other hand, allow for better control over contours and surface finish but involve additional steps and time.

2.4.1 Clinical fabrication techniques for customized healing abutments

Direct chairside customization is a relatively simple approach in which a prefabricated healing abutment is modified intraorally to reproduce the desired cervical and emergence contours. A light-cured or self-cured composite resin may be incrementally added around the transmucosal

portion of the abutment, followed by contouring, finishing, and polishing to obtain a smooth and anatomically appropriate surface. This technique allows immediate customization according to the clinical soft-tissue architecture and can be performed without extensive laboratory involvement. However, the final contour and surface quality are dependent on operator skill, and inadequate finishing or polishing may result in surface irregularities and plaque retention [12,14].
Indirect fabrication techniques involve transferring the required peri-implant contour to a working cast or digital model, followed by fabrication of the customized healing abutment outside the oral cavity. Resin-based materials such as PMMA can be shaped and finished under controlled laboratory conditions, allowing greater control over the emergence profile and surface characteristics. This approach may provide improved reproducibility of the intended contour compared with direct chairside modification, although it requires additional clinical and laboratory procedures. Customized healing abutment protocols have been described for conditioning the peri-implant soft tissues according to the planned prosthetic emergence profile [4,14].

CAD-CAM fabrication provides a digitally guided method for producing customized healing abutments. An intraoral scan or digital impression can be used to record the implant position and surrounding soft-tissue architecture. The desired emergence profile is then designed virtually according to the planned definitive restoration, and the customized component is subsequently fabricated by milling an appropriate material. This workflow allows precise control of the three-dimensional contour and facilitates reproducibility and communication between the clinical and laboratory stages. Nevertheless, its routine application may be influenced by equipment availability, cost, software requirements, and operator expertise [12,14].
Additive manufacturing represents a further digital approach for the production of customized healing components. In this workflow, the desired abutment geometry is designed digitally and subsequently fabricated by layer-by-layer deposition of a suitable printable material. The technique provides considerable flexibility in reproducing patient-specific contours and may be particularly useful when individualized or complex geometries are required. However, its clinical application remains dependent on the availability of validated materials, printing accuracy, post-processing procedures, and adequate evidence regarding long-term clinical performance. Therefore, additive manufacturing should currently be considered an evolving approach rather than a universally established alternative to conventional or CAD-CAM fabrication [12].

The clinical performance of customized healing abutments depends on the fabrication method, material properties, accuracy of contour reproduction, and operator expertise. Direct chairside customization offers the advantage of immediate contour modification with minimal laboratory involvement, whereas indirect techniques provide greater control over the shape and surface finish. CAD-CAM workflows allow digital control and reproducibility of the customized emergence profile and can facilitate integration with the planned definitive restoration. Additive manufacturing provides additional flexibility for producing individualized geometries, although its clinical application remains an evolving field. Current evidence does not establish a single fabrication technique as superior in all clinical situations; therefore, the choice of technique should be based on the required soft-tissue contour, clinical indications, available resources, and clinician expertise [4,12,14].

Overall, the selection of material and fabrication technique should be based on clinical requirements, esthetic demands, and available resources. While traditional chairside methods remain practical, digital approaches are increasingly offering improved precision and predictability in customizing healing abutments.

2.4.2 Transfer of peri-implant soft-tissue contour and gingival cuff

Accurate transfer of the peri-implant soft-tissue contour is an important step in reproducing the emergence profile developed by a customized healing abutment. Conventional implant-level impressions can record the implant position; however, additional modification of the impression component may be required when the peri-implant mucosa has been deliberately conditioned to an individualized contour. A customized impression coping can be shaped to correspond to the transmucosal portion of the customized healing abutment, thereby supporting the peri-implant gingival cuff during impression making and allowing the developed soft-tissue architecture to be reproduced on the working cast. This approach facilitates fabrication of the definitive restoration

with a transmucosal contour that is consistent with the conditioned peri-implant tissues [15].

