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Research Article

Antimicrobial Photodynamic Therapy (Helbo®) as an Adjunctive Approach for the Preservation of Dental Implants Following Early Postoperative Surgical Wound Dehiscence: A Case Report

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Abstract

Background: Early postoperative surgical wound dehiscence following dental implant placement is an uncommon but clinically significant complication that may result in alveolar bone exposure, bacterial contamination, impaired soft tissue healing, and possible implant failure. Although various treatment strategies have been described, there is currently no standardised management protocol, and clinical evidence regarding the adjunctive use of antimicrobial photodynamic therapy (aPDT) in this setting remains limited. This case highlights the potential clinical value of antimicrobial photodynamic therapy (HELBO®) as part of a multidisciplinary treatment approach for preserving newly placed dental implants. This case report aimed to present the successful preservation of newly placed dental implants affected by early postoperative surgical wound dehiscence using adjunctive HELBO® antimicrobial photodynamic therapy.

Case Presentation: This case report describes a 74-year-old completely edentulous male patient with severe mandibular alveolar ridge atrophy who underwent placement of two implants in the interforaminal region to improve the retention of a mandibular complete overdenture. Several days after surgery, early postoperative surgical wound dehiscence developed, resulting in loss of primary wound closure and exposure of the alveolar bone. Initial surgical wound revision and atraumatic resuturing failed to achieve stable wound closure. A comprehensive treatment protocol consisting of mechanical debridement, systemic antibiotic therapy, and adjunctive antimicrobial photodynamic therapy (HELBO®) was subsequently implemented to control bacterial contamination, promote soft tissue healing, and preserve the implants.

Results: The treatment resulted in progressive resolution of inflammation, formation of healthy granulation tissue, complete secondary wound epithelialization, and successful preservation of both implants. Clinical and radiographic follow-up confirmed stable osseointegration, enabling successful completion of the planned implant-retained mandibular overdenture rehabilitation. Adjunctive antimicrobial photodynamic therapy combined with meticulous local wound care resulted in complete secondary wound healing without signs of infection or implant failure. The implants remained clinically stable and were successfully preserved throughout follow-up.

Conclusion: This case demonstrates the successful management of early postoperative surgical wound dehiscence with alveolar bone exposure through a comprehensive treatment protocol incorporating adjunctive antimicrobial photodynamic therapy (HELBO®). The successful preservation of both implants, achievement of complete secondary wound healing, and uneventful osseointegration highlight the potential clinical value of this minimally invasive adjunctive therapy in managing biologic complications following implant surgery. Further prospective clinical studies are warranted to establish its effectiveness and define its role in evidence-based treatment protocols.

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Introduction

Dental implants are currently regarded as a predictable and well-established treatment modality for the rehabilitation of partially and completely edentulous patients, demonstrating high long-term survival and success rates [1-3]. Continuous advances in implant design, surface characteristics, surgical techniques, and prosthetic protocols have further enhanced the predictability of implant therapy [3]. However, biological and surgical complications may still occur during the early healing phase, particularly when primary wound closure is compromised, potentially resulting in soft tissue dehiscence, implant surface exposure, bacterial contamination, and an increased risk of peri-implant infection and implant failure [4-6].

Primary wound healing is a fundamental prerequisite for successful osseointegration [7,8]. Adequate adaptation and tension-free closure of the mucoperiosteal flap protect the underlying alveolar bone and implant surface from contamination by the oral microbiota, minimise the risk of infection, and provide optimal conditions for both soft- and hard-tissue healing [2,7,8]. Conversely, early postoperative wound dehiscence disrupts soft tissue continuity, exposing the alveolar bone and, in some cases, the implant or healing abutment to the oral environment. Such exposure facilitates bacterial colonisation and biofilm formation, thereby increasing the risk of inflammatory complications and compromising the long-term prognosis of implant therapy [2,6,9].

The aetiology of postoperative wound dehiscence is multifactorial and may involve excessive flap tension, impaired vascular supply, thin soft tissue biotype, local trauma, microbial contamination, systemic patient-related factors, and mechanical stress during the early healing phase [10, 11]. Clinically, this complication is associated not only with delayed wound healing but also with a potential impairment of osseointegration, which may ultimately lead to early implant failure if not recognised and managed promptly [2,11,12].

Conventional management of wound dehiscence generally includes local mechanical debridement, meticulous plaque control, systemic antibiotic therapy when indicated, and surgical wound revision with an attempt to re-establish primary closure [13,14]. However, these approaches do not always achieve predictable outcomes, particularly when secondary wound healing has already been established, and the alveolar bone remains exposed [14,15]. Consequently, increasing attention has been directed toward adjunctive therapeutic modalities capable of improving microbial control while simultaneously creating favourable biological conditions for tissue healing [15–17].

This case report presents the successful use of HELBO® antimicrobial photodynamic therapy as an adjunctive treatment for preserving dental implants affected by early postoperative surgical wound dehiscence, thereby avoiding implant removal and promoting successful secondary wound healing.

The Indian Society of Periodontology Good Clinical Practice Recommendations for Peri-implant Care published in the Journal of Indian Society of Periodontology provide evidence-based guidelines divided into three main sections: peri-implant health and maintenance, peri-implant mucositis, and peri-implantitis. Developed by 28 subject experts across India via literature reviews and group consensus. Designed to bridge the gap between academic theory and everyday clinical practice for general dental practitioners. Emphasises multidisciplinary collaboration among periodontics, prosthodontics, and oral surgery [18].

