Effective electrolytic cleaning and regenerative therapy for peri-implantitis

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Peri-implant diseases are inflammatory conditions affecting the soft and hard tissues surrounding dental implants. They are primarily classified into peri-implant mucositis and peri-implantitis. Peri-implant mucositis involves inflammation limited to the peri-implant soft tissues, without any associated bone loss, and is considered reversible with appropriate intervention. In contrast, peri-implantitis affects both the soft tissues and the supporting alveolar bone, leading to progressive bone loss and potentially compromising the structural stability of the implant. If not properly managed, peri-implantitis poses a serious risk to implant longevity and may ultimately result in implant failure.[1,2]

The pathogenesis of peri-implantitis is closely linked to the formation and maturation of a bacterial biofilm on the implant surface. This biofilm, a complex and resilient community of microorganisms encased in an extracellular polymeric matrix, is a critical etiological factor in the onset and progression of peri-implant diseases.[3] The host immune response to these biofilms is characterised by the stimulation of inflammatory cells, including neutrophils and macrophages, which release pro-inflammatory cytokines and enzymes that degrade bone tissue. This inflammatory cascade leads to peri-implant bone resorption, jeopardising the stability of the implant.[4] Given the central role of biofilm in disease progression, effective biofilm removal is key in the management of peri-implantitis.

Treatment strategies for peri-implant diseases have evolved to include various approaches, often requiring a combination of mechanical debridement, antimicrobial therapy, and, in more advanced cases, surgical intervention. Mechanical debridement remains a cornerstone of treatment, focusing on the physical removal of biofilm and calculus from the implant surface. This may involve the use of specialised instruments such as ultrasonic scalers, titanium curettes, or air-polishing devices. In recent years, electrolytic cleaning has emerged as a novel approach for biofilm removal, utilising low-level electrical currents to disrupt and detach bacterial biofilms from the implant surface.

However, in cases of established peri-implantitis, non-surgical approaches may be insufficient to fully resolve the disease, and surgical interventions are often necessary to achieve thorough decontamination of the implant surface and to facilitate the regeneration of lost peri-implant tissues. The goal of these procedures is to re-establish a stable and healthy peri-implant environment conducive to the long-term stability of the implant. [5,6]

In this clinical case, we describe the successful management of peri-implantitis through a comprehensive treatment that integrates meticulous mechanical cleaning with regenerative techniques. This case highlights the critical importance of the efficacy of biofilm removal strategies and the application of regenerative procedures to achieve optimal clinical outcomes. The integration of these techniques not only stops the progression of the disease but also facilitates the regeneration of lost bone and soft tissue, thereby ensuring the long-term stability and function of the dental implant.

Initial situation

A 40-year-old female, healthy (ASA I), non-smoker, taking no medication, came to our practice in 2020 from a referral dentist and with a diagnosis of peri-implantitis in the posterior area. The patient mentioned that the implants were placed seven years ago, and that she failed to attend her follow-up appointments. The patient requested to keep her implants.

On intra-oral examination, the implants in positions #36 and #37 showed a probing depth greater than 6 mm, positive BOP (Bleeding on Probing), suppuration, redness and swelling, and dental plaque.

The radiographic examination revealed both horizontal and vertical bone loss around the implants, particularly around implant #37 (Fig. 1).

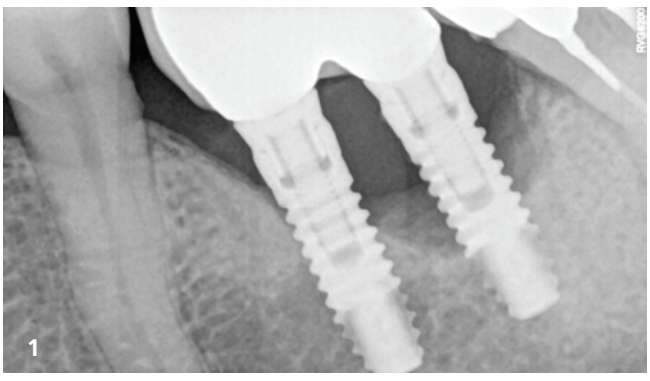


Fig. 1: Preoperative radiograph showing horizontal and vertical bone loss around implants #36 and #37, severe at #37.

