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Clinical Evaluation of Operculectomy Using a 940 nm Diode Laser in the Management of Pericoronitis: A Retrospective Case Record Study

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KEYWORDS

Diode laser, Operculectomy, Pericoronitis, operculum, laser therapy.

ABSTRACT:

Background: Operculectomy is a definitive treatment for pericoronitis, commonly caused by a partially erupted mandibular third molar. Traditional scalpel-based operculectomy often leads to discomfort, bleeding, and delayed healing. Diode laser operculectomy, particularly with the Biolase Epic X (940 nm), offers a minimally invasive alternative with superior outcomes.

Aim: To evaluate the clinical effectiveness of diode laser operculectomy using Biolase Epic X (940 nm) as a sole treatment modality in patients with pericoronitis.

Methodology: This retrospective case record study included 40 patients treated between January 2021 and December 2024. Twenty patients underwent diode laser operculectomy, and twenty received conventional surgical operculectomy treatment. Data on pain scores (Day 1, 3, and 7), recurrence, number of follow-ups, and medication usage were collected and statistically analyzed.

Results: Laser operculectomy showed significantly lower pain scores on Day 7 (1.2 ± 0.9) compared to the conventional group (3.4 ± 1.3, $p < 0.01$). Recurrence was 10% in the laser group versus 35% in the conventional group. The laser group also required fewer follow-up visits and reduced use of antibiotics and analgesics.

Conclusion: Diode laser operculectomy using the Biolase Epic X (940 nm) provides a safe, effective, and minimally invasive solution for managing pericoronitis, with enhanced post-operative outcomes compared to conventional methods.

1. Introduction

Pericoronitis is a common inflammatory condition affecting the soft tissue surrounding the crown of a partially erupted tooth, most often the mandibular third molars. The presence of an operculum, a soft tissue flap covering part of the erupting molar, creates a favorable environment for food impaction and microbial accumulation. If untreated, pericoronitis may lead to severe pain, localized swelling, limited mouth opening, and systemic infection. One of the definitive treatments for recurrent pericoronitis is operculectomy, the surgical excision of the operculum to eliminate the source of irritation and inflammation (1,2).

Conventional operculectomy, typically performed with a scalpel or electrocautery, is effective but may be associated with bleeding, delayed healing, post-operative discomfort, and risk of secondary infection. These limitations have prompted the exploration of laser-based techniques for soft tissue surgery in the oral cavity. Among the available options, diode lasers have emerged as a reliable tool in minor oral surgical procedures due to their favorable interaction with soft tissues (3,4).

Diode lasers operate in the near-infrared spectrum, with wavelengths ranging from 810 to 980 nm. The Biolase Epic X, a 940 nm diode laser, is specifically designed for soft tissue applications. This wavelength is preferentially absorbed by hemoglobin and melanin, making it highly efficient in coagulating blood vessels and vaporizing soft tissues with minimal collateral damage (5,6). The laser energy delivered via a flexible fiberoptic tip enables

precision and safety in delicate surgical areas such as the posterior mandible.

The mechanism of diode laser operculectomy involves the photo-thermal ablation of soft tissue, where laser energy denatures cellular proteins and disrupts bacterial membranes. The bactericidal effect is well-documented, leading to a significant reduction in microbial load in the surgical area (7). Moreover, diode laser irradiation induces photobiomodulation—a biological response involving mitochondrial activation, enhanced ATP production, increased fibroblast proliferation, and faster tissue remodeling (8). This translates into improved wound healing and reduced postoperative discomfort for the patient.

Another advantage of diode laser operculectomy is the minimal need for suturing and anesthesia. Due to the hemostatic properties of the 940 nm wavelength, bleeding is significantly reduced, allowing for a clear surgical field and reduced operative time. Patients also report reduced swelling and inflammation due to lymphatic sealing and anti-inflammatory effects of the laser (9,10).

Multiple studies have highlighted the role of lasers in periodontal and soft tissue procedures. In the context of operculectomy, diode lasers provide better patient acceptance, faster healing, and lower recurrence compared to conventional scalpel techniques (11,12). However, literature focusing exclusively on diode laser operculectomy as the sole treatment modality for pericoronitis is limited.

This retrospective study aims to evaluate the clinical outcomes of diode laser operculectomy, assessing parameters such as post-operative pain, recurrence, follow-up visits, and need for systemic medications. The results will offer insight into the efficacy of laser monotherapy and its potential as a standard treatment protocol in pericoronitis-related operculum excision.

2. Materials and Methods

This retrospective observational study was conducted at the Department of Periodontics and Oral Surgery, Saveetha Dental College, following approval from the institutional ethics committee. Case records of patients treated for pericoronitis between January 2021 and December 2024 were reviewed.

