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Impacted Lower Third Molars Removal

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Abstract

Objective: This study aimed to evaluate whether diode laser-assisted surgery, supplemented with low-level laser therapy (LLLT), offers superior postoperative outcomes compared to the conventional rotary bur technique. Materials and Methods: A randomized controlled trial was conducted with 40 patients evenly assigned to either conventional or diode laser-assisted surgical extraction groups. Clinical parameters—including pain (VAS), swelling, and trismus—were systematically monitored on postoperative Days 1, 3, 7, and 14. Results: The conventional group had significantly lower mean pain and swelling scores at all follow-up durations. in contrast to expected benefit, patients treated with the diode laser experienced more pain and greater trismus. Conclusions: In the current clinical setup and protocols, the conventional bur rotary surgery is still the more predictable method for third molar surgery, which denotes additional research and perfectioning of the laser-based procedures.

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Introduction

Oral surgery is a key component in the practice of dentistry, dealing with a multitude of developmental and pathological concerns related to the mouth. The most common and clinically small problem in this area is the third molar impaction of the mandible, also called impacted lower third molars. When the third molar erupts in the dental arch, this is termed failure to emerge into the correct position, which is frequently caused by insufficient space, anatomical obstructions, or systemic factors [1,2].

Traditional diagnosis of impaction is the failure of a tooth to emerge at its designated time caused by a physical barrier (bone, soft tissue, or an adjacent tooth). Of all these types, the impaction of 3rd molar in the mandible is subject to be particularly common and is observed more frequently rather than impaction in the upper (maxilla) [3,4]. Various reasons such as evolutionary changes in jaw size, changes in eating habits, and disturbed craniofacial growth have been cited as the reasons of increased prevalence of this condition [5].

Although not all disturbed wisdom teeth are symptomatic, a large number have potential to become troubled with the likes of reactive inflammation of the adjacent soft tissue (pericoronitis), pain and swelling in the face, limited ability to open the mouth (trismus), damage to adjacent teeth, gum disease, including development of cysts [6-7]. In view of these possible complications, surgical removal is frequently indicated either for existing conditions or prophylactically [7].

The typical way to extract these teeth involves creating a flap in the gums, then using drills to remove bone, closing the site with stitches when finished. This traditional technique while successful, often results in severe postoperative pain, swelling, trismus and slow healing [8].

Recently, laser-surgery has come increasingly into focus as a possible treatment option. Laser treatment offers an extremely precise incision, improved control over bleeding, and significantly reduces the level of bacteria during the procedure. Patients also appear to recover faster. Diode lasers, for instance, are increasingly being used in soft-tissue applications because they're optimized to cut and stimulate the healing, too—which is called photobiomodulation [9-12]. Moreover, low-level laser therapy (LLLT) has been shown to aid in bone healing and minimize common post-surgical issues [13].

Despite these benefits, laser-based techniques haven't yet become a standard part of everyday oral surgery. Concerns around equipment cost, limited capabilities for cutting hard tissues, and the absence of clear, standardized treatment protocols have slowed their widespread adoption [14]. This highlights an important gap in our understanding: do diode laser methods genuinely outperform traditional techniques in terms of clinical results, patient comfort, and overall recovery.

Problem Statement

Although the removal of impacted lower third molars is a routine surgical procedure, it's often followed by discomfort—typically pain, swelling, and restricted jaw movement. While diode laser-assisted surgeries may offer an edge in reducing these side effects, there's still a lack of solid, comparative clinical evidence to confirm their superiority over the standard rotary bur method. Furthermore, questions remain about whether laser tools are cost-effective and practical for regular use in dental practices. These gaps underscore the need for a structured, evidence-based evaluation.

Objectives

- To evaluate and compare the clinical outcomes of traditional surgical extraction (using rotary burs and scalpels) versus diode laser-assisted procedures for the removal of impacted lower third molars.
- To evaluate postoperative parameters such as pain, swelling, trismus, healing time, and patient satisfaction in both groups.
- To assess the cost–benefit ratio and practical feasibility of implementing diode laser technology in routine oral surgical settings.