Antimicrobial Photodynamic Therapy (aPDT) is a minimally invasive therapeutic approach based on the activation of a photosensitising agent by light of a specific wavelength in the presence of oxygen, resulting in the generation of reactive oxygen species that selectively destroy microorganisms and disrupt the biofilm [19–21]. Unlike systemic antibiotics, this mechanism does not promote bacterial resistance and causes minimal damage to the surrounding healthy tissues [21,22]. The HELBO® system is one of the most extensively investigated commercial antimicrobial photodynamic therapy systems in dentistry and has demonstrated promising results as an adjunctive treatment for periodontitis, peri-implant diseases, and other oral infections [16,23-26]. Nevertheless, evidence regarding its application in the management of early postoperative wound dehiscence following dental implant placement, particularly with the objective of implant preservation, remains scarce [16,26].

Numerous *in vitro*, animal, and clinical studies have demonstrated that aPDT effectively reduces the microbial load and disrupts biofilm formation, thereby contributing to improved infection control without inducing bacterial resistance.

Today, Photodynamic Therapy (PDT) has become an established therapeutic modality in several medical and dental disciplines because of its broad antimicrobial activity, minimal invasiveness, and favourable safety profile [27-30].

This systematic review and meta-analysis found that adjunctive antimicrobial Photodynamic Therapy (aPDT) significantly improves clinical outcomes compared to mechanical debridement alone. By combining it with mechanical treatment, patients show notable reductions in Probing Pocket Depth (PPD), Bleeding on Probing (BoP), and Crestal Bone Loss (CBL) in both peri-implant mucositis and peri-implantitis [31].

This case report aims to describe the successful preservation of dental implants following early postoperative surgical wound dehiscence using adjunctive HELBO® antimicrobial photodynamic therapy and to highlight its potential clinical value in managing this challenging complication. Management consisted of a comprehensive therapeutic protocol including surgical wound revision, mechanical debridement, systemic antibiotic therapy, and adjunctive antimicrobial photodynamic therapy (HELBO®). The originality of this report lies in demonstrating successful secondary wound healing, preservation of both implants, successful osseointegration, and completion of prosthetic rehabilitation despite the failure

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of repeated primary wound closure and the initially high risk of implant loss. This case is unique because it demonstrates successful secondary wound healing, preservation of both implants, complete osseointegration, and definitive prosthetic rehabilitation despite repeated failure to achieve primary wound closure and an initially high risk of implant loss.

Although antimicrobial Photodynamic Therapy (aPDT) has been investigated as an adjunctive treatment for peri-implant diseases, there is limited clinical evidence regarding its use for the preservation of newly placed dental implants following early postoperative surgical wound dehiscence. Consequently, evidence-based recommendations for this specific clinical scenario remain scarce.

Case Presentation

A 67-year-old male patient presented to the Department of Periodontology and Oral Implantology complaining of long-standing functional difficulties caused by the instability of his mandibular complete denture. The patient had been completely edentulous for more than 30 years and had worn complete dentures in both jaws throughout this period. While the maxillary denture provided satisfactory function and esthetics, the mandibular denture exhibited poor retention and stability because of severe alveolar ridge atrophy despite repeated adjustments and relining procedures.

The patient's medical and dental history revealed no systemic diseases or contraindications to implant therapy. He was a non-smoker, had no history of diabetes mellitus, and reported no other systemic conditions likely to compromise wound healing. Clinical examination and Cone-Beam Computed Tomography (CBCT) demonstrated advanced horizontal and vertical mandibular ridge atrophy, indicating that placement of four implants would require additional bone augmentation procedures (Figure 1). Following a comprehensive discussion with the patient, a treatment plan involving placement of two implants in the interforaminal region was selected to improve the retention and stability of a mandibular implant-retained overdenture.

Implant surgery was performed under local anaesthesia following a conventional surgical protocol. After preparation of the implant osteotomies, two dental implants of appropriate dimensions were placed in the anterior mandible, achieving satisfactory primary stability. A postoperative radiographic examination confirmed correct implant positioning (Figure 2). The surgical wound was closed with primary adaptation of the mucoperiosteal flap using non-resorbable silk sutures.

The first postoperative examination, performed 24 hours after surgery, revealed an uneventful healing process without signs of infection, bleeding, or wound complications. However, several days later, progressive separation of the wound margins occurred, resulting in loss of primary wound closure and the onset of secondary wound healing. Despite routine postoperative care, wound dehiscence progressively increased, leading to exposure of a portion of the alveolar bone in the implant region (Figure 3).

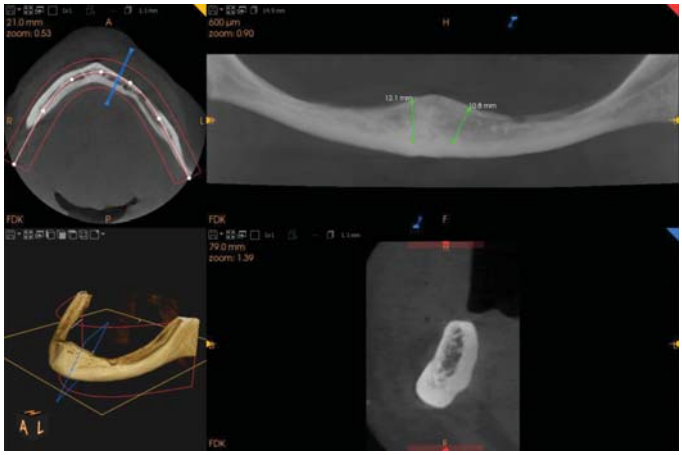

Figure 1: Cone-beam computed tomography (CBCT) demonstrated advanced horizontal and vertical mandibular ridge atrophy.

