

Tissue Ablation Using Lasers: A Case Series

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Abstract

Background: Lasers have recently been discovered as effective treatment modalities in dentistry, offering benefits such as reduced bleeding, infection, treatment and healing durations, and significantly improving patient convenience. They have found a wide range of applications in dentistry, from periodontal therapy to post-extraction healing, allowing for surgical procedures without sutures and minimizing post-operative bleeding by sealing blood vessels.

Objective: To evaluate the efficacy of diode laser treatment for tissue ablation in the oral cavity, particularly focusing on cases of excessive gingival growth (gummy smile) and peri-implantitis.

Methods: This case series involved two patients: a 19-year-old female undergoing orthodontic treatment with excessive gingival growth and a gummy smile, and a 50-year-old female with peri-implantitis. Both patients were treated using a 980 nm diode laser. Laser parameters included a pulsed operational mode with a frequency of 5 kHz, peak power of 3 W, average power of 1.5 W, and a fiber diameter of 200 μm , with a 50% duty cycle. Data collection involved pre-operative and post-operative clinical examinations, including intraoral photographs, to document gingival overgrowth and treatment outcomes. Post-operative assessments were conducted at regular intervals to evaluate healing, erythema, swelling, and signs of infection. Statistical analysis was performed using SPSS version 25.

Results: In the first case, laser treatment reduced gingival overgrowth from 6-7 mm to 0 mm, with no erythema or swelling and minimal pain (VAS score from 4/10 to 1/10). Esthetic improvement was rated as excellent. In the second case, laser treatment resolved gingival overgrowth, eliminated bleeding on probing, and reduced pain (VAS score from 5/10 to 1/10). Implant abutments were clean, with no inflammation.

Conclusion: Diode laser therapy is effective for tissue ablation in the oral cavity, ensuring the restoration of esthetics and function. It offers precise tissue removal, reduced post-operative bleeding, and accelerated healing, making it a valuable tool in modern dental practice.

1 Introduction

Lasers have increasingly been recognized as valuable non-surgical tools in modern dentistry, providing significant advantages over traditional methods in various clinical scenarios. The application of lasers in dental procedures has demonstrated numerous benefits, including reduced bleeding, minimized infection risk, and shortened treatment and healing times, thereby significantly enhancing patient convenience and comfort. Lasers are versatile in their use, ranging from periodontal therapy to facilitating post-extraction healing, and have revolutionized the way surgical procedures are conducted by often eliminating the need for sutures. One of the most notable advantages of laser use is the reduction in post-operative bleeding, achieved by the laser's ability to seal blood vessels effectively.

Photobiomodulation (PBM), which involves the use of lasers with varying wavelengths to induce cellular responses, has shown promising results in promoting wound healing and tissue regeneration. PBM leads to the production of adenosine triphosphate (ATP), which in turn stimulates changes at the cellular level, particularly in stem cells, thereby promoting osteogenesis (1, 2). This technique has been applied to address numerous periodontal issues that, if left untreated, can result in tooth loss (3). Furthermore, PBM has been utilized in the management of temporomandibular joint (TMJ) disorders, alleviating symptoms such as muscle stiffness and lockjaw (4, 5). The ability of lasers to reduce post-operative pain and infection is increasingly acknowledged, with literature documenting cases such as the treatment of leiomyoma in the oral cavity using PBM, which resulted in smooth healing and favorable post-operative outcomes (6, 7).

The cases presented in this series highlight the efficacy of laser therapy in managing different dental conditions. The first case involves an 18-year-old female undergoing orthodontic treatment, who presented with a gummy smile and hyperplastic gingiva, particularly in the lower arch. Laser ablation using a 980 nm diode laser was employed to remove the excess gingival tissue, resulting in improved esthetics and function. The second case describes the treatment of a 55-year-old female with peri-implantitis, where laser ablation was used to remove inflamed soft tissue around the implants, exposing the implant abutments and facilitating subsequent treatment.