Digital impression techniques provide an alternative method for recording peri-implant soft-tissue architecture. Intraoral scanning can capture the implant position together with the surrounding mucosal contours and can subsequently be integrated with the planned prosthetic emergence profile. Digital workflows may therefore facilitate accurate transfer of individualized soft-tissue information while reducing some of the laboratory steps associated with conventional impressions. However, factors such as the depth of the peri-implant sulcus, scan accessibility, tissue mobility, and scanner performance may influence the accuracy of soft-tissue registration [12,14,15].

The contour of the natural tooth or extracted root can also serve as an anatomical reference when designing the transmucosal portion of a customized healing abutment. The proposed tooth outline and root morphology can be transferred to a working cast or digital model to estimate the desired cervical and subgingival emergence profile. This approach attempts to reproduce the three-dimensional form of the natural tooth at the implant site and may assist in establishing a more anatomically appropriate soft-tissue contour during healing [15].

2.5 Clinical Outcomes and Esthetic Considerations

The ultimate goal of using customized healing abutments is to achieve stable peri-implant tissues with predictable esthetic outcomes. Clinical success in implant dentistry today is not limited to osseointegration alone but also includes harmonious integration of the restoration with surrounding soft tissues. One of the most consistently reported benefits of customized healing abutments is improved soft tissue contour [1-3]. By guiding tissue healing from an early stage, these abutments help in developing a more natural gingival architecture around the implant site. This is particularly relevant in the anterior region, where even slight discrepancies in contour can be easily noticeable.

Papilla preservation and formation are also critical factors in esthetic implant outcomes. Loss or inadequate fill of the interdental papilla can result in unaesthetic "black triangles." Clinical observations suggest that when soft tissues are shaped early using customized contours, there is a greater likelihood of maintaining papillary height and volume [2,3,5]. This may be attributed to reduced tissue collapse and better support during the healing phase.

Another commonly discussed parameter is the stability of the gingival margin. Customized healing abutments appear to support more stable marginal tissue levels by minimizing repeated tissue manipulation [9,13]. This aligns with the concept of maintaining a consistent transmucosal contour, which may help preserve the soft tissue seal and reduce recession over time.

Esthetic evaluation in implant dentistry is often assessed using indices such as the Pink Esthetic Score (PES), which considers parameters like papilla fill, soft tissue level, contour, and color. Studies have indicated that sites managed with customized healing abutments tend to show favourable PES values, reflecting improved integration with adjacent natural teeth [2,5,14].

Comparative clinical evidence has demonstrated measurable differences between customized and prefabricated healing abutments. In a randomized controlled trial involving immediate implant sites, the mean change in Pink Esthetic Score (PES) was −0.333 ± 1.51 in the customized group compared with −2.75 ± 0.96 in the prefabricated group, with the difference reaching statistical significance ($p = 0.022$). The customized group also demonstrated significantly lower buccal volume variation at 1 and 4 months, whereas no significant difference in marginal bone change was observed between the groups at the 6-month follow-up. These findings suggest that customized healing abutments may provide better preservation of peri-implant soft-tissue architecture and esthetic stability, although the available evidence remains limited by the small sample size and short follow-up period [1].

Beyond esthetic outcomes, the clinical performance of customized healing abutments is influenced by factors such as tissue phenotype, implant position, prosthetic design, surface characteristics, and clinician expertise. Therefore, the benefits of customization should be interpreted in the context of individual patient and treatment-related variables rather than considered as an independent determinant of peri-implant health [1,2,10]. This contributes to better long-term peri-implant health and reduces the risk of inflammatory complications [10].

However, it is important to note that clinical outcomes may vary depending on factors such as tissue biotype, implant position, and clinician expertise. While customized healing abutments offer clear advantages, their success is closely

linked to proper case selection and execution. Overall, current evidence supports the use of customized healing abutments as a valuable tool in improving both esthetic and functional outcomes, particularly in cases where soft tissue management is critical [1,4,14].