Treatment planning

The treatment started with a non-surgical approach to reduce inflammation. Next, a surgical procedure was performed to decontaminate the implants, followed by guided bone regeneration (GBR). A new screw-retained splinted crown on the implants was then placed.

The treatment workflow included:

1. Non-surgical periodontal supportive therapy: oral hygiene instructions, rinsing with 0.12 % chlorhexidine (CHX), and the application of metronidazole at a concentration of 5 mg/ml, along with the use of a solution of local antibiotic and hyaluronic acid. Follow-up appointments were scheduled and conducted on the following dates: 11 November 2020, 9 December 2020, 6 January 2021, 2 February 2021, 3 March 2021.
2. Surgical treatment, which involved GalvoSurge®, GBR using autogenous bone chips and Straumann® Membrane Flex.
3. Final prosthetic rehabilitation with screw-retained splinted crowns on implants.
4. Follow-up visits for control.

Surgical procedure

After the non-surgical treatment, clinical examination in 2021 showed a decrease in inflammation, though it was not completely resolved (Fig. 2). Lidocaine 2 % with epinephrine 1:100,000 was administered. Upon removal of the prosthesis, the peri-implant mucosa surrounding the implants in positions #36 and #37 exhibited localised inflammation with evident redness, swelling and bleeding (Fig. 3).

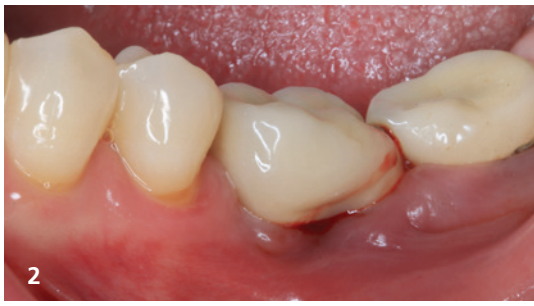
A full-thickness flap was elevated to access the defect and mechanically remove the granulation tissue surrounding the implants (Fig. 4). The bone defect was assessed using the modified criteria established by Monje et al., and was classified as a Class 3b defect, making it suitable for reconstructive therapy. First, implant disinfection was done with ablative mechanical debridement, CHX 0.12 %, metronidazole 5 mg/ml, and a solution of local antibiotic and hyaluronic acid (Fig. 5).

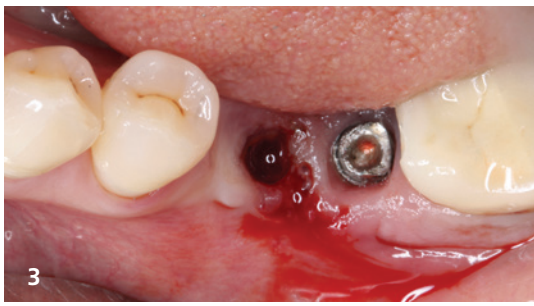
The implant cleaning and disinfection were done with CHX 0.12 % and the GalvoSurge®. Implant disinfection was performed using GalvoSurge®, applying only gentle pressure to the implant being treated. In this two-minute process, hydrogen ions interact with captured electrons to produce hydrogen bubbles that lift the biofilm off the implant surface (Fig. 6). Additionally, regenerative therapy was performed through GBR. Autogenous bone chips, combined with bone harvested from the tuber, were placed into the defect as grafts. These materials helped in bone augmentation and covered the exposed implant threads, thereby enhancing the healing and re-osseointegration at the implant site (Figs. 7–9).

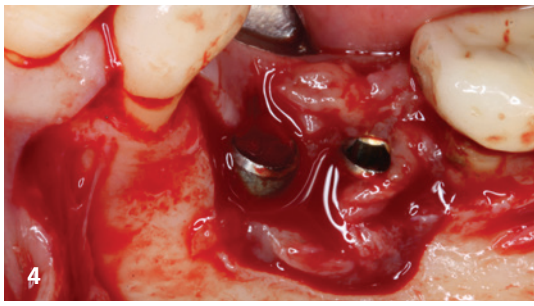
Tooth #38 was extracted. Closure caps were placed, and the Straumann® Membrane Flex, a minimally-crosslinked porcine peritoneum collagen membrane, was fixed in place with pins. This protects the graft area from unwanted soft-tissue infiltration during the healing phase (Figs. 10–12).