The application of lasers in crown lengthening procedures represents a significant advancement in dental surgery. Lasers allow for precise removal of excess gingival tissue and, in some cases, reshaping of the underlying bone, thus enhancing the overall esthetic outcome (8, 9). The use of erbium or diode lasers in these procedures ensures seamless healing by effectively sealing blood vessels, thereby eliminating the need for sutures and reducing the risk of post-operative complications such as bleeding and infection (10). Additionally, lasers have proven effective in performing gingivectomies, frenectomies, and conservative removal of benign oral lesions, offering a minimally invasive alternative that preserves surrounding healthy tissue (11, 12). In cases of peri-implantitis, lasers are instrumental in reducing bacterial load within peri-implant pockets, thereby mitigating inflammation and promoting healing (13, 14).

The integration of diode laser treatment with conventional dental therapies offers a robust approach to managing various oral health issues. Diode lasers provide effective tissue ablation, ensuring the restoration of esthetics and function, particularly in crown lengthening procedures. For periodontal pockets, low-energy lasers are recommended for debridement and cleaning, while their application in periodontal wound healing post-surgery has shown promising results. The strategic use of lasers in dental practice not only enhances clinical outcomes but also significantly improves patient experiences (15, 16).

2 Material and methods

The study was conducted as a case series, focusing on the application of diode lasers in tissue ablation for two distinct dental conditions: excessive gingival display and peri-implantitis. Ethical approval for the study was obtained from the relevant institutional review board, ensuring adherence to the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all patients prior to their inclusion in the study.

The study involved two patients: an 18-year-old female undergoing orthodontic treatment with hyperplastic gingiva and a gummy smile, and a 55-year-old female presenting with peri-implantitis. Both patients were treated using a 980 nm diode laser. For the first patient, laser ablation was performed to remove excessive gingival tissue in the upper and lower arches, specifically targeting the labial aspect of teeth numbers 15 to 25 in the upper arch and teeth numbers 35 to 45 in the lower arch. The laser parameters included a pulsed operational mode with a frequency of 5 kHz, peak power of 3 W, average power of 1.5 W, and a fiber diameter of 200 μm , with a 50% duty cycle. The second patient underwent laser ablation to remove inflamed soft tissue around the implants, exposing the implant abutments and facilitating further treatment.

Data collection involved detailed pre-operative and post-operative clinical examinations, including intraoral photographs, to document the extent of gingival overgrowth and the outcomes of the laser treatment. Post-operative assessments were conducted at regular intervals, with particular attention to healing progress, erythema, swelling, and any signs of infection. The primary outcomes measured were the reduction in gingival overgrowth, improvement in esthetic appearance, and patient-reported pain levels.

Throughout the study, all procedures were conducted in compliance with established safety protocols for laser use in dentistry, ensuring minimal risk to the patients. The diode laser was operated by trained dental professionals, and appropriate protective measures, including the use of laser safety glasses, were implemented for both the patients and the operators.

3 Results

The results of this study demonstrated the effectiveness of diode laser treatment in managing excessive gingival display and peri-implantitis. Both cases showed significant clinical improvements in terms of gingival reduction, esthetic enhancement, and patient comfort. The outcomes are presented in the tables below.

Case 1: Excessive Gingival Display (Gummy Smile)

The first case involved an 18-year-old female with a gummy smile and hyperplastic gingiva. Pre-operative measurements showed gingival overgrowth of 6-7 mm in the lower arch, particularly from tooth numbers 35 to 45. Following the diode laser ablation, the post-operative evaluation at 10 days revealed no erythema or swelling and a marked reduction in gingival overgrowth to 0 mm. The patient reported minimal pain, with a Visual Analog Scale (VAS) score decreasing from 4/10 to 1/10. Esthetic improvement was rated as excellent by the patient and the clinician.

