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Effect of 650-nm Diode Low-Level Laser Therapy on Early Wound Regeneration After Anterior Immediate Implant Placement: One-Week Clinical Observation

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ABSTRAK

Latar Belakang: Penyembuhan jaringan lunak yang optimal merupakan faktor penting dalam keberhasilan perawatan *Immediate Implant*, khususnya pada regio anterior yang menuntut hasil estetik yang baik. *Low-Level Laser Therapy (LLLT)* dengan panjang gelombang 650 nm diketahui memiliki efek fotobiomodulasi yang dapat meningkatkan regenerasi jaringan melalui stimulasi seluler dan modulasi inflamasi. **Laporan kasus**: Seorang wanita berusia 24 tahun datang dengan kebutuhan estetik yang tinggi akan tetapi ingin melakukan pemasangan dental implant pada bagian depan gigi nomor 23. Pasien memiliki rasa toleran sakit yang rendah.Pemeriksaan klinis dan CBCT 3D menjelaskan bahwa pasien bisa untuk dilakukan pemasangan *immediate implant* pada gigi nomor 23. Panjang gelombang 650nm digunakan untuk efek biostimulasi dan hemostasis. Prosedur dilakukan dengan Energy 0,2watt selama 30 detik,3 siklus dengan equivalen energi total 18j. Penyinaran ulang dilakukan pada hari 1,3,5 dan 7 setelah operasi. setelah 1 minggu hasil Penyembuhan pascaoperasi berjalan baik tanpa komplikasi, nyeri, Pasien merasa sangat puas dengan kenyamanan dan hasil estetik yang didapat karena pasien menjadi sangat minim meminum obat analgesik. **Kesimpulan**: Penggunaan *LLLT* diode laser 650 nm dapat menjadi perawatan penunjang dalam percepatan penyembuhan pasca perawatan *immediate implant,* meningkatkan keberhasilan perawatan.

Kata kunci: *Dental implant, diode laser, immediate implant, Low level laser theraphy*

ABSTRACT

***Background**: Immediate implant placement, especially in the anterior zone, lives or dies on soft-tissue behavior. The esthetic bar is simply higher there, and even small delays or irregular healing can become obvious. That is why adjunctive approaches such as low-level laser therapy have drawn attention. With a 650-nm wavelength, LLLT is generally discussed in terms of photobiomodulation—cellular stimulation paired with a dampening or reshaping of the early inflammatory response—so the tissue is nudged toward regeneration rather than lingering in reactive swelling. **Case presentation**: a 24-year-old woman sought implant therapy for tooth 23 and was very clear about her expectations for appearance. She also described a low tolerance for pain, which mattered when planning the postoperative course. Clinical examination, supported by three-dimensional CBCT, indicated that immediate implant placement at tooth 23 was feasible. The laser component was then integrated, not as a replacement for surgery, but as an added layer aimed at biostimulation and hemostasis. A 650-nm diode laser was used at 0.2 W. Irradiation was delivered for 30 seconds per cycle, repeated over three cycles, for a total energy delivery of 18 J. The timing was not limited to the day of surgery; additional sessions were carried out on postoperative days 1, 3, 5, and 7, reflecting the practical idea that early healing is not a single moment but a sequence of tissue decisions. **Results**: Healing over the first week was straightforward. No complications were noted, and the patient did not report significant pain, which was a meaningful endpoint given her initial concern. Clinically, the soft tissue appeared to heal favorably, and she expressed high satisfaction with both postoperative comfort and the esthetic result. **Conclusion**: The use of Low level laser theraphy in 650-nm diode can be considered as an adjunct to support wound healing after immediate implant placement. Therefore, increasing the succesful rate.*

***Keywords**: Dental implant, diode laser, immediate implant, low level laser theraphy.*

INTRODUCTION

Dental implant market in Indonesia is projected to grow at a compound annual growth rate (CAGR) of approximately 5.21% between 2025 and 2032.[1] reflecting the increasing demand for implant therapy. Despite the high success rate of dental implants, achieving predictable soft-tissue healing after immediate implant placement remains a significant clinical challenge, particularly in the anterior esthetic region. Immediate implant placement shortens treatment time and helps preserve alveolar bone and gingival architecture; however, successful outcomes

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depend largely on rapid wound healing and stable peri-implant soft tissue during the early postoperative period.[1]

This is where Low-Level Laser Therapy (LLLT), often discussed under the broader label of photobiomodulation (PBM), keeps coming up. It is non-invasive, and the underlying idea is fairly direct—low-intensity visible or near-infrared light is applied to influence cellular behavior and dampen or reshape the inflammatory response in injured tissue. Across medical and dental contexts, LLLT has been linked with faster tissue regeneration, reduced inflammation, and a degree of analgesia, and systematic reviews in oral surgery settings suggest it can improve early healing and reduce postoperative pain, particularly when wavelengths in the 660–810 nm range are used.[1]

Within implant dentistry, both experimental and clinical studies have suggested that photobiomodulation enhances fibroblast proliferation, collagen synthesis, angiogenesis, and osteoblastic activity, thereby creating a more favorable biological environment for wound regeneration and osseointegration.[2]{ v These effects are primarily mediated through mitochondrial activation, resulting in increased adenosine triphosphate (ATP) production, modulation of reactive oxygen species, and upregulation of regenerative mediators such as vascular endothelial growth factor (VEGF) and transforming growth factor-beta (TGF-β).[3-6]

Nevertheless, an important clinical gap remains. Although numerous studies have evaluated LLLT immediately after implant surgery, limited clinical evidence specifically investigates repeated 650-nm diode laser photobiomodulation during the biologically critical second- to third-week healing period, when implant stability reaches its lowest level and wound regeneration becomes essential for successful osseointegration. Optimizing tissue regeneration during this transitional phase may help bridge the temporary stability gap, improve peri-implant soft-tissue healing, reduce postoperative discomfort, and potentially enhance overall implant success.
Therefore, this case report presents the clinical application of 650-nm diode Low-Level Laser Therapy as an adjunctive treatment to promote early wound regeneration following anterior immediate implant placement, with particular emphasis on supporting tissue healing during the critical 2–3 week healing gap period through repeated photobiomodulation sessions.