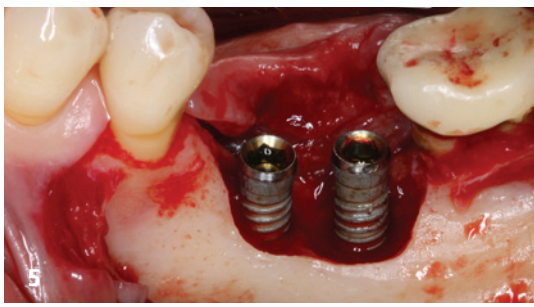
Suturing was performed with 4/0 Vicryl and 6/0 Prolene, using interrupted sutures to facilitate primary intention wound healing, while the implant remained without the prosthetic crown for six months (Fig. 13). After this period of submerged healing, the reinstallation of the suprastructures was planned.

In 2021, six months after the initial surgery, a full-thickness flap was elevated, revealing that the implants were surrounded by bone (Figs. 14+15). Healing abutments were then inserted, and interrupted sutures were inserted using 6/0 Prolene (Fig. 16). The healing abutments play an essential role in facilitating proper healing of the gingival tissue around the implant, shaping the tissue for an optimal









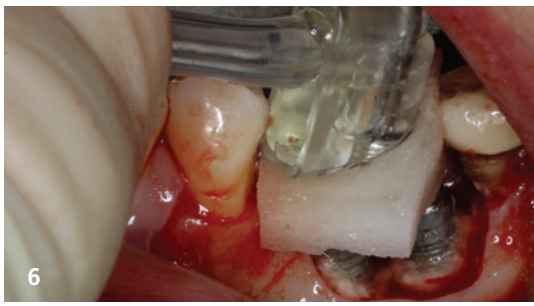
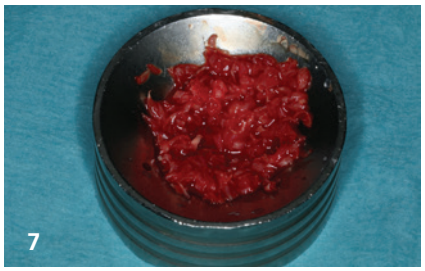
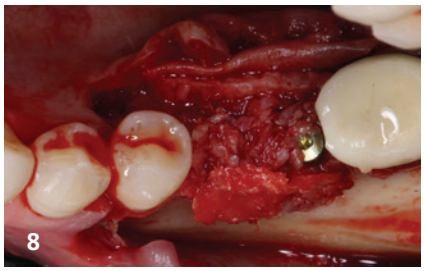
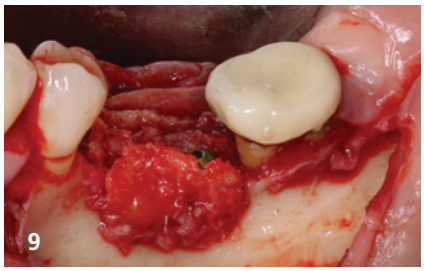
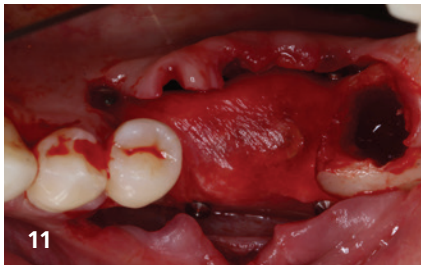


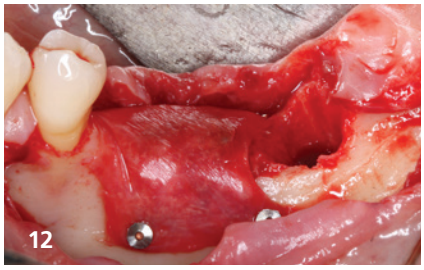
Fig. 2: Clinical view after non-surgical therapy, showing partial reduction of peri-implant inflammation. – **Fig. 3:** Peri-implant mucosa following prosthesis removal, with redness, swelling, and bleeding on probing. – **Fig. 4:** Full-thickness flap elevated to access peri-implant defect and remove granulation tissue. – **Fig. 5:** Mechanical debridement with chlorhexidine, metronidazole, and local antibiotic/hyaluronic acid solution. – **Fig. 6:** Electrolytic implant cleaning using GalvoSurge®, with hydrogen bubbles detaching biofilm.