2.6 Limitations and future directions

Despite the growing interest in customized healing abutments, certain limitations need to be considered. One of the primary concerns is the lack of standardized protocols regarding their design, material selection, and clinical application [1,4]. Different studies have used varying techniques and outcome measures, making direct comparison difficult.

Another limitation is the predominance of short-term clinical data. While immediate and early outcomes appear promising, there is limited evidence on long-term stability of peri-implant tissues when customized healing abutments are used [1,8]. Well-designed longitudinal studies are required to validate their effectiveness over extended periods.

Technique sensitivity is also an important factor. Chairside customization, particularly with composite materials, depends heavily on operator skill. Inadequate contouring or finishing may negatively affect soft tissue response and increase the risk of plaque accumulation. Similarly, digital workflows, although more precise, require access to appropriate technology and expertise [11,12].

Cost and time considerations may further influence their routine use. Customized approaches, especially those involving CAD-CAM or laboratory procedures, may increase treatment expenses and require additional clinical steps. This may limit their application in routine cases where esthetic demands are minimal.

Looking ahead, advancements in digital dentistry are expected to enhance the predictability and accessibility of customized healing abutments. Integration of intraoral scanning, CAD design, and 3D printing technologies may allow more efficient and standardized fabrication. Additionally, future research focusing on material biocompatibility, surface characteristics, and long-term clinical outcomes will provide clearer guidelines for their use [1,4,12].

3. Discussion

The available evidence suggests that customized healing abutments can contribute to peri-implant soft-tissue conditioning by allowing the transmucosal contour to be adapted to the individual clinical situation. A summary of the relevant studies and their principal findings is presented in Table 1. Their potential benefits are particularly relevant when the planned emergence profile requires modification of the peri-implant soft-tissue architecture. However, the magnitude of these benefits varies among studies, and the available evidence remains heterogeneous with respect to study design, materials, follow-up duration, and clinical outcomes [1,4,14].

Table 1. Summary of studies on customized healing abutments and peri-implant soft tissue stability

Author	Year	Focus of study	Main findings
Berglundh & Lindhe	1996	Peri-implant mucosal dimensions	Described biologic width around implants and the importance of soft tissue seal.
Ericsson *et al.*	1996	Abutment disconnection/reconnection	Repeated manipulation may negatively affect peri-implant soft tissues.
Hermann *et al.*	2001	Biologic width around implants	Stable soft tissue attachment is essential for peri-implant health.
Rompen *et al.*	2006	Soft tissue stability	Proper tissue management is important for esthetic implant outcomes.
Canullo & Rasperini	2007	Platform switching	Better preservation of peri-implant soft and hard tissues observed.
Linkevicius & Apse	2009	Soft tissue thickness	Thicker peri-implant mucosa associated with reduced crestal bone loss.
Degidi *et al.*	2011	One abutment-one time concept	Reduced abutment manipulation supported tissue stability.
Koutouzis & Neiva	2011	Implant-abutment microbial interface	Implant-abutment junction may act as microbial reservoir influencing peri-implant health.
Mangano *et al.*	2012	CAD/CAM customized healing abutments	Customized contours improved emergence profile and tissue shaping.
Joda *et al.*	2014	Digital workflows and CAD/CAM	Digital customization improved precision and clinical efficiency.

From a clinical perspective, customized healing abutments may facilitate development of a prosthetically driven emergence profile while reducing the need for repeated manipulation of the peri-implant tissues. Nevertheless, customization should not be considered an isolated determinant of implant esthetic success. Implant position, tissue phenotype, restorative contours, oral hygiene, and patient-related factors also influence the final peri-implant outcome [2,5,6,14].