A total of 40 patients who underwent operculectomy were selected and divided into two groups: Group A (n = 20) received diode laser operculectomy using Biolase Epic X (940 nm), while Group B (n = 20) underwent conventional treatment with mechanical debridement, irrigation, and medications. Inclusion criteria included patients aged 18 to 40 years, diagnosed with pericoronitis of mandibular third molars, and having at least one documented follow-up visit. Patients with systemic diseases, immediate extractions, or incomplete records were excluded.

In Group A, diode laser operculectomy was performed using the Biolase Epic X diode laser at a wavelength of 940 nm, with a power output of 1.5 watts in continuous wave mode. A 400 µm fiber optic tip was used in contact mode to excise the operculum. Prior to laser application, the area was irrigated with saline and chlorhexidine. Local anesthesia was administered only if necessary. No sutures were placed. Hemostasis was achieved through laser coagulation, and post-operative instructions were provided.

Parameters recorded included pain scores on Day 1, 3, and 7 using a Visual Analog Scale (VAS), recurrence within one month, number of follow-up visits, and need for antibiotics and analgesics.

Data was entered into Microsoft Excel and analyzed using SPSS version 22.0. Descriptive statistics were used to calculate mean and standard deviation for continuous variables. Independent t-test and chi-square tests were applied to compare clinical outcomes between the groups. A p value < 0.05 was considered statistically significant.

3. Results

Out of 40 patients, the mean age was comparable between the laser and conventional groups, with a nearly equal distribution of males and females.

The laser operculectomy group exhibited significantly faster pain reduction. On Day 1, the mean pain score was 6.8 ± 1.2, similar to the conventional group (7.1 ± 1.1, $p = 0.24$). However, by Day 3, the laser group showed a marked decrease (3.2 ± 0.9) versus the conventional group (5.0 ± 1.3, $p < 0.01$). By Day 7, the laser group reported minimal discomfort (1.2 ± 0.9) compared to the conventional group (3.4 ± 1.3, $p < 0.01$), as depicted in Table 1 and figure 1.

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Recurrence of pericoronitis symptoms within one month occurred in 2 patients (10%) in the laser group and 7 patients (35%) in the conventional group, showing a statistically significant reduction in the laser group (p = 0.04), as shown in Table 2 and figure 1

The mean number of follow-up visits required was also lower in the laser group (1.2 ± 0.5) compared to the conventional group (2.6 ± 1.1, p < 0.05). Additionally, only 25% of patients in the laser group required antibiotics post-operatively, compared to 80% in the conventional group. Analgesic use was also lower in the laser group (50% vs. 95%, p < 0.01).

No complications or adverse events were reported in either group, affirming the safety of diode laser operculectomy.

Table 1: Pain Score Comparison (VAS) Between Groups

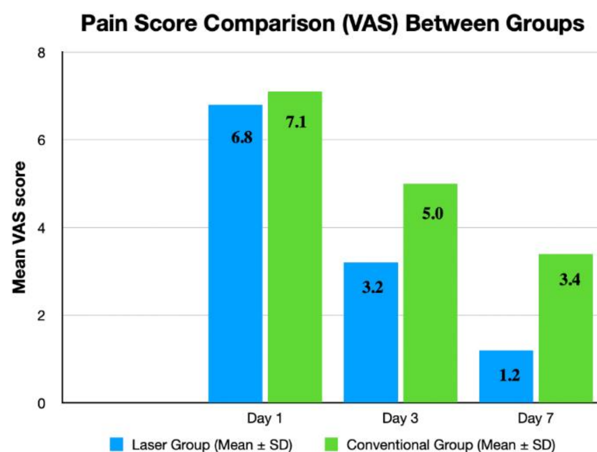
Day	Laser Group (Mean ± SD)	Conventional Group (Mean ± SD)	p-value
Day 1	6.8 ± 1.2	7.1 ± 1.1	0.24 (NS)
Day 3	3.2 ± 0.9	5.0 ± 1.3	<0.01*
Day 7	1.2 ± 0.9	3.4 ± 1.3	<0.01*

NS – Not Significant; * – Statistically Significant

Table 2: Post-Operative Outcomes

Parameter	Laser Group (n=20)	Conventional Group (n=20)	p-value
Recurrence within 1 month	2 (10%)	7 (35%)	0.04*
Mean No. of Follow-ups	1.2 ± 0.5	2.6 ± 1.1	<0.05*
Antibiotic Use	5 (25%)	16 (80%)	<0.01*
Analgesic Use	10 (50%)	19 (95%)	<0.01*