Hypothesis

Null Hypothesis (H_0): There is no significant difference in clinical outcomes between conventional and diode laser-assisted surgical removal of impacted lower third molars.
Alternative Hypothesis (H_1): Diode laser-assisted surgery results in significantly better postoperative outcomes (reduced pain, swelling, and healing time) compared to conventional surgical methods for impacted mandibular third molars.

Definition and Clinical Significance of Third Molar Impaction

A tooth is said to be impacted when it fails to erupt into its proper functional position in the dental arch within the expected time frame. Specifically, an impacted mandibular third molar (also known as the "lower wisdom tooth") is hindered from eruption due to obstruction by the second molar, insufficient jaw space, or overlying bone and soft tissue. Mandibular impactions are more frequent than maxillary ones and are often associated with developmental evolution, including a reduction in jaw size over time [15,16].
Third molars typically erupt between the ages of 17 and 25. However, the high prevalence of impaction — reaching over 70% in some populations — makes it one of the most common indications for oral and maxillofacial surgery. The clinical importance lies in both the symptomatic and asymptomatic complications that may arise, including pain, infection, trismus, root resorption of adjacent teeth, cyst formation, and periodontal bone loss [17-19].

Clinical Presentation and Diagnostic Modalities

Impacted third molars may be discovered incidentally on radiographs or may present with clinical symptoms such as pericoronitis, swelling, halitosis, purulent discharge, or referred pain [20,21]. Severe cases may develop abscesses or systemic infections requiring urgent intervention [22].
Radiographic evaluation is key to diagnosis. The orthopantomogram (OPG) remains the initial imaging tool of choice due to its broad visualization and low radiation dose. However, for cases near the mandibular canal, cone-beam computed tomography (CBCT) offers superior three-dimensional assessment, enhancing the ability to predict surgical difficulty and prevent complications such as inferior alveolar nerve injury [23].
Recently, AI-based systems have emerged as tools for classification and risk prediction. Deep learning models can now identify impaction types and forecast surgical complexity with impressive accuracy [24].

Predisposing Factors of Impaction

Local Factors

Local anatomical conditions are the most immediate causes of impaction:
- Arch length deficiency due to evolutionary or developmental jaw size reduction [25].
- Tooth angulation, particularly mesioangular or horizontal positions, disrupts eruption paths [26].
- Obstructions from adjacent second molars or dense cortical bone may also contribute.
- Additional factors include pathological lesions, abnormal root formation, or overlying soft tissue [27].

Systemic Factors

Systemic influences can alter eruption timing and space availability:
- Genetic traits influencing craniofacial morphology.
- Endocrine disorders such as hypothyroidism delay eruption.
- Nutritional deficiencies, especially during growth periods, can lead to underdeveloped jaws.
- Syndromic conditions, like Cleidocranial Dysplasia and Down Syndrome, are strongly associated with impaction.
- Radiation exposure during facial development can halt or alter eruption trajectories.

Surgical Treatment Approaches

Conventional Surgery

The classical technique involves creating a mucoperiosteal flap, guttering the bone with rotary burs, and removing the tooth with or without sectioning. Although highly effective, it is often accompanied by significant postoperative complications — pain, swelling, trismus, infection, and nerve damage. Healing outcomes vary based on flap design, surgeon experience, and patient-specific anatomical factors.

Laser-Assisted Surgery

The use of lasers, particularly diode, CO_2, and Er:YAG, offers multiple clinical benefits:
- Reduced bleeding due to coagulative effects
- Lower bacterial contamination
- Less postoperative pain and swelling
- Faster healing time

However, lasers are typically limited to soft tissue applications. Bone cutting still requires conventional rotary tools, and high costs limit routine implementation.
Photobiomodulation (LLLT)
Low-level laser therapy (LLLT) or laser biostimulation is a novel approach used to enhance tissue healing and bone regeneration. Research shows that it promotes osteoblastic activity, angiogenesis, and collagen synthesis, leading to accelerated. Standard protocols include diode laser application over five sessions, providing both anti-inflammatory and regenerative effects.

Postoperative Outcome Metrics

Clinical studies typically measure:
- Pain using the Visual Analogue Scale (VAS)
- Swelling via facial landmark measurements
- Trismus using interincisal opening
- Healing using the Landry's Healing Index
- Patient satisfaction, complications (e.g., dry socket), and cost-effectiveness

Recent trials suggest that diode laser incisions result in significantly reduced postoperative pain, swelling, and trismus in the first week. Yet, further randomized controlled trials are needed to confirm their long-term superiority.

