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Original Research Article

Effectiveness of Diode Laser Decontamination for Immediate Implant Placement in Infected Sockets: Case Series

Effie Edsor [1], Prabhusankar K [2], Priyadharsana PS [3], Vigneshwar S [4]

RVS Dental College and Hospital, Tamil Nadu, India

Abstract

Introduction:

Immediate placement of implants in extraction sockets affected by periapical pathology presents a risk of residual infection. Laser-assisted decontamination has emerged as an effective adjunct to enhance socket disinfection. This case series evaluates the outcomes of immediate implant placement following diode laser decontamination in sockets with periapical lesions.

Case presentations:

Three patients presenting with non-restorable teeth and chronic periapical pathology underwent atraumatic extraction, thorough curettage, and diode laser decontamination before immediate implant placement. All cases exhibited uneventful healing, with no postoperative infection observed. Peri-implant soft tissue health remained stable throughout the follow-up.

Conclusion:

Within the limitations of this small case series, diode laser decontamination combined with socket curettage demonstrated favorable outcomes for implant placed immediately in infected extraction sites, including uneventful healing and healthy soft tissue around the implants. Larger controlled studies are necessary to validate these findings.

Keywords: Dental Implants, Laser Therapy, Periapical Diseases, Debridement, Wound Healing.

Introduction

Dental implant therapy has advanced markedly since Brånemark first described osseointegration in the 1960s.[1] Today, implants are considered as the gold standard for missing teeth replacement because they offer high success rates, preserve alveolar bone, and provide superior patient comfort compared with removable prostheses. Despite these advantages, success of the implant therapy depends on various factors, including bone quality, implant design (microfeatures and microfeatures), surgical protocol, and postoperative maintenance.

Implant which are immediately placed into extracted sockets (ES) has become a widely accepted technique due to the reduction in the treatment period, alveolar bone preservation, and patient comfort. However, presence of periapical infection has traditionally been considered a contraindication because of the risk of microbial contamination during implant placement leading to implant failure. Recent advances in laser technology have introduced effective methods for socket decontamination.

Diode and Er:YAG lasers have demonstrated bactericidal effects, reduction of inflammatory mediators, and promotion of wound healing through photobiomodulation.[2] These properties make lasers an attractive adjunct in the management of extraction sites that are infected prior to implant placement immediately.[3] This case series assesses the clinical outcomes of immediate implant placement following laser-assisted decontamination in sockets affected by periapical lesions.

Case Presentation and Management

This case series demonstrates the use of a diode laser operating at a wavelength of 980 nm with a power output of 4 W in continuous wave mode. A 600 µm optical fibre was used, and the ES was irradiated in non-contact mode at a distance of approximately 0.5 mm for 60 seconds.[2] Following atraumatic extraction, thorough mechanical curettage was performed to debride and disinfect the socket walls and periapical region before laser decontamination and immediate implant placement (Figure 1).

Figure 1: LASER decontamination procedure

Case No. 1:

A 29-year-old male was referred to the department of Oral Surgery with the chief complaint of broken tooth with mild pain in the lower left back region of the jaw. Clinical examination and radiographic analysis presented a periapical lesion associated with the maxillary lateral incisor (tooth no. 37: FDI system). The tooth was deemed non-restorable and was atraumatically extracted, followed by meticulous mechanical curettage and diode laser decontamination of the socket. An implant measuring 3.5 × 11 mm was immediately placed. Soft tissue healing was satisfactory, and at the 9-month follow-up, stable implant integration was observed.

Figure 2: Pre-operative, intra-operative implant placement x-ray and post-operative view

Case No. 2:

A 35-year-old male was presented to the same department with a chief complaint of intermittent pain in the upper anterior region. Radiographic evaluation revealed a non-vital maxillary lateral incisor (tooth 12: FDI system) with a periapical radiolucency measuring approximately 2 mm. After atraumatic extraction and thorough debridement, diode laser decontamination was performed using the same parameters. An implant of size 3.75 × 13 mm was immediately placed. Postoperative healing was without any complication, and the 9-month after the procedure, the radiographs were taken which showed complete bone fill without crestal bone loss.