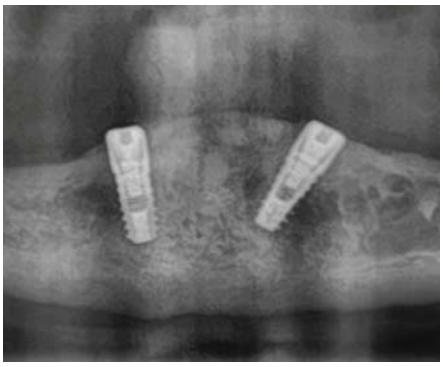

Figure 2: Immediate postoperative panoramic radiograph demonstrating successful placement of two dental implants in the interforaminal region of the severely resorbed edentulous mandible. The implants exhibited appropriate angulation and positioning within the available alveolar bone, providing the foundation for a mandibular implant-retained overdenture.

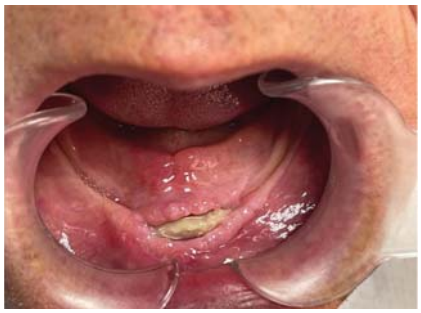

Figure 3: Baseline clinical presentation of early postoperative surgical wound dehiscence following mandibular implant placement, with exposed alveolar bone and delayed soft tissue healing before adjunctive HELBO® antimicrobial photodynamic therapy.

Surgical wound revision and adjunctive antimicrobial photodynamic therapy

Following the diagnosis of early postoperative wound dehiscence, the patient was placed under close clinical observation because of the increased risk of bacterial contamination and possible impairment of osseointegration. Clinical examination demonstrated progressive widening of the dehisced wound with persistent exposure of the underlying alveolar bone adjacent to the implants. Although no purulent

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exudate or systemic signs of infection were observed, the exposed surgical site represented a highly susceptible environment for microbial colonisation and biofilm formation.

Considering the unfavourable clinical course, surgical wound revision was performed under local anaesthesia. The wound margins were carefully refreshed to remove the epithelialized tissue and to improve their biological potential for healing. The surgical site was thoroughly irrigated with sterile saline, and meticulous mechanical debridement of the exposed tissues was carried out to reduce the microbial load and eliminate superficial contaminants. The mucoperiosteal flap was then mobilised and repositioned, followed by atraumatic resuturing using interrupted 4-0 silk sutures in an attempt to re-establish primary wound closure.

Before initiation of antimicrobial photodynamic therapy, the patient received systemic antibiotic therapy with amoxicillin/clavulanic acid (Amoxiclav®) and oral serratiopeptidase (Serrapeptase®) according to the postoperative treatment protocol. Despite this initial pharmacological management, wound dehiscence persisted, prompting the use of HELBO® antimicrobial photodynamic therapy as an adjunctive treatment to enhance local decontamination and promote secondary wound healing.

Despite satisfactory intraoperative adaptation of the wound margins, repeated postoperative examinations demonstrated recurrence of wound separation within several days. The second loss of primary closure confirmed that conventional surgical management alone was insufficient to achieve stable healing. Progressive secondary wound healing became inevitable, while the exposed alveolar bone remained at considerable risk of bacterial contamination. The key stages of clinical management, together with the corresponding treatment outcomes, are summarised chronologically in Table 1.

At this stage, preservation of the implants became the primary therapeutic objective. Rather than performing additional surgical interventions that could further compromise the vascular supply of the already fragile soft tissues, a comprehensive conservative treatment protocol was implemented. This protocol consisted of meticulous mechanical plaque control, local wound irrigation, systemic antibiotic therapy, strict oral hygiene measures, and adjunctive antimicrobial photodynamic therapy (HELBO®).

The decision to incorporate antimicrobial photodynamic therapy was based on its ability to selectively reduce the bacterial burden within the surgical wound without inducing bacterial resistance or causing thermal injury to the surrounding tissues. Because successful wound healing depends on both adequate microbial control and preservation of tissue vitality, adjunctive photodynamic therapy was considered a biologically favourable approach for supporting secondary wound healing while minimising the risk of implant contamination.

The HELBO® protocol was initiated immediately after completion of mechanical debridement. Following gentle cleaning of the wound surface, the HELBO® photosensitizer was applied directly to the exposed surgical area and allowed to penetrate the contaminated tissues according to the manufacturer's recommendations. Excess photosensitizer was subsequently removed by gentle irrigation, after which the treated area was illuminated using the HELBO® diode laser (approximately 660 nm wavelength), thereby activating the photosensitizer and generating reactive oxygen species responsible for selective microbial destruction (Figures 4 and 5).

The treatment was repeated according to a predefined clinical protocol during the early healing phase. Throughout the treatment period, the patient remained under regular clinical supervision, allowing continuous assessment of soft tissue healing, control of inflammation, and monitoring of implant stability. A comprehensive overview of the HELBO® antimicrobial Photodynamic Therapy (aPDT) protocol used in the management of this case is provided in Table 2.

Table 1: Chronological timeline of the clinical management and treatment outcomes.

Time	Clinical event
Day 0	Placement of two implants
Day 7	Surgical wound dehiscence with alveolar bone exposure
Day 8	Surgical wound revision and resuturing
Day 10	Mechanical debridement + antibiotics + HELBO® aPDT initiated
Week 2	Healthy granulation tissue observed
Week 4	Complete secondary epithelialization
Month 3	Successful osseointegration
Month 4	Implant-retained mandibular overdenture delivered.

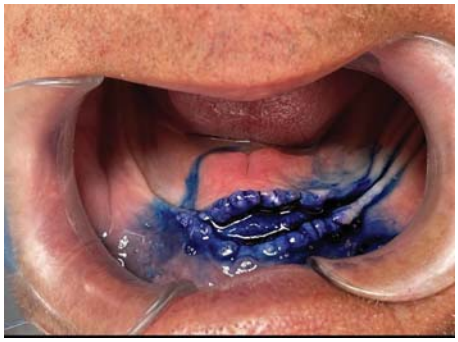

Figure 4: Clinical appearance following application of the HELBO® photosensitizer to the peri-implant tissues, immediately before laser irradiation.