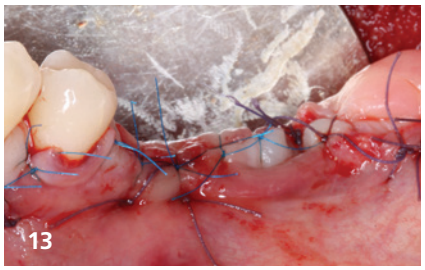


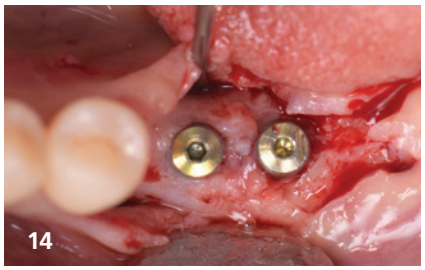


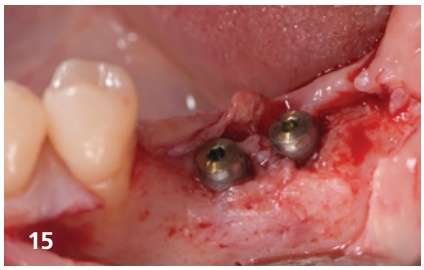












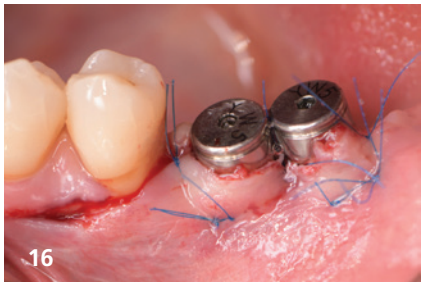


Fig. 7: Autogenous bone chips and graft material. – **Fig. 8:** Grafted defect covering exposed implant threads to support re-osseointegration. – **Fig. 9:** Fully grafted defect prior to placement of collagen membrane. – **Fig. 10:** Extraction of tooth #38 to allow proper defect management and grafting. – **Fig. 11:** Placement of Straumann® Membrane Flex to prevent soft-tissue ingrowth. – **Fig. 12:** Membrane secured with pins to protect the graft during healing. – **Fig. 13:** Flap closure with 4/0 Vicryl and 6/0 Prolene sutures, allowing submerged healing. – **Fig. 14:** Six-month postoperative view showing regenerated peri-implant bone around implants #36 and #37. – **Fig. 15:** Close-up of regenerated peri-implant bone prior to healing abutment placement. – **Fig. 16:** Healing abutments inserted to shape gingival tissue and protect implants.

fit of the final prosthesis, and protecting the implant from contaminants.

Prosthetic procedure

After the healing period, the next step involved selection of the appropriate shade for the fully polished zirconia prosthetic to ensure aesthetic integration with the surrounding natural dentition. To achieve a precise match and optimal visual outcome, a shade guide was used, and the selected shade was confirmed with the patient (Fig. 17). An impression was taken with the open-tray technique, using additional silicone material for its high dimensional stability and accuracy (Fig. 18). Then it was sent to the dental laboratory for the fabrication of the final prosthesis.

The gingiva was evaluated before the placement of the final prosthetics (Fig. 19). A fully polished zirconia prosthetic was then carefully fabricated and inserted and torqued to 35 Ncm (Figs. 20+21) and the subsequent x-ray revealed satisfactory results (Fig. 22).

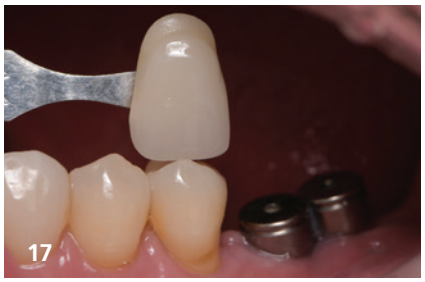
At the follow-up recall in 2021, the clinical evaluation indicated that the peri-implant soft tissues were in good health, with no signs of inflammation. Additionally, the marginal levels were appropriately maintained (Fig. 23).

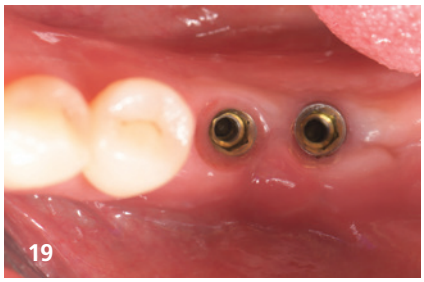
The following year, the clinical evaluation revealed similar findings, with the peri-implant soft tissues remaining healthy. The radiographic examination also showed that the peri-implant marginal bone levels were stable, with no evidence of bone resorption (Fig. 24).

