Building up immunological firewalls

How ceramic implants can deliver immune sustainable outcomes and transform overall health

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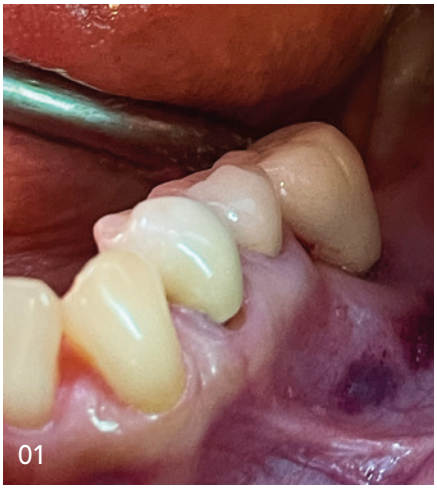
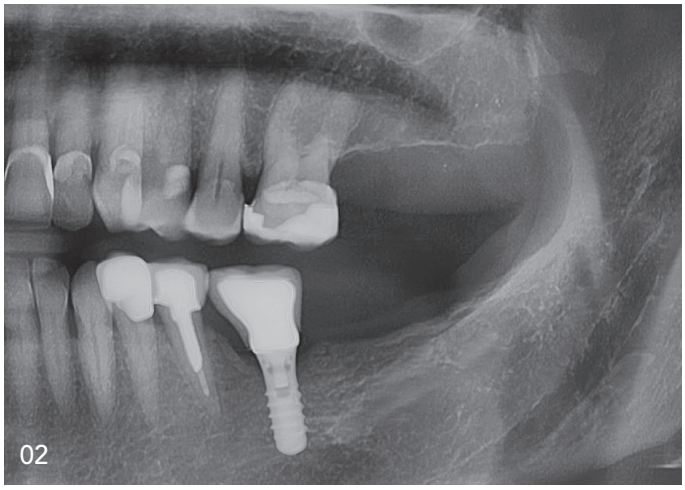
Introduction

It is well established that diseases like periodontitis and peri-implantitis can have systemic effects on general health.[1–4] A key factor may be the compromised barrier function of oral soft tissues, which can allow pathogens to penetrate deeper into the body, triggering systemic inflammatory responses. This may result in an increased concentration of aMMP-8, leading to an elevated rate of tissue degradation.[5] This phenomenon represents a localised immune overload, potentially leading to chronic systemic stress.

An analogy can be drawn to "leaky gut," where a compromised intestinal barrier is implicated in chronic autoimmune conditions and allergies.[6] Similarly, "leaky gum" highlights the role of impaired soft-tissue barriers in oral health. This connection underscores the critical role of dentistry in contributing to immune health by restoring these protective barriers and utilising biocompatible materials.

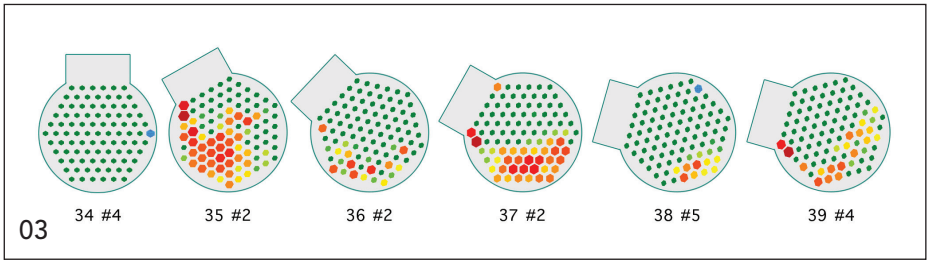
Integrative biological dentistry addresses these issues by employing strategies that support immunological relief, enhance barrier functions, optimal bone regeneration and the use of materials with high biocompatibility. Ceramic implants exemplify this approach, offering documented advantages in soft-tissue integration,[7] aesthetic outcomes, and immunological sustainability. Recent studies using transalveolar ultrasound have further revealed favourable intraosseous behaviour of ceramic materials,[8] showing reduced osteoimmunological stress and decreased cytokine loads unlike titanium, which can release





01
Clinical baseline situation showing titanium implant at position 36 with recurrent inflammatory reactions.

02
Radiographic baseline situation revealing crater-like bone loss around implant 36.



03
Transalveolar ultrasound measurement highlighting osteolytically altered bone areas in red and healthy bone structure in green.