Figure 5: Antimicrobial photodynamic therapy (HELBO®) performed after surgical wound revision and mechanical debridement. The photosensitizer is activated with a diode laser to achieve antimicrobial decontamination of the exposed surgical site.

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Table 2: Detailed HELBO® antimicrobial photodynamic therapy (aPDT) protocol used in the present case.

Parameter	Details
Photosensitizer	HELBO® Photosensitizer (bredent medical GmbH)
Biofilm visualization	HELBO® Biofilm Marker
Laser system	TheraLite Laser
Wavelength	660 nm
Output power	120 mW
Application time of photosensitizer	60 seconds before irradiation
Irradiation protocol	4 × 60 seconds over the entire wound surface (≈4 cm wound length)
Treatment schedule	Days 0, 2, 4, and 7
Wound preparation	Mechanical debridement and chlorhexidine irrigation before each session
Systemic antibiotics	None administered during HELBO® therapy
Clinical outcome	Complete wound closure observed 2 weeks after completion of the HELBO® treatment protocol.

Clinical outcome, implant preservation and prosthetic rehabilitation

Following the initiation of adjunctive antimicrobial photodynamic therapy (HELBO®), gradual clinical improvement became evident during successive follow-up visits. Early healing was characterised by progressive reduction of local inflammatory signs, including erythema, tissue oedema, and wound exudation. The exposed alveolar bone remained free of necrotic changes or clinical signs of acute infection throughout the observation period.

Within the following days, healthy granulation tissue progressively developed over the previously exposed surgical site, indicating favourable biological conditions for secondary wound healing. Continuous reduction of the wound dimensions was observed, accompanied by gradual migration of the surrounding soft tissues toward the centre of the defect. No additional wound dehiscence occurred during the subsequent healing period.

Regular clinical evaluations confirmed progressive secondary epithelialization without evidence of suppuration, increasing soft tissue inflammation, or peri-implant abscess formation. Importantly, both implants remained clinically stable throughout the healing phase, exhibiting no mobility or signs suggestive of early implant failure.

Serial radiographic examinations demonstrated preservation of peri-implant bone architecture without radiographic evidence of progressive crestal bone loss or peri-implant radiolucency. These findings suggested successful maintenance of osseointegration despite the early postoperative complication.

Complete soft tissue healing was achieved by secondary intention, resulting in stable epithelial coverage of the surgical area with satisfactory contour and tissue maturation. The final clinical appearance demonstrated healthy peri-implant mucosa without signs of persistent inflammation or recurrent wound breakdown.

Technical flow of prosthetic rehabilitation on two implants. In this patient, an implant-retained partial prosthesis on two implants was made, with the complete structure developed in a fully digital CAD/CAM workflow. The first step was digital planning in exocad software, where an individual titanium bar was designed. The bar is constructed with distal CEKA sliders on both sides, as well as with an occlusal CEKA retention element, which ensures stable retention, proper load distribution and long-term work functionality. After the completion of the CAD design, the bar was made by CNC milling from a prefabricated medical titanium block, which achieved an exceptional precision of fit on the implant components and a high level of structural passivity. In the next phase, the metal skeleton of the partial prosthesis is designed in the exocad Partial module. The skeleton is designed with precisely defined beds for CEKA Teflon retention inserts, which enables their correct positioning and optimal retention of the finishing work. The metal skeleton is made by 3D metal printing technology (SLM) using BEGO CoCr alloy, which is certified and specially indicated for the production of partial skeletons due to its biocompatibility, mechanical resistance and high dimensional stability. After finishing the metal structure, the denture base was made, and VITA MFT acrylic teeth were placed, which ensure natural aesthetics, functional occlusion and long-term wear resistance. The finalisation of the work was carried out by polymerisation using Ivoclar acrylate, which achieved a stable, aesthetically harmonious and long-lasting final restoration. The result of this digital protocol is an extremely precise implant-retained partial prosthesis that combines the advantages of CAD/CAM titanium milling, 3D metal printing and modern retention systems, with maximum functionality, reliability and comfort for the patient. The complete digital construction, CAD design, fabrication of the titanium crossbar, 3D printing of the metal skeleton and the final fabrication of the prosthetic work were carried out by Dental Laboratory Bulić (Beograd, Srbija). The technical process of making an implant-retained partial prosthesis on two implants and the materials used are shown in Tables 3 and 4.

Following confirmation of successful osseointegration, prosthetic treatment was continued according to the original treatment plan. Healing abutments were placed uneventfully, and subsequent prosthetic procedures were completed to fabricate an implant-retained mandibular over denture (Figure 6-8). The definitive prosthesis demonstrated excellent retention and stability, providing a substantial improvement in masticatory efficiency, phonetics, and overall patient satisfaction compared with the previously unstable conventional mandibular denture (Figures 9 -12).

At follow-up examinations, the peri-implant tissues remained clinically healthy, with no evidence of recurrent infection, mucosal dehiscence, implant mobility, or prosthetic complications. The patient reported complete resolution of symptoms and expressed a high level of satisfaction with both the functional and esthetic outcome of treatment.

A postoperative peri-apical radiograph obtained after completion of the HELBO® antimicrobial photodynamic therapy

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Table 3: The technical process of making an implant-retained partial prosthesis on two implants.