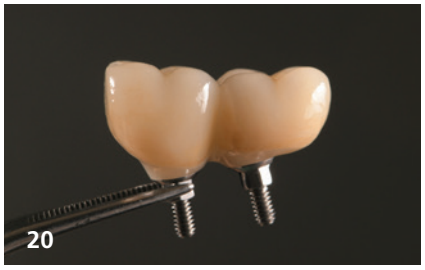
In 2023, similar results were observed, with the peri-implant tissues remaining healthy. The radiographic examination confirmed that marginal bone levels were intact. The treatment was successful, and the patient reported satisfaction with the aesthetic and functional outcomes. (Figs. 25+26).

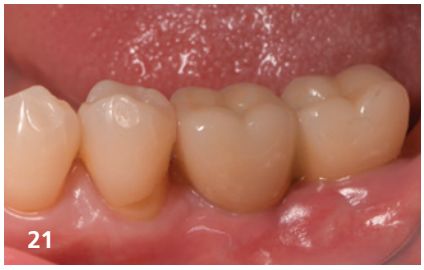
Treatment outcomes

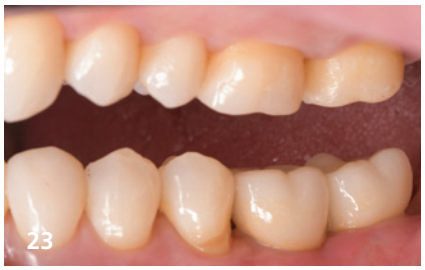
The follow-up visits confirmed the absence of any biological or radiographic

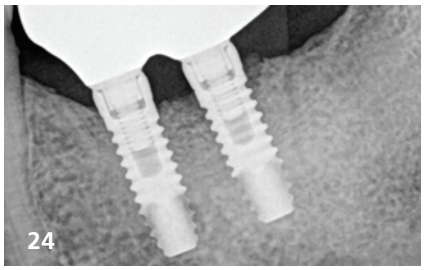












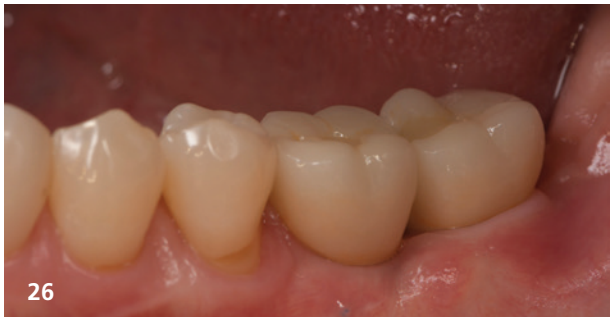


Fig. 17: Shade selection for zirconia prosthesis to match adjacent dentition. – **Fig. 18:** Open-tray impression using addition silicone for accurate prosthetic fabrication. – **Fig. 19:** Evaluation of peri-implant soft tissue before final prosthetic placement. – **Fig. 20:** Fully polished zirconia crowns. – **Fig. 21:** Final prosthesis torqued to 35 Ncm for stability. – **Fig. 22:** Post-insertion radiograph confirming correct seating of prosthesis. – **Fig. 23:** Follow-up showing healthy peri-implant soft tissues without inflammation. – **Fig. 24:** One-year radiograph demonstrating stable marginal bone levels around implants. – **Fig. 25:** Radiograph in 2023 showing preserved peri-implant bone and long-term treatment success. – **Fig. 26:** Clinical evaluation in 2023 confirming healthy peri-implant tissues and gingival architecture.

issues, demonstrating excellent health in both hard and soft tissues. This outcome highlights the success of the surgical procedure, further improved using GalvoSurge® and GBR.

Conclusion

The GalvoSurge® device offers a predictable method for electrochemical decontamination of contaminated implant surfaces and may facilitate conditions favourable for re-establishing osseointegration. Nevertheless, initial management should prioritise conservative modalities—mechanical debridement, biofilm disruption, and adjunctive antimicrobial strategies. Consistent maintenance therapy and structured follow-up intervals remain fundamental to preventing disease recurrence and ensuring implant survival.

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References

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