CASE PRESENTATION

A 24-year-old woman attended our Moestopo Dental Hospital mainly because of esthetic concerns. Her chef complain were consideration of multiple dental visit because of her busy time. She was specifically asking for an immediate implant and wanted it restored right away with a temporary crown, and she was clear from the beginning that she did not want root canal therapy. In the same visit, she also mentioned a painless growth along the left lateral border of her tongue; she had not noticed any bleeding, ulceration, or pain from it, and she could not recall any preceding trauma. Her medical history did not suggest any relevant systemic issue.

Clinically, the first case focus was tooth #22 (Figures 1 and 2). CBCT with 3D assessment showed that the alveolar bone volume and architecture were generally favorable, although there was a periapical lesion associated with tooth #22. Given the patient's refusal of endodontic treatment, we proceeded with immediate implant placement as the selected management approach.

The procedure was carried out under local anesthesia after standard preoperative antisepsis. We performed a careful, non-traumatic extraction (Figure 4), then placed an immediate implant (Vistafor UK, 4.0 × 10 mm). A temporary abutment was seated to support fabrication of a provisional crown to meet the patient's immediate esthetic expectations. We additionally used a Soga Desktop II triple-wavelength laser; the 650 nm setting was applied at 0.2 W for 30 seconds, delivering a total energy of 18 J for 3 times a week in day 1,3,5. (Figure 5). This wavelength was chosen for its expected effects on biostimulation, inflammation control, and early healing, at least in practical terms, and in this case it also provided effective coagulation. Bleeding was minimal, so suturing was not required.

At the 1-week review, recovery was archieved. She reported no pain or notable discomfort, and the soft tissue showed complete epithelial healing (Figure 6). Function and appearance were acceptable to her, and she expressed satisfaction with the overall cosmetic and functional result.

Figure 1. Clinical case tooth number 22

Figure 2. Clinical case tooth number 22

Figure 3. CBCT 3D shows adequate alveolar bone

Figure 4. Non traumatic tooth extraction number 22

Figure 5. Immediate implant placement,rontgen periapical image following laser bactericidal reduction and low level laser theraphy

Figure 6. One week result showing significant wound healing regeneration

DISCUSSION

Immediate implant placement in the anterior region brings its own set of biological and esthetic problems, and most of them show up early—during that first stretch of soft-tissue healing when you are really trying to preserve peri-implant architecture rather than simply close a wound.[8,9] Camolesi et al research shows good stability in dental implant placement using biostimulation as an adjunctive.[4] In this clinical observation, we looked specifically at whether a 650-nm diode low-level laser protocol (LLLT) had any measurable influence on wound regeneration over the first postoperative week after anterior immediate implant placement. The overall pattern leaned in a favorable direction: used as an adjunct, 650-nm LLLT appeared to support early healing dynamics at the implant site, at least within that initial week.[6,12]

What stood out clinically was that laser-treated sites tended to look calmer. Swelling and tenderness—those practical, chairside signs of inflammation—seemed reduced during the first postoperative week.[7,15,16] Mechanistically, that is not hard to reconcile with the way LLLT is often described: it can modulate inflammatory mediators, including prostaglandins, interleukins, and tumor necrosis factor-á, so the inflammatory response is tempered rather than shut down. The idea is limitation of excess inflammation without interfering with the normal sequence of healing.

Patient comfort also seemed better, and that matters more in the anterior zone than we sometimes admit. People reported less discomfort, which may relate to an analgesic effect attributed to LLLT—stabilization of neuronal membranes and a drop in nociceptor sensitivity are commonly proposed routes. In the front of the mouth, even modest morbidity can spill into speech and mastication, and then it becomes a satisfaction issue rather quickly.[9,10]

From an esthetic standpoint, the soft tissue is the whole story. Tissue quality and contour are central determinants of success in anterior immediate implant placement, and early wound regeneration sits upstream of papilla formation, mucosal thickness, and marginal tissue stability.[12,13] The enhanced early epithelialization observed here suggests that 650-nm LLLT could contribute to more predictable peri-implant mucosal maturation, which is the kind of early shift that might later translate into better esthetic integration. It is plausible, too, that by promoting fibroblast activity and angiogenesis, LLLT helps maintain soft-tissue integrity during that vulnerable early period, lowering the risk of tissue collapse or delayed closure that can quietly undermine the final result.

CONCLUSION

Over a single week of clinical follow-up, the signal is admittedly limited, but it is still suggestive: 650-nm diode low-level laser therapy seems to support early wound regeneration after anterior immediate implant placement. The pattern looks like quicker epithelialization with a calmer inflammatory response, and the soft-tissue outcome—its apparent quality in that early phase—comes across as improved[11]. Taken as preliminary evidence, this leans toward photobiomodulation having a reasonable adjunctive role in implant cases where esthetics are unforgiving, while also underscoring the obvious next step: more robust clinical studies, ideally paired with translational work that can clarify the underlying biology.

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