1. Digital CAD design	An individual implant bar designed in Exocad with distal CEKA sliders on both sides and an occlusal CEKA retention element.	Exocad CAD	Precise planning of retention and force distribution.
2. Making the crossbar	Individual bar made by CNC milling from a prefabricated medical titanium block.	Medical titanium	Passive fit and biomechanical stability.
3. Skeleton design	In the Exocad Partial module, a skeleton was designed with integrated trays for CEKA Teflon inserts.	Exocad PartialCAD	Precise positioning of retention elements.
4. Making the skeleton	Metal skeleton made with SLM 3D printing technology.	BEGO CoCr	High strength, precision and biocompatibility.
5. The final stage	Placement of VITA MFT acrylate teeth and finishing with Ivoclar acrylate.	VITA MFT + Ivoclar	Aesthetics, function and durability.
6. Final control	Fit control, retention, occlusion and finishing.	Quality control	Predictable function and patient comfort.

Table 4: Materials used.

Component	Material / Manufacturer
Implant bar	Medical titanium - CNC milling
Retention system	CEKA attachment system
Retention inserts	CEKA teflon
Metal skeleton	BEGO CoCr (SLM 3D print)
Acrylic teeth	VITA MFT
Base acrylate	Ivoclar

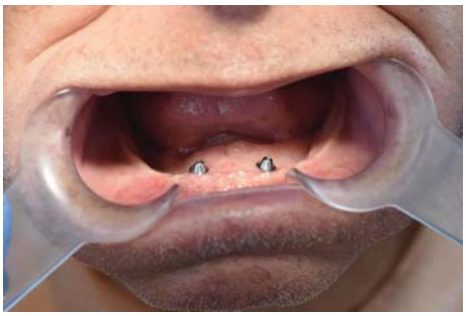

Figure 6: Clinical intraoral view of the preserved mandibular implants with Locator abutments in place, demonstrating healthy and stable peri-implant soft tissues before definitive prosthetic rehabilitation.

Figure 7: CAD/CAM-milled titanium bar framework on the three-dimensional printed mandibular model for an implant-supported overdenture, used to verify passive fit before clinical insertion.

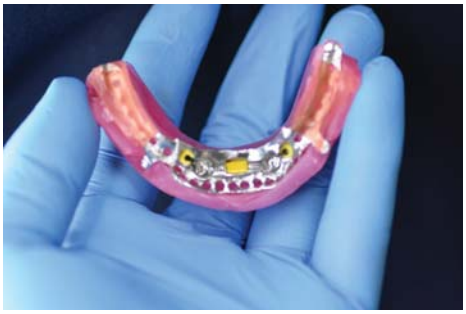

Figure 8: Intaglio surface of the definitive mandibular full-arch implant-supported prosthesis showing the CAD/CAM titanium framework, screw-access channels, and hygienic contour designed to facilitate oral hygiene maintenance

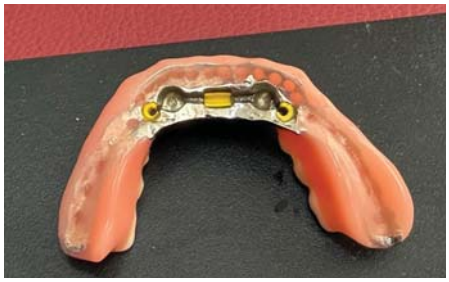

Figure 9: Intaglio surface of the mandibular implant-supported overdenture demonstrating the metal reinforcement framework with clip attachment for a two-implant bar-retained overdenture.

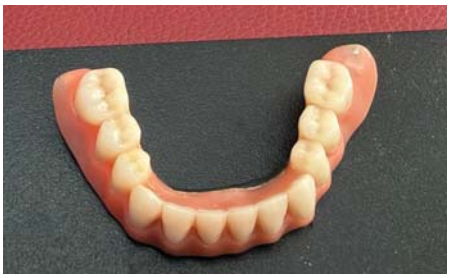

Figure 10: Definitive mandibular implant-supported overdenture designed to restore function, stability, and retention in the edentulous mandible.

Figure 11: Clinical intraoral view of the mandibular implant-supported bar following successful soft tissue healing, demonstrating stable peri-implant mucosa before prosthetic rehabilitation.

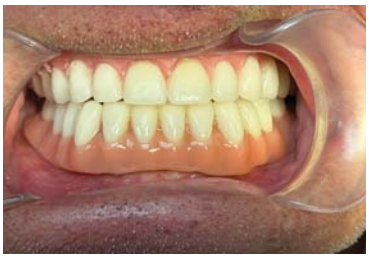

Figure 12: Final clinical outcome after successful management of early postoperative surgical wound dehiscence with adjunctive antimicrobial photodynamic therapy (HELBO®), demonstrating complete soft tissue healing, preservation of the dental implants, and satisfactory prosthetic rehabilitation.

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Figure 13: Post-treatment periapical radiograph obtained following completion of HELBO® antimicrobial photodynamic therapy, demonstrating stable implant positioning with no radiographic evidence of peri-implant bone loss or other pathological changes.

demonstrated stable implant positioning and preservation of the surrounding peri-implant bone levels, with no radiographic evidence of additional bone loss or implant instability (Figure 13).

Overall, the multidisciplinary treatment protocol - including surgical wound revision, meticulous mechanical debridement, systemic antibiotic therapy, and adjunctive antimicrobial photodynamic therapy (HELBO®) - enabled successful preservation of both implants despite failure of repeated primary wound closure and the initial high risk of implant loss.

Discussion

Dental implant therapy has become one of the most predictable treatment modalities for the rehabilitation of edentulous patients. Nevertheless, successful treatment depends not only on accurate implant placement and primary stability but also on uneventful healing of the surrounding soft tissues during the early postoperative period [8,12]. Primary wound closure plays a pivotal role in protecting the surgical site from bacterial contamination and establishing a favourable biological environment for osseointegration [32,33]. When this process is disrupted by early wound dehiscence, clinicians are faced with a challenging situation for which evidence-based treatment recommendations remain limited [9].