NS – Not Significant; * – Statistically Significant



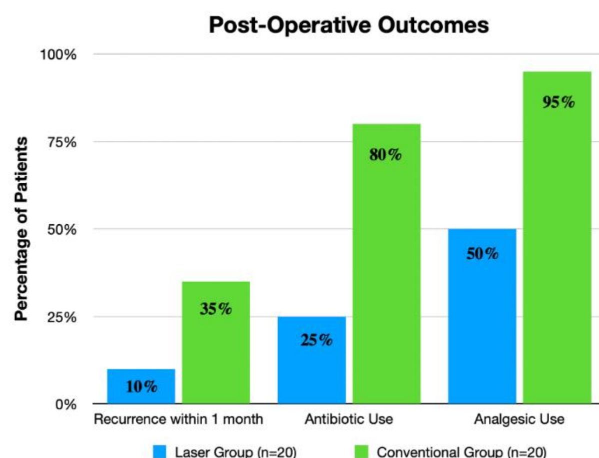


Figure 1: Comparison of pain scores and post-operative outcomes between diode laser and conventional operculectomy groups. (A) Mean VAS scores on Days 1, 3, and 7. The laser group showed significantly lower pain from Day 3 onward; (B) Post-operative outcomes—recurrence, antibiotic, and analgesic use—were all lower in the laser group.The blue bars represent the Laser Group (n = 20), and the green bars represent the Conventional Group (n = 20). Pain scores were measured using the Visual Analogue Scale (VAS), ranging from 0 (no pain) to 10 (worst pain). Data for pain scores are presented as mean ± standard deviation, while post-operative outcomes are shown as percentages of patients. Asterisks (*) indicate statistically significant differences between groups (p < 0.05), and NS denotes results that were not statistically significant.

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4. Discussion

Operculectomy remains a critical treatment modality for patients suffering from recurrent pericoronitis. The transition from conventional surgical techniques to laser-based interventions offers a paradigm shift in terms of patient outcomes and clinical efficiency. This study assessed the role of diode laser operculectomy as a standalone approach and compared it with conventional non-surgical management.

Our results show a consistent and significant reduction in pain scores following laser operculectomy. This can be attributed to photobiomodulation effects, which stimulate mitochondrial activity, promote cellular proliferation, and reduce inflammatory mediators at the surgical site (13). The precise ablation of soft tissue with minimal trauma reduces peripheral nociceptor activation, contributing to improved postoperative comfort.

The reduced recurrence rate (10% in laser group vs. 35% in conventional group) further supports the effectiveness of complete tissue removal via laser. Unlike debridement or temporary measures, laser excision of the operculum eliminates the inflamed tissue and prevents food impaction or bacterial colonization. These results are in line with previous studies by Kaur et al. and Gojkov-Vukelic et al., who observed minimal recurrence after diode laser excisions (14,15).

A major benefit highlighted is the reduction in follow-up visits, which not only enhances patient convenience but also reduces clinical workload. The laser's hemostatic ability reduces intraoperative bleeding, while the bactericidal and anti-edematous properties minimize complications and the need for post-op care.

The antibiotic and analgesic sparing effect is another significant finding. Over 75% of patients treated with laser did not require antibiotics, and half managed without analgesics. This is especially important in modern dental practice where overprescription of antibiotics and painkillers remains a concern due to resistance and dependency risks (16,17).

Despite these promising outcomes, the study has some limitations. Being retrospective in nature, it is subject to selection and reporting bias. Pain scores were recorded from case notes and may be influenced by subjective perception. Also, histological or microbiological evaluations were not performed. A future prospective randomized trial with long-term follow-up and microbiological data would help substantiate these findings (19-21).

Nonetheless, the present study provides compelling evidence that diode laser operculectomy using the 940 nm diode is a highly effective, safe, and patient-friendly modality for treating pericoronitis. It reduces pain, recurrence, and medication dependency, and should be considered a valuable tool in modern soft tissue oral surgery.

5. Conclusion

Diode laser operculectomy demonstrates clear clinical superiority over conventional treatment for pericoronitis. It significantly reduces postoperative pain, recurrence rates, and dependence on antibiotics and analgesics, while also minimizing the number of follow-up visits. The technique's precision, bactericidal action, and biostimulatory effects contribute to accelerated healing and enhanced patient satisfaction. Given these advantages, diode laser operculectomy should be considered a standard and patient-centered approach for managing pericoronal flap-related conditions, especially in cases of recurrent pericoronitis. Further prospective studies are recommended to validate these findings and explore long-term outcomes.

Conflict of Interest:

The authors declare no conflict of interest.

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