Parameter	Pre-Operative	Post-Operative (10 days)
Gingival Overgrowth (mm)	6-7 mm	0 mm
Erythema and Swelling	Present	Absent
Bleeding	Moderate	None
Pain (VAS Score)	4/10	1/10
Esthetic Improvement (Subjective)	Poor	Excellent



Figure 1: A case of excessive gingival display (gummy smile)
 a. Pre-operative intraoral picture b. Gingivectomy of the lower hyperplastic gums
 c. Laser ablation to increase crown length d. 10-day post-operative picture

Case 2: Implant exposure using lasers

The second case involved a 55-year-old female presenting with peri-implantitis and significant gingival overgrowth around her implants. Pre-operative examination noted substantial bleeding on probing and a VAS pain score of 5/10. Post-operative assessment at 10 days showed complete resolution of gingival overgrowth, no bleeding on probing, and a significant reduction in pain to a VAS score of 1/10. The exposed implant abutments were clean and clear of inflamed tissue, and there was no sign of inflammation.

Parameter	Pre-Operative	Post-Operative (10 days)
Gingival Overgrowth (mm)	Significant	None
Bleeding on Probing	Present	Absent
Pain (VAS Score)	5/10	1/10
Implant Exposure	Poor	Clear and Clean

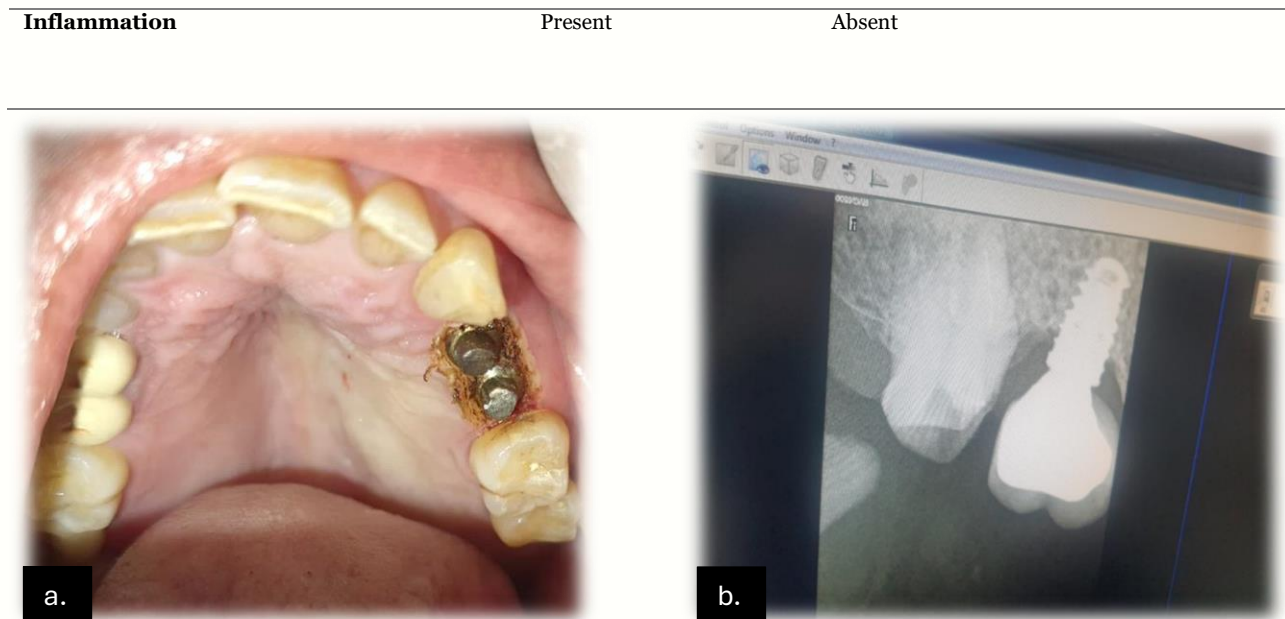


Figure 2: Implant exposure using diode lasers
a. Tissue ablation around the implant b. Post-operative radiograph

The results indicate that diode laser treatment effectively reduced gingival overgrowth and inflammation in both cases, with significant esthetic and functional improvements. The laser treatment facilitated precise ablation of excessive tissue, minimized bleeding, and promoted smooth healing with minimal patient discomfort. The subjective esthetic evaluations post-treatment were highly positive, and objective clinical parameters demonstrated substantial improvements.