Early postoperative wound dehiscence is generally regarded as a multifactorial complication. Excessive flap tension, compromised blood supply, thin peri-implant soft tissues, local trauma, early mechanical loading, bacterial contamination, and patient-related systemic factors may all contribute to wound breakdown [9,34]. Although many cases heal uneventfully by secondary intention, persistent exposure of the alveolar bone substantially increases the risk of microbial colonisation and biofilm formation. If bacterial contamination progresses toward the Implant surface during the critical healing period, osseointegration may be jeopardised, potentially resulting in early implant failure [34,35].

In the present case, repeated surgical wound revision failed to restore stable primary closure despite careful refreshment of the wound margins and atraumatic re-suturing. This clinical course suggested that additional surgical interventions alone would be unlikely to improve the biological conditions for healing and might even compromise the vascular supply of the already traumatised soft tissues. Consequently, treatment strategy shifted from repeated attempts at primary closure toward optimisation of secondary wound healing through meticulous infection control and preservation of tissue vitality.

Successful osseointegration is a complex biological process that depends on the coordinated interaction between bone remodelling, soft tissue healing, and effective control of the microbial environment during the early postoperative period [36,37]. Although contemporary implant systems achieve high long-term survival rates, biological complications occurring shortly after implant placement remain a significant clinical concern because they may interfere with the establishment of a stable implant–bone interface [38,39]. Among these complications, early postoperative wound dehiscence represents a particularly challenging condition owing to the disruption of primary soft tissue closure and the subsequent exposure of the surgical site to the oral environment [40].

Primary wound closure is generally regarded as one of the fundamental principles of implant surgery [32]. A well-adapted, tension-free mucoperiosteal flap not only protects the underlying bone and implant surface from bacterial contamination but also preserves a favourable biological environment for angiogenesis, fibroblast migration, collagen deposition, and early bone healing [41]. When wound integrity is compromised, the exposed tissues become susceptible to colonisation by the complex oral microbiota, increasing the likelihood of biofilm formation and inflammatory complications that may adversely affect osseointegration [33].

The aetiology of early postoperative wound dehiscence is multifactorial [42]. Previous studies have identified excessive flap tension, inadequate periosteal releasing incisions, thin peri-implant soft tissue phenotype, compromised vascular supply, surgical trauma, postoperative mechanical irritation, microbial contamination, and systemic host-related factors as potential contributors [43]. Even in otherwise healthy patients, local anatomical conditions—particularly severe alveolar ridge atrophy - may limit the availability of soft tissue for tension-free wound closure, thereby increasing the risk of postoperative wound breakdown.

The present case illustrates several of these challenges. The patient presented with advanced mandibular ridge atrophy, which restricted soft tissue mobility despite careful surgical technique. Although primary wound closure was achieved intraoperatively, progressive wound separation developed during the early healing period. Surgical wound revision with freshening of the wound margins and atraumatic resuturing represented the most appropriate initial therapeutic approach. However, recurrence of wound dehiscence indicated that restoration of stable primary closure was biologically unattainable under the existing local conditions.

This observation has important clinical implications. Repeated attempts to achieve primary closure are not invariably associated with improved healing and may even compromise tissue vascularisation through additional surgical manipulation. Instead, once repeated wound breakdown occurs, the therapeutic objective should shift from restoration

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of primary closure toward optimisation of secondary wound healing while preserving tissue vitality and minimising microbial contamination. In our opinion, this biological transition represents the key turning point in the management of the present case.

Biofilm control as a pre-requisite for implant preservation

One of the most critical biological events following early postoperative wound dehiscence is the rapid colonisation of the exposed surgical site by the oral microbiota. Within hours of exposure, salivary proteins form a conditioning film that facilitates bacterial adhesion, followed by progressive biofilm maturation. If this microbial challenge is not effectively controlled, inflammatory processes may extend toward the implant surface and interfere with the delicate biological events required for successful osseointegration.

Unlike established peri-implantitis, where bacterial biofilms develop on a previously osseointegrated implant, early postoperative contamination occurs during the critical phase of bone healing. At this stage, the implant–bone interface is still undergoing biological maturation, rendering it particularly vulnerable to persistent microbial challenge. Consequently, therapeutic interventions should focus not only on eliminating existing contamination but also on preventing further biofilm development while minimising additional tissue trauma.

Mechanical debridement remains the cornerstone of local infection control. However, because implant surfaces possess complex micro- and nano-topographies specifically designed to enhance osseointegration, complete mechanical elimination of microorganisms is often difficult to achieve. Residual microorganisms may persist within microscopic surface irregularities and continue to contribute to biofilm formation. For this reason, adjunctive methods capable of enhancing microbial reduction without damaging implant surfaces have attracted increasing clinical interest.

Biological rationale for antimicrobial photodynamic therapy

Antimicrobial Photodynamic Therapy (aPDT) is based on a well-established photochemical principle involving three essential components: a photosensitising agent, light of an appropriate wavelength, and molecular oxygen. Upon activation, the photosensitizer generates reactive oxygen species capable of selectively damaging bacterial cell membranes, proteins, and nucleic acids, ultimately leading to microbial destruction while preserving surrounding host tissues.

An important advantage of this mechanism is that it does not rely on conventional antibiotic pathways and therefore is not associated with the development of bacterial resistance. Furthermore, antimicrobial photodynamic therapy does not produce the thermal effects observed with some laser systems, making it particularly suitable for application in healing surgical wounds where preservation of tissue vitality is essential.

The HELBO® system represents one of the most extensively investigated antimicrobial photodynamic therapy systems in dentistry. Previous clinical studies have demonstrated its beneficial adjunctive effects in the treatment of periodontitis, peri-implant mucositis, peri-implantitis, and other oral infections. Reported benefits include reduction of bacterial counts, improvement of clinical inflammatory parameters, and enhancement of periodontal wound healing when combined with conventional mechanical therapy.