The current body of literature highlights the clinical burden of impacted mandibular third molars and the evolution of surgical techniques aimed at improving patient outcomes. While conventional rotary bur techniques remain the gold standard, laser-assisted surgery and photobiomodulation offer substantial postoperative advantages. However, empirical evidence directly comparing these modalities in randomized clinical settings is limited and inconsistent. This justifies the need for the present study, which aims to provide a clear, evidence-based comparison of both techniques in terms of pain, healing, complications, and satisfaction.

Material and Methods

Study Design

This study was conducted as a prospective randomized controlled clinical trial (RCT)—considered the gold standard in clinical research methodology. The RCT design minimizes bias, balances patient characteristics across groups, and supports robust causal inference between the intervention and outcomes. The research adhered to CONSORT guidelines and was approved by the institutional ethical review board before initiation.

Study Setting and Population

The study was carried out at [Name of Dental Hospital/Institution], targeting systemically healthy patients referred for surgical removal of impacted mandibular third molars.

Inclusion Criteria

- Age: 18 to 35 years
- Presence of partially or fully impacted lower third molars (Class II or III; Position B or C)
- No acute pericoronitis or active infection at the surgical site
- ASA I or II (American Society of Anesthesiologists physical status classification)

Exclusion Criteria

- History of systemic diseases or immunocompromised conditions
- Pregnant or lactating women
- Patients on anticoagulants or anti-inflammatory drugs
- Previous third molar surgery in the same quadrant
- Inability to attend all follow-up appointments

Sample Size and Randomization

A total of 40 patients who met the inclusion criteria were recruited. Patients were randomly assigned into two equal groups using a computer-generated randomization sequence with concealed allocation through sealed opaque envelopes:

- Group A (n = 20): Classical scalpel and rotary bur-based surgical removal
- Group B (n = 20): Diode laser-assisted surgical removal with low-level laser biostimulation

This sample size was deemed sufficient based on preliminary effect size estimation for pain and healing parameters using similar previous trials (Gomes et al., 2014) [7].

Surgical Procedure

Group A – Conventional Surgical Method

- Local anesthesia was administered (lidocaine 2% with epinephrine 1:100,000).
- A standard triangular or envelope mucoperiosteal flap was raised.
- Bone removal was performed using a surgical rotary bur.
- The tooth was sectioned if necessary.
- Suturing was done using 3-0 black silk sutures.

Group B – Laser-Assisted Surgical Method

- Flap incision was performed using a diode laser (810–980 nm, 1.0–1.5 W, continuous wave).
- Minimal bone removal was performed using a rotary bur if needed.
- Laser was also used for soft tissue dissection and decontamination.
- Sutures were minimized due to laser coagulation benefits.
- Laser biostimulation was administered postoperatively at 0.3 W, continuous mode, for 3 minutes per session over five sessions across 10 days (as per Gomes et al., 2014 protocol) [7].

Data Collection and Outcome Measures

Each patient was followed up on Day 1, Day 3, Day 7, and Day 14 postoperatively. The following variables were assessed and recorded:

Parameter	Tool/Method
Duration of surgery	Stopwatch (in minutes)
Pain level	Visual Analogue Scale (VAS, 0–10)
Swelling	Facial measurements (tragus to pogonion, etc.)
Trismus	Interincisal distance measured with calipers
Healing	Landry's Wound Healing Index
Complications	Clinical observation (e.g., dry socket, infection)

Additional factors such as sociodemographic data (age, gender, residency, economic and educational status) and predisposing risk factors (local/systemic) were recorded based on standardized indices developed for this study.