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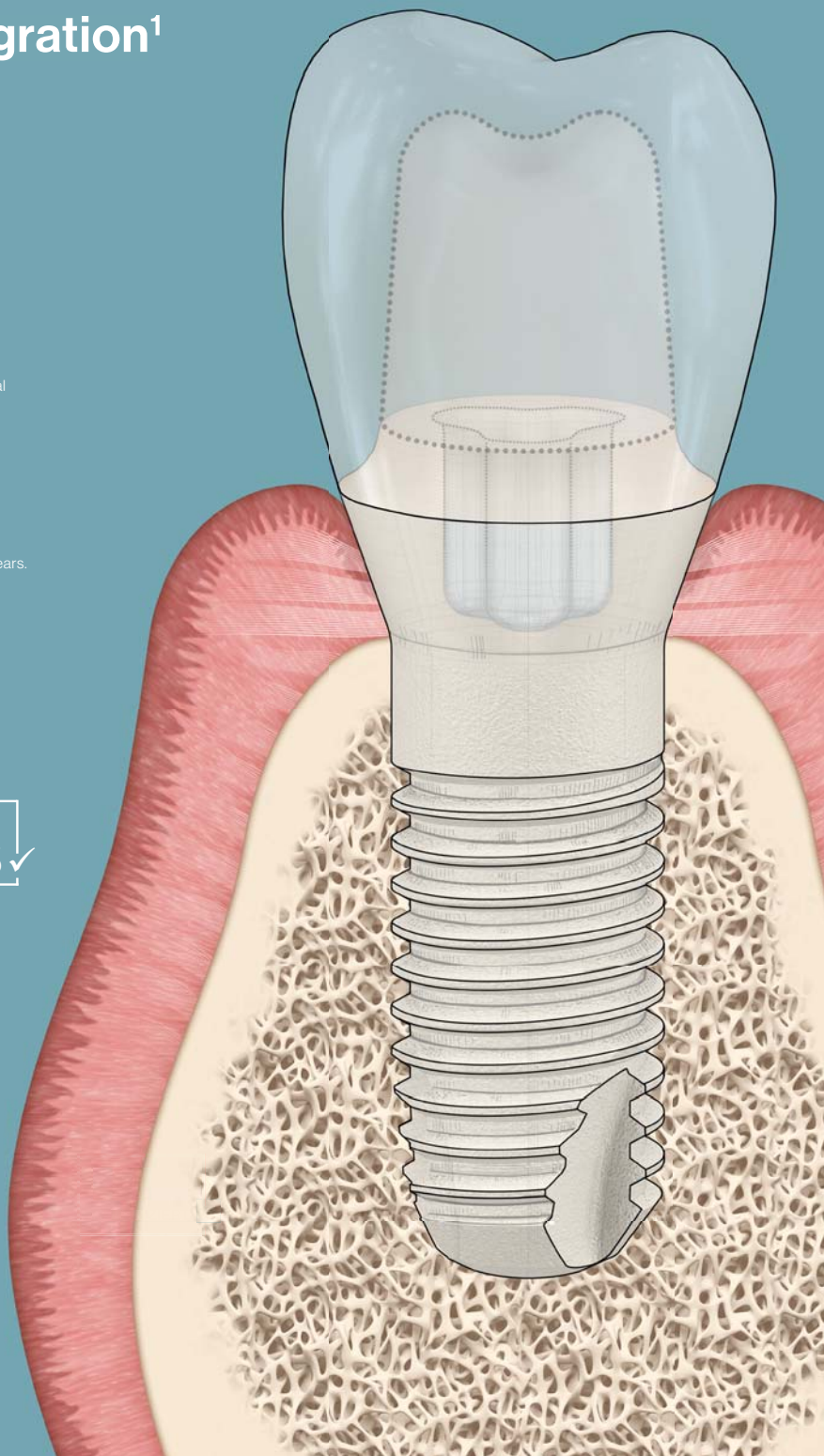

