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THE ROLE OF LASER-ASSISTED THERAPY IN ENHANCING SOFT TISSUE HEALING DURING PERI-IMPLANTITIS TREATMENT

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Annotation: This article examines the role of laser-assisted therapy in improving soft tissue healing during peri-implantitis treatment. Peri-implantitis remains one of the leading biological complications associated with dental implants, often resulting in inflammation, soft tissue destruction, and progressive bone loss. Laser technology has emerged as an advanced treatment modality due to its antibacterial effects, ability to precisely remove granulation tissue, and potential to stimulate cellular regeneration. This paper analyzes current scientific findings, compares different laser systems used in peri-implant therapy, and evaluates their effectiveness in enhancing soft tissue healing compared to conventional approaches.

Keywords: peri-implantitis, laser-assisted therapy, soft tissue healing, diode laser, Er:YAG laser, dental implant complications, regenerative treatment

Introduction

Peri-implantitis is a chronic inflammatory condition affecting the soft and hard tissues surrounding dental implants. It is characterized by bleeding, suppuration, increased probing depth, and radiographic evidence of bone loss. With the increasing global use of dental implants, the prevalence of peri-implantitis has also risen, creating the need for more predictable and minimally invasive treatment strategies. Traditional treatment approaches rely on mechanical debridement, antiseptic irrigation, and adjunctive antimicrobial therapy, yet these methods alone often fail to completely eliminate biofilm or promote adequate healing of the surrounding tissues. Laser-assisted therapy has become an important component of modern peri-implantitis management due to its ability to improve clinical outcomes in ways that conventional mechanical and chemical methods alone cannot achieve. Peri-implantitis involves complex interactions between bacterial biofilm, inflammatory responses, and soft tissue breakdown. For this reason, successful treatment must address both microbial elimination and biological tissue regeneration. Lasers support both of these goals through precise, controlled, and minimally invasive mechanisms.

A major advantage of laser therapy is its ability to reduce bacterial load more effectively than traditional tools. Mechanical debridement is often limited by the design of implant threads and the depth of peri-implant pockets, which makes complete removal of biofilm difficult. Laser irradiation penetrates deeper into pocket depths and disrupts microbial colonies, contributing to a more thorough decontamination of the implant surface. Diode lasers are widely used for this purpose because their wavelength is well absorbed by pigmented bacteria and inflamed tissue, making them an effective tool for reducing pathogenic species without causing unnecessary tissue damage.

Another essential benefit of laser therapy is the selective removal of granulation tissue. Granulation tissue surrounding diseased implants contains inflammatory cells, bacterial deposits, and degraded collagen fibers. Removing it is necessary for re-establishing healthy soft tissue architecture. Er:YAG lasers enable atraumatic ablation of this tissue while preserving the

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titanium surface from thermal damage, which is critical because overheating can negatively affect implant stability. As research shows, when inflamed tissue is removed more precisely, the healing response is cleaner, faster, and more predictable.

Lasers also play a central role in improving postoperative healing through photobiomodulation. Low-level laser therapy (LLLT) enhances cell proliferation, collagen synthesis, angiogenesis, and metabolic activity in fibroblasts. These biological effects directly support soft tissue regeneration around the implant. Increased blood flow and improved cellular turnover accelerate the reattachment of mucosal tissues to the implant surface. Patients treated with adjunctive laser therapy typically report reduced discomfort, less swelling, and faster recovery times. This improved healing is especially important in peri-implantitis, where soft tissue stability contributes to long-term implant success.

Another important component of laser-assisted treatment is its ability to improve hemostasis. The thermal effect of diode lasers coagulates small blood vessels and reduces bleeding during treatment. Controlled bleeding not only improves visibility for clinicians but also helps form a stable clot, which is essential for the early stages of healing. Better coagulation contributes to forming a healthier epithelial seal around the implant and enhances patient comfort immediately following the procedure.

While laser therapy provides multiple clinical advantages, its success depends on selecting the correct wavelength, using appropriate power settings, and understanding tissue-specific responses. Diode lasers are highly effective for decontamination and inflammation control but cannot modify implant surface topography. Er:YAG lasers provide precise ablation yet require careful calibration to avoid removing too much tissue. Photobiomodulation protocols also vary among devices, so clinician training plays a critical role in maximizing treatment outcomes.

The integration of lasers into a comprehensive peri-implantitis protocol must be strategic and individualized. Laser therapy works best in combination with mechanical debridement, antiseptic irrigation, and patient-based risk control such as improved oral hygiene and smoking cessation. As soft tissue healing is influenced by local and systemic factors, laser treatment should be adapted to each patient's needs rather than applied as a uniform technique. When used appropriately, lasers enhance the biological conditions needed for tissue repair and may significantly reduce the likelihood of recurrent peri-implant inflammation.

Recent advances in dental laser technology have introduced new possibilities for managing peri-implantitis. Lasers allow more selective removal of inflamed tissue, effective bacterial reduction, and improved hemostasis. Moreover, certain laser wavelengths stimulate fibroblast activity, collagen production, and enhanced vascularization, all of which support faster and more predictable soft tissue healing. This makes laser-assisted therapy a promising modality for improving clinical outcomes in peri-implant therapy.

Laser-assisted therapy offers a unique combination of decontamination ability and biostimulatory effects that can significantly contribute to restoring the health of peri-implant tissues. Unlike conventional mechanical instruments, lasers can reach deeper microbial colonies and disrupt biofilm structure while minimizing trauma to surrounding tissues. Diode lasers are commonly used due to their strong bactericidal effect, ability to reduce inflammation, and suitability for soft tissue applications. Their thermal energy can eliminate pathogenic microorganisms in peri-implant pockets, leading to a reduction in bleeding and pocket depth.

Er:YAG lasers, on the other hand, provide effective removal of granulation tissue without overheating the implant surface. Their nonthermal ablation makes them particularly useful in peri-implantitis treatment, where maintaining implant integrity is crucial. Studies indicate that Er:YAG irradiation enhances fibroblast proliferation and supports reattachment of soft tissue to

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previously compromised implant surfaces. This improves the biological environment needed for stable soft tissue healing.

Another important advantage of laser therapy is its role in photobiomodulation. Low-level laser therapy stimulates cellular metabolism, increases ATP production, and accelerates the repair process. These effects promote faster epithelial closure, reduced postoperative discomfort, and improved regenerative potential. When combined with mechanical debridement and antiseptic treatment, lasers enhance the overall therapeutic outcome by creating a cleaner and more biologically active environment for healing.

Despite these advantages, the effectiveness of laser therapy depends on appropriate wavelength selection, power settings, and operator skill. Not all laser systems provide the same therapeutic benefits, and improper use may damage implant surfaces or surrounding tissues. Nevertheless, when applied correctly, laser-assisted treatment has demonstrated improved clinical parameters such as reduced inflammation, enhanced soft tissue attachment, and improved patient comfort.

Conclusion

Laser-assisted therapy plays a significant role in enhancing soft tissue healing during the treatment of peri-implantitis. Its bactericidal properties, ability to selectively remove diseased tissue, and capacity to stimulate cellular regeneration make it an effective adjunct to conventional treatment methods. Diode and Er:YAG lasers show particularly promising results, offering a minimally invasive approach that improves the biological environment around affected implants. While lasers cannot replace comprehensive peri-implant therapy, they substantially contribute to better clinical outcomes when integrated into a multifaceted treatment protocol. Future clinical research should continue to evaluate optimal laser parameters and long-term outcomes to further refine their use in peri-implant disease management.

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