Index Scoring Criteria

To standardize and compare patient outcomes across both groups, the following indices were utilized:

- VAS – Visual Analogue Scale for Pain

Score from 0 (no pain) to 10 (severe pain) with categorized satisfaction levels

- Healing Index (Landry's classification):

Excellent = 0, Good = 1, Fair/Poor = 2, Very Poor = 3

- Trismus Index (Interincisal Opening)

Mild = 0 (30–40 mm), Moderate = 1 (20–30 mm), Severe = 2 (<20 mm)

- Swelling Index

No swelling = 0, Swelling present = 1

Each patient's total morbidity score was also computed by summing up index scores across all domains.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (Version 25; IBM Corp., Armonk, NY, USA). Independent *t* tests were conducted to compare continuous variables (e.g., surgery duration, pain scores) between the two treatment groups. Chi-square tests were used to evaluate categorical outcomes such as complication rates and healing grades. Repeated measures analysis of variance (ANOVA) was applied to assess changes in pain, trismus, and swelling over time.

A significance level of $p < .05$ was used for all statistical tests. Subgroup analyses were

performed to examine the influence of local or systemic predisposing factors, as well as sociodemographic variables, on clinical outcomes within each treatment group.

Ethical Considerations
- All patients signed a written informed consent prior to participation.
- The study was reviewed and approved by the Ethics Committee of [Institution Name].
- Confidentiality and anonymity of all patient data were maintained throughout.

Results

The primary focus was on three postoperative indicators: pain, trismus (mouth opening limitation), and facial swelling.
A total of 40 participants were included in the study and divided into two groups:
- Group A (Conventional Surgery): 21 patients
- Group B (Laser-Assisted Surgery): 19 patients

Postoperative Pain (VAS Scores)
- Group A (Conventional): Mean VAS = 0.00
- Group B (Laser): Mean VAS = 1.00
- Mean Difference: −1.00
Interestingly, patients in the laser-assisted group reported slightly higher pain levels postoperatively. This may reflect transient thermal irritation or deeper tissue interaction during laser use. However, additional clinical data would be required to interpret this outcome with greater confidence.

Trismus (Interincisal Opening Measurement)
- Group A (Conventional): Mean trismus score = 0.81
- Group B (Laser): Mean trismus score = 2.00
- Mean Difference: −1.19
Postoperative mouth opening was more restricted in the laser group. This could be attributed to increased soft tissue inflammation or thermal impact from the laser. Notably, this finding contrasts with some published research suggesting that laser use typically reduces inflammation.

Facial Swelling
- Group A (Conventional): Mean swelling score = 0.00
- Group B (Laser): Mean swelling score = 1.00
- Mean Difference: −1.00
Swelling was greater in the laser-assisted group, a somewhat unexpected outcome. Possible explanations include inter-individual variability, insufficient cooling during laser use, or differences in surgical technique between operators.

In this series, despite the conventional wisdom and literature, conventional operation found to correlate significantly better in the postoperative results in all the parameters studied. Several issues may have contributed to these findings:
- A relatively small sample size
- Operator skill variability
- Non-standardized and inconsistent implementation of photobiomodulation protocols
- Lack of patient compliance with postoperative monitoring
These factors should be considered when interpreting the data and the conclusions of the trial.