However, evidence regarding the application of HELBO® specifically for early postoperative wound dehiscence following implant placement remains extremely limited. Consequently, the present case contributes additional clinical evidence in an area where standardised therapeutic protocols have not yet been established.

Why was HELBO® selected in this patient?

The decision to incorporate antimicrobial photodynamic therapy into the treatment protocol was based on several clinical considerations.

First, repeated surgical revision had failed to restore stable primary wound closure, indicating that additional surgical manipulation alone was unlikely to improve the biological conditions for healing.

Second, despite exposure of the alveolar bone, the implants remained clinically stable and showed no radiographic evidence of failed osseointegration. Therefore, implant removal was not considered justified.

Third, preservation of the existing soft tissues was regarded as a priority. Additional flap elevation or repeated attempts at aggressive surgical closure could have further compromised vascular supply and delayed healing.

Within this clinical context, adjunctive antimicrobial photodynamic therapy was selected as part of a comprehensive treatment strategy designed to reduce microbial contamination while preserving tissue vitality and supporting secondary wound healing. Importantly, HELBO® was not intended to replace conventional surgical principles but rather to complement established treatment measures including mechanical debridement, careful wound management, systemic antibiotic therapy, and strict plaque control.

The favourable clinical outcome observed in this patient suggests that such an integrated therapeutic strategy may represent a rational approach in carefully selected cases of early postoperative wound dehiscence. Nevertheless, the present report describes the outcome of a single patient and should therefore be interpreted with appropriate scientific caution.

Comparison with the available literature

Early postoperative wound dehiscence following dental implant placement has received considerably less attention in the scientific literature than biological complications such as peri-implant mucositis or peri-implantitis. Most published studies primarily focus on prevention of wound dehiscence

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through tension-free flap design, soft tissue management, and adequate primary closure, whereas evidence regarding management after wound breakdown has already occurred remains limited [6,9,45].

Conventional treatment protocols generally include local wound irrigation, mechanical debridement, chlorhexidine application, systemic antibiotics when clinically indicated, and, whenever feasible, surgical wound revision aimed at re-establishing primary closure. However, the outcomes of repeated surgical closure are not always predictable, particularly in patients with severe ridge atrophy or limited soft tissue availability. Under such circumstances, secondary wound healing may become unavoidable [33,34,44].

Antimicrobial photodynamic therapy has been investigated primarily as an adjunctive treatment for periodontitis and peri-implant diseases. Several clinical studies have demonstrated reductions in bacterial load and improvements in clinical inflammatory parameters when antimicrobial photodynamic therapy is combined with conventional mechanical debridement. Nevertheless, published evidence specifically addressing its use in the management of early postoperative wound dehiscence following implant placement remains scarce [26,46-50].

The present case therefore contributes additional clinical evidence by illustrating the successful preservation of two implants despite repeated failure of primary wound closure. Although no causal relationship can be established from a single case, the favourable outcome supports the concept that adjunctive antimicrobial photodynamic therapy may have a role within a comprehensive biologically oriented treatment protocol [28,51].

The case report by Garcia de Carvalho G et al., describes the successful management of peri-implantitis using antimicrobial Photodynamic Therapy (aPDT) as an adjunct to surgical treatment and Guided Bone Regeneration (GBR). The patient presented with peri-implantitis characterised by peri-implant bone loss. Following surgical flap elevation and removal of granulation tissue, the implant surface was decontaminated using aPDT, which combined a photosensitizer with laser irradiation to reduce the bacterial biofilm without damaging the titanium implant surface. After decontamination, guided bone regeneration was performed using a bone graft and a resorbable membrane to restore the lost peri-implant bone [52]. During follow-up, the authors observed: resolution of clinical signs of inflammation, reduction in probing pocket depth and bleeding on probing, radiographic evidence of bone regeneration around the implant and successful preservation and continued function of the implant. The authors concluded that aPDT may serve as a valuable adjunctive therapy in the surgical treatment of peri-implantitis, as it provides effective implant surface decontamination while preserving the integrity of the implant surface. When combined with guided bone regeneration, it may contribute to favourable clinical and radiographic outcomes. However, because this report describes a single clinical case, the authors emphasised the need for larger controlled clinical studies to confirm these findings [52].

Although our case involves early postoperative surgical wound dehiscence rather than peri-implantitis, the publication by Garcia de Carvalho G et al., supports the biological rationale for using aPDT around dental implants. It demonstrates that aPDT can effectively reduce the microbial burden, promote a favourable healing environment, and facilitate successful preservation of dental implants when used as an adjunct to conventional surgical management [52].

Although most published studies have evaluated antimicrobial photodynamic therapy in the management of peri-implantitis rather than early postoperative wound dehiscence, their findings support the ability of aPDT to reduce microbial contamination while preserving the integrity of the implant surface. Garcia de Carvalho et al., demonstrated successful implant preservation and favourable clinical and radiographic outcomes when aPDT was combined with guided bone regeneration for peri-implantitis. Similarly, systematic reviews have concluded that aPDT may improve clinical outcomes when used as an adjunct to conventional mechanical debridement, although the magnitude of its additional benefit remains variable across studies. In the present case, HELBO® antimicrobial photodynamic therapy was applied in a different clinical scenario - early postoperative surgical wound dehiscence with exposed implant sites—where conventional evidence remains scarce. The favourable healing observed suggests that local photodynamic decontamination may represent a useful minimally invasive adjunct for supporting secondary wound healing and reducing the risk of implant-related complications.