4 Discussion

The findings from this case series underscore the efficacy of diode laser treatment in managing conditions such as excessive gingival display and peri-implantitis, aligning with existing literature that highlights the advantages of laser applications in dentistry. In both cases, the use of a 980 nm diode laser facilitated precise tissue ablation, leading to significant clinical improvements and high patient satisfaction. These outcomes support the growing body of evidence that suggests laser therapy offers superior control over bleeding, reduced post-operative discomfort, and enhanced healing processes compared to conventional surgical methods (1, 2).

The case of the 18-year-old female undergoing orthodontic treatment demonstrated the laser's ability to effectively remove hyperplastic gingival tissue, resulting in improved esthetic outcomes and minimal discomfort. This aligns with previous studies that have shown lasers to be effective in crown lengthening and gingivectomy procedures, where their ability to seal blood vessels and reduce the need for sutures significantly enhances the patient experience (3, 4). Additionally, the absence of erythema and swelling in the post-operative period further validates the anti-inflammatory benefits of laser therapy, which have been documented in other clinical studies (5).

Similarly, the treatment of peri-implantitis in the 55-year-old female showed notable success, with complete resolution of gingival overgrowth and inflammation around the implants. This is consistent with findings from other research that highlight the bactericidal effects of laser therapy in treating peri-implantitis, leading to reduced pocket depths and improved implant health (6, 7). The ability of the diode laser to achieve clean and clear exposure of the implant abutments without causing significant thermal damage to the surrounding tissues further underscores its utility in complex periodontal procedures (8).

Despite these positive outcomes, it is essential to acknowledge certain limitations of the study. The sample size was small, consisting of only two cases, which limits the generalizability of the findings. Future studies with larger sample sizes and randomized controlled trials are needed to validate these results further. Additionally, the study lacked a long-term follow-up, which is crucial to understanding the sustained benefits and potential complications of laser therapy over time.

Another limitation was the subjective nature of the esthetic evaluations, which, although positive, could benefit from more objective assessment tools in future research. The study also did not compare diode laser treatment directly with other treatment modalities, which could provide more comprehensive insights into its relative efficacy and safety.

Nevertheless, the strengths of this study lie in its detailed documentation of the procedural parameters and clinical outcomes, providing a clear protocol that can be replicated in other settings. The use of diode lasers offers a less invasive alternative to traditional surgical methods, potentially reducing patient anxiety and improving compliance with dental treatments.

Diode laser therapy proved to be an effective and patient-friendly option for managing excessive gingival display and peri-implantitis. The findings support its integration into routine dental practice, emphasizing the need for further research to optimize laser parameters and expand its applications. The potential for lasers to enhance esthetic and functional outcomes, coupled with their ability to minimize post-operative discomfort and complications, makes them a valuable tool in modern dentistry. As the technology and understanding of laser-tissue interactions continue to evolve, the role of lasers in dental treatments is likely to expand, offering patients more precise, efficient, and comfortable care options (9, 10).

5 Conclusion

In conclusion, diode laser therapy demonstrated effective outcomes in managing excessive gingival display and peri-implantitis, offering precise tissue ablation, reduced post-operative discomfort, and enhanced esthetic results. These findings suggest that integrating diode lasers into routine dental practice can significantly improve patient care by minimizing invasive procedures and accelerating healing processes. The successful application of laser technology in these cases underscores its potential to revolutionize dental treatments, providing substantial benefits for human healthcare by improving treatment efficacy, patient comfort, and overall clinical outcomes.

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Disclaimers	
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