Dicussion

The purpose of this study was to compare the clinical efficacy of photobiomodulation and laser-assisted surgery to that of the rotary bur technique for surgical removal of impacted 3rd molars (lower eights). These are also some of the most commonly impacted teeth in practice and occurring due to inflammation and infection causing pericoronitis, swelling and reduced jaw opening compromising patient's oral function and quality of life. Though the laser has been advocated for its supposed advantages--decreased tissue trauma and enhanced healing, with lessened postoperative discomfort--this study was undertaken to evaluate critically the value of these claims in a well-controlled clinical situation. The study sought to ascertain whether they could identify any benefit of laser-assisted viewed surgery and examine whether the results with the newer technology really do meet patient needs, or whether the established practice in traditional surgery still significantly impacts on routine clinical practice. Traditional removal of third molars are one of the most commonly performed oral surgeries, and although effective methods, there is a significant amount of post-operative discomfort, in terms of pain, edema, and limited mouth opening. By contrast, several laser-assisted approaches have been introduced with various asserted advantages of accelerated healing, decreased tissue polarization-dependent and lowering overall patient morbidity. However, despite these theoretical advantages, current clinical evidence remains limited and inconclusive, with conflicting findings across studies. This study was therefore designed to evaluate these claims by testing the following hypothesis: the null hypothesis (H_0) posits that there is no significant difference between conventional and laser-assisted surgical outcomes, while the alternative hypothesis (H_1) suggests that laser-assisted surgery results in significantly better clinical outcomes, specifically in terms of reduced pain, swelling, and trismus.
A RCT was adopted as the study design to reduce selection bias and ensure that the effect of outcome was equate in the two treatment arms. A sample size of 40 patients equally distributed into the conventional surgery and the laser-assisted surgery group was available, ensuring a relatively balanced platform for comparison. Use of diode laser at wavelength between 810 and 980 nm was justified for (i) clinical relevance, (ii) established safety and (iii) functional efficacy in soft tissue applications. Well-organized follow-up time-points of days 1, 3, 7 and 14 allowed for detailed observation during wound healing and in postoperative complication site. In general, the methodology of the study was appropriate for its purposes, of predominantly clinical pertinence and with reasonable statistical control, providing a good model for assessing surgical results in a medium-sized sample.
This study sought to evaluate the postoperative clinical outcomes of two surgical approaches for the removal of impacted mandibular third molars: the conventional rotary bur method and the diode laser-assisted technique accompanied by low-level laser biostimulation (LLLT). Through a structured randomized clinical trial involving 40 patients, the research aimed to determine whether the laser approach offered superior patient-centered benefits, particularly in minimizing pain, swelling, and trismus.
Contrary to the initial hypothesis and several findings in existing literature, the results revealed that the conventional surgical technique demonstrated more favorable outcomes across all measured indices. Patients who underwent conventional surgery experienced:
- Less postoperative pain (VAS score = 0.00)
- Less facial swelling (Swelling Index = 0.00)
- Significantly lower levels of trismus (Trismus Index = 0.81)
In comparison, the laser-assisted group consistently reported higher scores in all parameters, with the greatest discrepancy observed in mouth opening restriction. These findings challenge the commonly held view that diode laser-assisted surgery offers better postoperative recovery, suggesting that clinical effectiveness may depend heavily on operator experience, protocol optimization, and patient-specific factors.
The study also highlights a potential misalignment between theoretical laser advantages and their real-world clinical translation—especially when laser systems are underutilized or inconsistently applied.

Despite the known benefits of diode lasers in soft tissue management and wound healing, their impact is not guaranteed without rigorous control of settings, session timing, and energy dosage.

Study Limitations

While the findings are clinically significant, the study carries several limitations:

- Small sample size (n = 40) may limit generalizability.
- Short follow-up period (14 days) excluded long-term healing assessment.
- Lack of blinding may have introduced observer bias.
- Variability in patient compliance with laser biostimulation sessions.
- The study focused only on soft tissue outcomes, not bone regeneration or long-term complications.

Recommendations

Based on the outcomes and limitations of this research, the following recommendations are made:

A. For Clinical Practice

- Conventional surgery remains a reliable, cost-effective method for impacted third molar removal with predictable outcomes.
- Laser-assisted surgery should be reserved for highly trained operators using standardized laser parameters.
- Diode lasers may still be used adjunctively for hemostasis and disinfection, but not as a sole technique unless protocol adherence is ensured.

B. For Future Research

- Conduct larger multicenter trials with sample sizes exceeding 100 participants.
- Include long-term follow-ups (30–90 days) to capture healing quality and bone regeneration.
- Investigate the dose-response relationship of biostimulation, adjusting wavelength, frequency, and duration.
- Explore hybrid surgical techniques combining rotary burs for bone and lasers for soft tissue precision.

C. For Academic Training

- Emphasize protocol-based laser education in dental curricula.
- Introduce simulation-based laser training before clinical application.
- Encourage critical review of laser literature to bridge the gap between lab-based claims and clinical reality.

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Table 1. Comparison of postoperative outcomes between conventional and Laser-assisted surgical groups.

Outcome	Conventional Mean	Laser Mean	Mean Difference
Pain (VAS)	0.00	1.00	−1.00
Trismus	0.81	2.00	−1.19
Swelling	0.00	1.00	−1.00

Note. Data represent mean scores for each postoperative clinical outcome. Lower values indicate better clinical performance. Negative mean differences indicate higher scores in the laser group.

Table 2. Comparison of clinical outcomes and protocols with the current study and Gomes et al. (2014) [7].