To the best of our knowledge, published evidence regarding the use of antimicrobial Photodynamic Therapy (aPDT) as an adjunctive treatment for the preservation of newly placed dental implants affected by early postoperative surgical wound dehiscence remains limited. Most available studies have focused on the management of peri-implant mucositis or peri-implantitis rather than early postoperative wound complications. This case therefore expands the currently available clinical evidence by demonstrating that adjunctive HELBO® antimicrobial photodynamic therapy, combined with meticulous local wound care and careful clinical follow-up, may support secondary wound healing while preserving implant stability and avoiding implant removal in selected cases.

Clinical implications

The present case highlights several practical considerations relevant to clinicians managing postoperative complications following implant placement.

First, early wound dehiscence should not automatically be interpreted as an indication for implant removal. Careful clinical and radiographic assessment of implant stability, peri-implant tissues, and the extent of microbial contamination should guide treatment decisions.

Second, repeated attempts to obtain primary wound closure may not always represent the most biologically favourable strategy. Excessive surgical manipulation of compromised soft

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tissues has the potential to impair vascular supply and delay healing. Once repeated wound closure has failed, therapeutic efforts should focus on preserving tissue vitality, minimising microbial contamination, and creating conditions favourable for secondary wound healing.

Third, successful implant preservation requires a multidisciplinary therapeutic approach rather than reliance on a single treatment modality. In the present case, the favourable clinical outcome was achieved through the combined effects of surgical wound revision, meticulous mechanical debridement, systemic antibiotic therapy, careful postoperative maintenance, and adjunctive antimicrobial photodynamic therapy. This integrated approach appears to have supported soft tissue healing while preserving conditions compatible with successful osseointegration.

From a clinical perspective, preservation of a newly placed implant is particularly important because implant removal is associated with additional surgical procedures, increased treatment costs, prolonged rehabilitation, and psychological burden for the patient. The favourable clinical outcome observed in the present case suggests that adjunctive HELBO® antimicrobial photodynamic therapy may represent a minimally invasive supportive treatment option when early postoperative wound dehiscence occurs in the absence of implant mobility or uncontrolled infection. Nevertheless, this report represents a single clinical case, and further prospective clinical studies are required to confirm the reproducibility and long-term effectiveness of this therapeutic approach.

Limitations

Several limitations should be acknowledged when interpreting the findings of this report. First, the present manuscript describes the clinical outcome of a single patient, which precludes generalisation of the observed results. Second, because multiple therapeutic interventions were implemented simultaneously, the specific contribution of antimicrobial photodynamic therapy to the overall clinical outcome cannot be determined. Third, microbiological analyses and quantitative inflammatory biomarkers were not available to objectively assess changes in the microbial burden or inflammatory response during treatment.

Despite these limitations, the case provides a detailed description of a clinically relevant complication that is infrequently reported in the literature. The comprehensive clinical and radiographic documentation, together with the successful long-term preservation of both implants and completion of prosthetic rehabilitation, offers valuable clinical insight that may help guide treatment of similar cases. Future prospective studies involving larger patient cohorts are required to evaluate the effectiveness of adjunctive antimicrobial photodynamic therapy in the management of early postoperative wound dehiscence following implant placement.

Clinical Significance

This case demonstrates that successful management of early postoperative wound dehiscence extends beyond restoration of primary wound closure alone. Preservation of a biologically favourable healing environment through meticulous infection control, maintenance of tissue vitality, and careful clinical monitoring may allow secondary wound healing without compromising osseointegration.

Within such a biologically guided treatment strategy, adjunctive antimicrobial photodynamic therapy may represent a useful therapeutic option in carefully selected patients. Although additional clinical evidence is required, this approach may contribute to implant preservation and successful prosthetic rehabilitation in situations traditionally associated with an increased risk of implant failure.

Conclusion

Early postoperative wound dehiscence following dental implant placement represents a challenging biological complication that may compromise soft tissue healing and increase the risk of implant failure if not managed appropriately. The present case demonstrates that successful implant preservation may still be achieved despite repeated failure of primary wound closure, provided that a biologically favourable healing environment is maintained through meticulous infection control and comprehensive supportive therapy.

In this patient, a multidisciplinary treatment protocol consisting of surgical wound revision, mechanical debridement, systemic antibiotic therapy, and adjunctive antimicrobial photodynamic therapy (HELBO®) was associated with progressive secondary wound healing, preservation of osseointegration, and successful completion of implant-retained prosthetic rehabilitation.

Although no causal relationship can be established from a single case, this report suggests that adjunctive antimicrobial photodynamic therapy may represent a valuable component of a biologically guided treatment strategy for carefully selected patients presenting with early postoperative wound dehiscence following implant placement.

Further prospective clinical studies with larger patient populations are necessary to evaluate the effectiveness, indications, and long-term clinical benefits of this multidisciplinary therapeutic approach.

From a clinical perspective, this case expands the potential application of antimicrobial photodynamic therapy beyond its established use in peri-implantitis. Early management of postoperative wound dehiscence is essential to prevent bacterial colonisation of exposed implant surfaces and subsequent biological complications. Although conclusions cannot be drawn from a single case report, the successful preservation of both implants highlights the potential value of incorporating HELBO® antimicrobial photodynamic therapy into the management of selected cases of early wound dehiscence. Prospective controlled clinical studies are required to establish standardised treatment protocols and confirm the reproducibility of these findings.

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Clinical message

Early postoperative wound dehiscence should not automatically be regarded as an indication for implant removal. Careful assessment of implant stability, control of microbial contamination, and preservation of the biological conditions necessary for wound healing may allow successful secondary healing and long-term implant survival, even when stable primary wound closure cannot be re-established.

Ethics approval and consent to participate

The patient received treatment according to established clinical protocols and in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained for treatment and publication of this case report and the accompanying clinical images.

Consent for publication

Written informed consent for publication of anonymised clinical information and photographic documentation was obtained from the patient.

Availability of data and materials

All relevant clinical data supporting the findings of this case report are included within the manuscript. Additional anonymised information may be made available by the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests related to this publication.

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