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2. **Brunello G, Rauch N, Becker K, Hakimi AR, Schwarz F, Becker J.** Two-piece zirconia implants in the posterior mandible and maxilla: a cohort study with a follow-up period of 9 years. Clin Oral Implants Res. 2022 Dec;33(12):1233–44. doi: 10.1111/clr.14005. PMID: 36184914.
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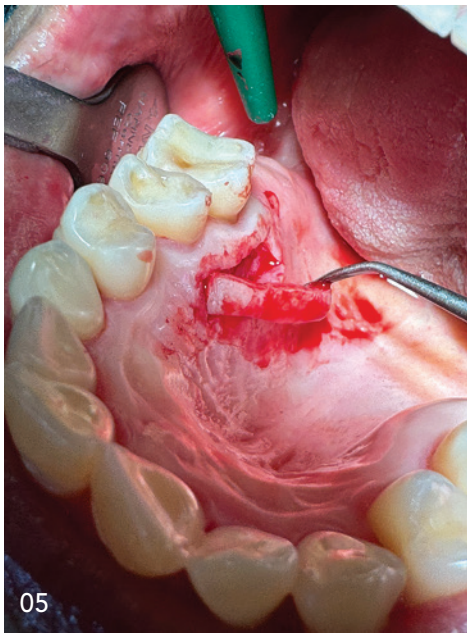
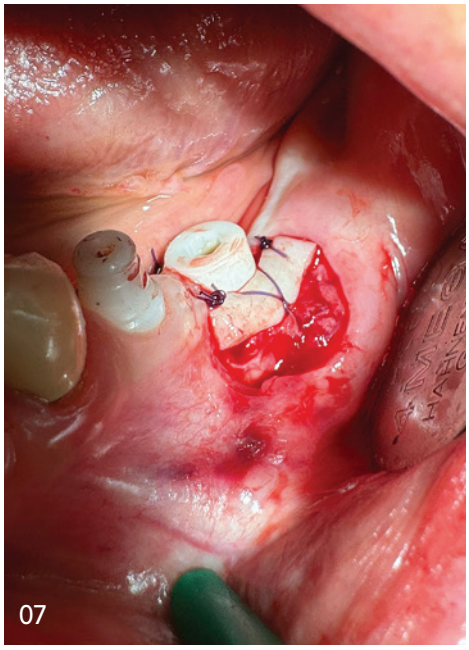


04
Postoperative clinical situation after immediate implantation at positions 35 and 36.

05
Harvesting of the free gingival graft from the palate.

06
Wound management of the donor site using A-PRF membranes and suturing technique.

07
Transplantation of the free gingival graft to the recipient site.



metal particles into bone, that could cause osteoimmunological stress.[8–10]

These findings reinforce the notion that reducing immunological stress in the oral and maxillofacial region can positively influence overall health.[11]

This case report demonstrates how targeted surgical techniques, and the use of biocompatible ceramics can simultaneously achieve immunological relief and aesthetically sustainable outcomes.

Materials and methods

Patient case and diagnosis

A 45-year-old female patient is presented with a chronically inflamed and painful titanium implant at tooth position 36. Clinical examination revealed a lack of keratinised mucosa, and radiological imaging showed crater-like bone loss around the implant. (Fig. 1). Previous disinfection treatments had failed to achieve stable conditions. The patient sought a long-term, inflammation-free, and aesthetically satisfactory solution.

Transalveolar ultrasound imaging identified osteolytic and degenerated areas with elevated cytokine activity of RANTES/CCL5[12] around both the titanium implant and an insufficiently treated root canal at tooth 35 (Figs. 2 & 3). These findings indicated potential contributors to systemic immunological stress and localised tissue degradation.

Surgical reconstruction

In the first stage of treatment, the peri-implantitis-affected titanium implant and the insufficiently treated tooth were removed. Inflammatory tissue was meticulously debrided using metal-free

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08
Healed, inflammation-free situation prior to prosthetic restoration.

09
Clinical condition following the placement of all-ceramic prosthetic restorations.

10
Radiographic condition after completion of all-ceramic prosthetic restorations.

rotating instruments, followed by disinfection with ozone gas[13] and water. Subsequently, two ceramic implants[14] (Fig. 4) with advantageous geometries for optimal integration were placed, achieving a primary stability of 45–50 Ncm. Bone defects and gaps were filled with autologous platelet-rich fibrin (A-PRF) membranes to provide high concentrations of growth factors, facilitating regeneration in hard and soft tissues. Injectable PRF (I-PRF) further enhanced the regenerative potential in the surrounding tissues.[15–17]

To restore the keratinised mucosa, a second procedure was performed eight weeks later, involving a free gingival graft (FGG) harvested from the palatal region[18] (Fig. 5). A split flap was created at the recipient site, and mobile mucosal tissues were removed before graft placement with minimal invasive suturing (Fig. 6). A-PRF membranes and I-PRF were used at both donor and recipient sites to enhance healing (Fig. 7). The surgical site healed without complications, and sutures were removed after 14 days.