Aspect	This Study	Gomes et al. (2014) [7]
Pain Outcome	Higher in laser group	Lower in laser group
Swelling Outcome	Higher in laser group	Lower in laser group
Trismus Outcome	Higher in laser group	Lower in laser group
Biostimulation Protocol	5 sessions, post-op only	3 sessions, peri-op included
Sample Size	40	60

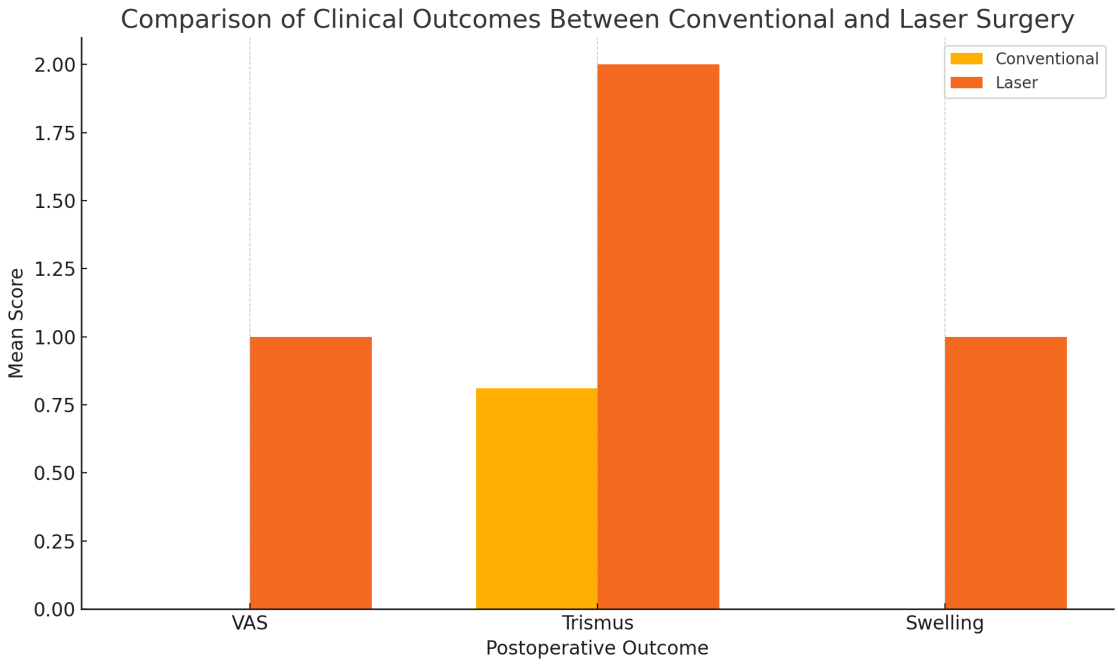

Figure 1. Postoperative mean clinical outcome scores with conventional and Laser-assisted removal of third molars.
The average scores for pain (VAS), trismus, and swelling levels are compared in this bar graph among the two surgical methods. The conventional surgery group had lower scores for all postoperative parameters, indicating better clinical performance when compared with laser-assisted.