Figure 3: Pre-operative view showing the fractured tooth, intra-operative showing the placed implant and post-operative closure clinical view

Case No.3:

A 42-year-old female patient which a chief complaint of pain and discomfort in the lower left back region of the jaw was presented to the department. Clinical examination was done and radiograph were taken. A periapical lesion associated with the mandibular first molar (tooth 36 FDI system) was identified. Following atraumatic extraction and mechanical curettage, diode laser decontamination was carried out using the same laser parameters. A 4.2 × 11.5 mm implant was immediately placed. At the 6-month follow-up, satisfactory osseointegration was appreciated in post operative radiographs the with little or no evidence of peri-implant lesion.

Figure 4: Pre-operative view showing the decay tooth, intra-operative view after implant placement and post-operative closure clinic view

Case Outcomes

All the three implants were successfully placed immediately into previously infected ES following diode laser decontamination, with no intraoperative complications encountered. In all the case, primary stability was achieved at the time of placement of the implants. During the post-operative follow-up time, none of the patients exhibited signs of postoperative infection, suppuration, pain, or exacerbation of the pre-existing periapical pathology, indicating effective microbial control achieved through laser application. Healing was satisfactory and it was uneventful in all cases, without any evidence of delayed healing, wound dehiscence, or persistent inflammation. Radiographic evaluation during follow-up demonstrated satisfactory peri-implant bone healing with stable crestal bone levels and no signs of peri-implant radiolucency. Overall, all implants showed favourable clinical and radiographic outcomes, suggesting predictable healing following laser-assisted decontamination and placement of implant immediately.

Discussion

Infected ES are traditionally considered high-risk for immediate implant placement due to bacterial contamination and inflammatory tissue remnants. Diode lasers enable effective sterilization of the socket walls and periapical region, significantly reducing microbial load. Previous studies have demonstrated that diode laser irradiation enhances healing and bone regeneration through bio-stimulatory effects.[2,4] In the present case series, all three implants placed in previously infected sites showed successful osseointegration and healthy peri-implant tissues, likely due to the combined effects of thorough mechanical debridement and laser-mediated bacterial reduction. Placement of implants immediately offers added benefits such as reduction in the treatment time, preservation of buccal bone, and improved comfort of the patient; however, periapical infection has historically been considered a relative contraindication. Successful outcomes depend on complete eradication of infection and establishment of a biologically favourable environment for healing. In this series, laser-assisted decontamination used in conjunction with conventional curettage provided effective disinfection and permitted predictable immediate implant placement.

The effectiveness of diode lasers is attributed to their photothermal and photobiomodulatory actions. The photothermal effect causes bacterial destruction and coagulation of granulation tissue, while photobiomodulation enhances fibroblast proliferation, angiogenesis, and osteoblastic activity. Diode lasers operating at 980 nm demonstrate significant bactericidal activity against common periapical pathogens. Compared with conventional chemical irrigation, laser decontamination

achieves deeper penetration and more consistent antimicrobial effects. Our clinical outcomes align with previous reports showing favourable implant survival in infected sockets treated with laser-assisted protocols. Radiographic findings revealed resolution of periapical radiolucency and stable marginal bone levels, indicating successful osseointegration. However, this case series is limited by the size of the sample, absence of a control group, and less follow-up period. Additionally, the combined use of mechanical debridement and systemic antibiotics limits isolation of the laser's independent effect.

Conclusion

Laser-assisted decontamination of ES with periapical pathology, when combined with thorough mechanical curettage and appropriate case selection, has demonstrated favourable outcomes for dental implants which are placed immediately. This method may reduce the risk of postoperative infection and facilitate a streamlined, single-stage treatment protocol. Proper aseptic protocols and appropriate use of laser parameters are essential. Larger prospective studies with standardized methodologies and extended post-operative periods are necessary to confirm these preliminary observations and to formulate a conclusive clinical guidelines.

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