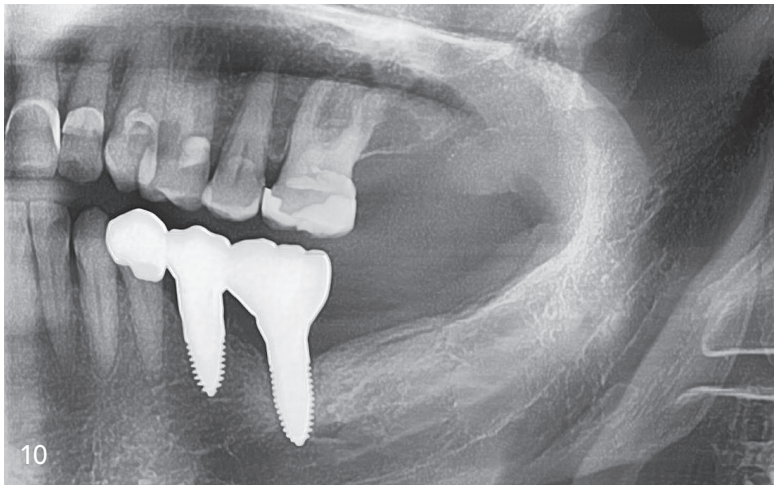
The final prosthetic restoration with fully ceramic crowns was completed after eight weeks under inflammation-free conditions (Figs. 8–10). By this stage, the patient reported complete pain relief, and the chronic inflammation was resolved, leading to high satisfaction even prior to prosthetic placement.

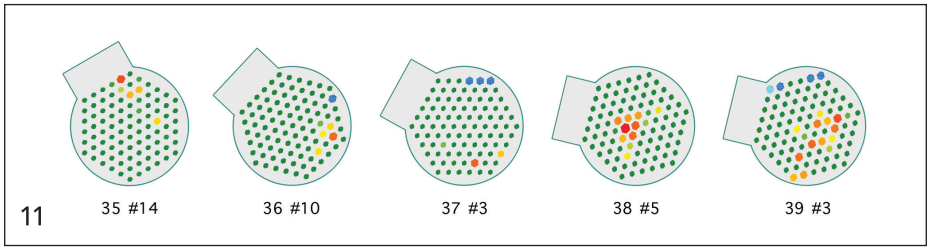
Results

The use of biocompatible ceramic implants and the restoration of stable biological conditions resulted in multiple significant outcomes:

1. **Immunological relief:** Transalveolar ultrasound measurements after nine months of treatment showed increased bone density (Fig. 11) and therefore, reduced osteoimmunological cytokine levels (RANTES/CCL5), confirming the effectiveness of bone regeneration concepts and the "immunological firewall" created by ceramic materials and special soft-tissue transplantation techniques.
2. **Sustainability:** The re-establishment of keratinised mucosa provided an effective soft-tissue barrier against pathogens, contributing to long-term implant stability.
3. **Aesthetic excellence:** The treatment fulfilled high aesthetic standards, achieving a natural appearance and ensuring patient satisfaction.

These results underscore the importance of combining advanced diagnostics with regenerative and biocompatible approaches to achieve sustainable outcomes in both functional and aesthetic dentistry.





11
Follow-up transalveolar ultrasound measurement showing complete bone healing and remineralisation after nine months.

"This case highlights how integrative biological dentistry can address both immunological and aesthetic challenges through advanced diagnostics and innovative surgical techniques."

Discussion

This case highlights how integrative biological dentistry can address both immunological and aesthetic challenges through advanced diagnostics and innovative surgical techniques. Chronic stress and systemic inflammatory responses, often originating from subclinical and clinical lesions in the oral cavity, can be effectively mitigated through the implementation of bone regeneration concepts and sealing immunological barriers.

The use of ceramic implants is particularly advantageous. Compared to titanium, ceramic materials exhibit superior biocompatibility, fostering better soft-tissue integration and minimising osteoimmunological stress. These minimally invasive procedures not only protect systemic health but also achieve high aesthetic standards, representing a whole-body approach to patient care.

The mouth-body connection emphasises the interplay between oral and systemic health. Chronic inflammation in the oral cavity, such as peri-implantitis, can exacerbate systemic conditions by perpetuating a state of low-grade immune activation. Studies have linked oral infections to increased risks of cardiovascular disease,[1,2,19] diabetes,[20] and autoimmune diseases like atopic dermatitis.[4] Conversely, resolving oral inflammation can have far-reaching health benefits, including improved metabolic function and reduced systemic inflammatory markers.

Ceramic implants are particularly suited for this integrative approach due to their unique properties. Unlike titanium, ceramics are bioinert, minimising the release of particles or ions that could trigger an immune response. Their excellent soft-tissue compatibility fosters a tight mucosal seal, which acts as a physical and immunological barrier against microbial invasion.

Conclusion

This case exemplifies how the strategic use of high-technology diagnostics and targeted surgical techniques can lead to immunologically sustainable and aesthetically excellent treatment outcomes. By creating an "immunological firewall," ceramic implants effectively combine functional and aesthetic benefits while contributing to overall health optimisation.

The integrative biological dentistry approach should not be viewed as conflicting with established concepts but as a natural progression and enhancement of traditional therapeutic philosophies. Ceramic implants emerge as the preferred choice for immunologically and aesthetically demanding treatment protocols.

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Literature