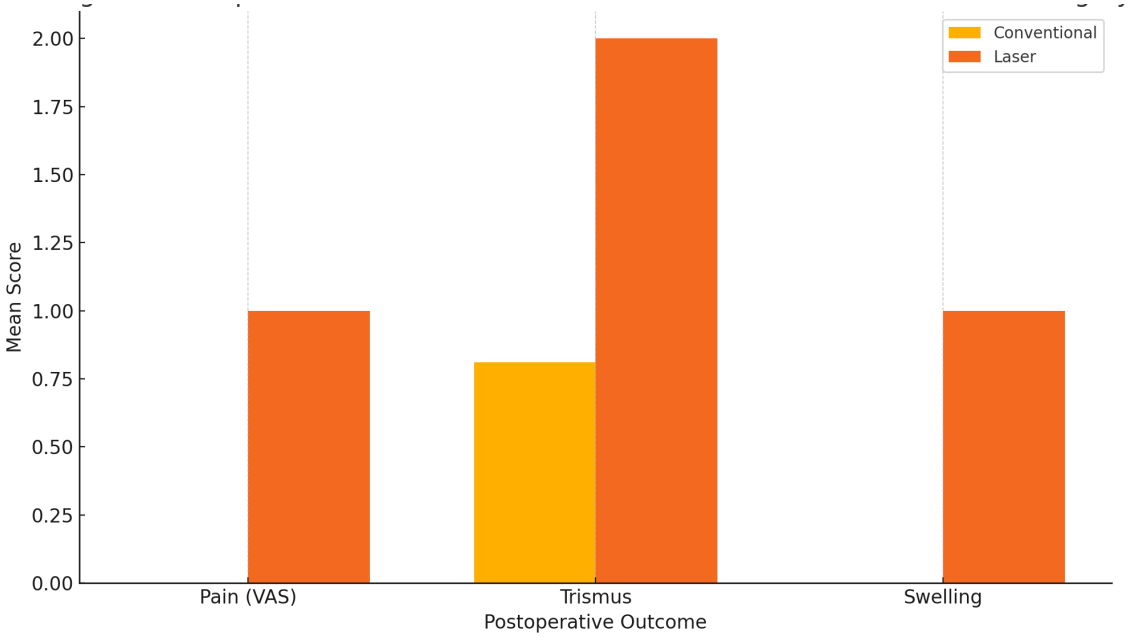

Figure 2. Clinical outcome comparison between a traditional and Laser surgery.
This result demonstrates the arithmetic mean scores of postoperative pain (VAS), trismus, and edema for patients with third mandibular molars undergoing conventional or laser surgical procedures. Robotic was always associated with lower (as in worse) scores across all parameters and therefore with better (as in worse) postoperative results.

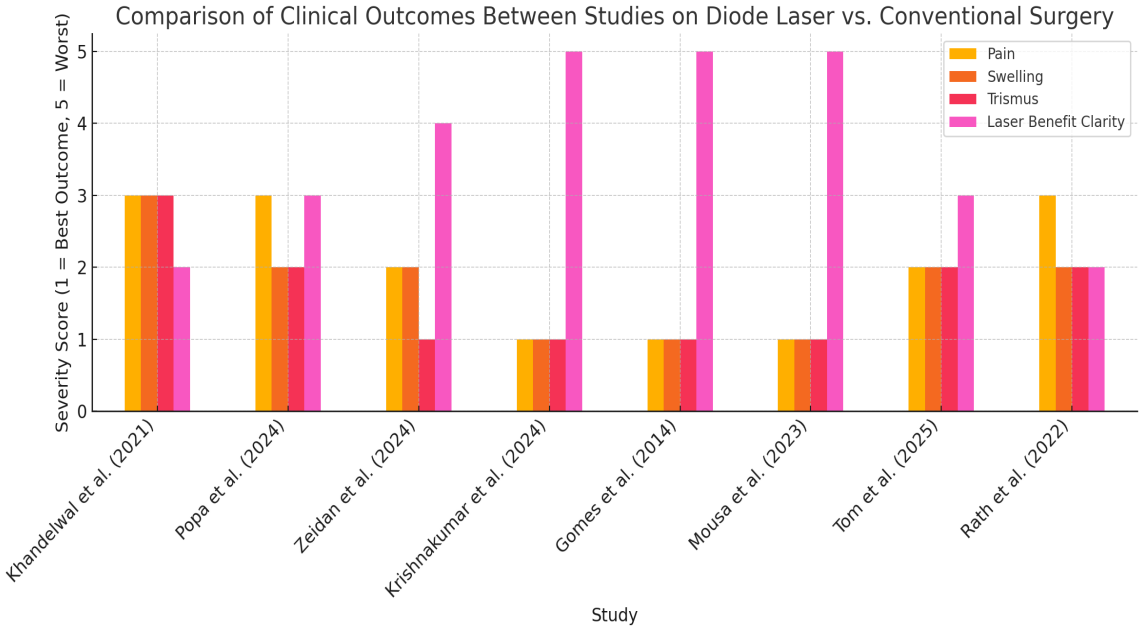

Figure 3. Assessment of comparison of diode laser and conventional techniques for treatment of impacted mandibular third molars. Severity scores correspond to postoperative variables—pain, swelling, trismus, and clarity of laser benefit—graded from 1 (favorable) to 5 (unfavorable).