Customized healing abutments have been introduced as a means to overcome these limitations by facilitating a more controlled and tissue-friendly healing environment. Unlike prefabricated titanium abutments, customized abutments are designed to replicate the emergence profile of the final prosthesis from the initial stages of healing. This approach allows the peri-implant soft tissues to adapt in a guided manner, reducing the need for subsequent modifications and minimizing tissue trauma [1,2,4,5,14].

One of the key biological advantages of customized healing abutments is their ability to support the "one abutment–one time" concept. By placing a definitive or near-definitive abutment at the time of implant uncovering or placement, repeated manipulation of the peri-implant tissues can be avoided [3,6]. This helps preserve the integrity of the soft tissue seal and reduces the risk of epithelial downgrowth and crestal bone loss. Several studies have demonstrated that minimizing abutment changes is associated with improved soft tissue stability and more favorable bone levels [3,6,13].

In addition to preserving tissue integrity, customized healing abutments play a significant role in shaping the peri-implant mucosa. The contour of the emergence profile directly influences gingival architecture, including papilla formation and mucosal thickness. Customized designs can provide appropriate support to the interproximal papilla and facilitate the development of a natural-looking soft tissue contour. This is particularly important in the esthetic zone, where even minor discrepancies can significantly affect the overall outcome [1,2,5,7,14].

Another important consideration is the impact of abutment design on plaque accumulation and peri-implant health. Improper emergence profiles may create plaque-retentive areas, increasing the risk of mucositis and peri-implantitis. Customized healing abutments allow for the creation of smoother and more hygienic contours, which can enhance patient-maintained oral hygiene and reduce inflammatory complications. The implant-abutment interface has also been identified as a potential microbial reservoir, further influencing peri-implant tissue health [10,14].

Radiographic and clinical evaluations reported in the literature suggest that marginal bone stability is influenced by both biological and mechanical factors. Concepts such as platform switching have demonstrated a significant role in preserving crestal bone levels by shifting the implant–abutment junction inward, thereby reducing stress and inflammatory cell infiltration at the crestal bone region. This observation can be explained by the preservation of the biological width and the minimization of mechanical and microbial insults at the implant–abutment junction. Soft tissue thickness is another critical determinant of peri-implant bone stability. It has been reported that implants surrounded by thicker mucosa exhibit reduced crestal bone loss, possibly due to better protection against mechanical and microbial challenges [7 – 9,11].

Material selection for customized healing abutments also plays a role in clinical outcomes. Composite resins, CAD/CAM-fabricated polymers, and hybrid materials have been used for customization, each with its own advantages and limitations. Factors such as surface roughness, biocompatibility, and ease of modification may influence soft tissue response. However, current evidence does not conclusively favour one material over another, indicating the need for further investigation [4,5,12].

Despite the promising outcomes associated with customized healing abutments, certain limitations must be considered. The fabrication process may require additional clinical time, technical expertise, and increased cost. Furthermore, variability in study designs, sample sizes, and outcome assessment methods in the available literature makes it difficult to establish standardized clinical guidelines. These factors highlight the need for cautious interpretation of existing evidence [2,5,12].

In summary, customized healing abutments offer a biologically driven approach to improving peri-implant soft tissue stability by preserving the soft tissue seal, guiding mucosal contour, and minimizing mechanical disruption. While current literature supports their clinical benefits, further well-designed longitudinal studies are necessary to

validate these findings and optimize their application in routine implant practice [1-5,12,14].

4. Conclusion

Customized healing abutments represent a clinically useful approach for individualized peri-implant soft-tissue conditioning and emergence-profile development. Current evidence indicates potential benefits in soft-tissue stability and esthetic outcomes compared with conventional prefabricated approaches; however, the magnitude and consistency of these benefits remain variable across studies. Selection of the material and fabrication technique should therefore be based on the clinical situation, prosthetic requirements, available technology, and clinician expertise. Further well-designed randomized clinical trials with standardized outcome measures and longer follow-up are required to establish the long-term clinical advantages of customized healing abutments.

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