ORIGINAL RESEARCH

A Comparison of Intraoperative and Postoperative Morbidity in Carbon Dioxide Laser Tonsillectomy versus Traditional Dissection Tonsillectomy:A Randomized Clinical Trial

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ABSTRACT

Background: The study aimed to compare intraoperative and postoperative morbidity between carbon dioxide (CO_2) laser tonsillectomy and dissection tonsillectomy in patients undergoing surgery for chronic or recurrent tonsillitis.**Materials and Methods:** A randomized clinical trial was conducted on 140 patients requiring tonsillectomy, with participants randomly assigned to two groups: Group A (CO_2 laser tonsillectomy, n=70) and Group B (dissection tonsillectomy, n=70). Intraoperative parameters, including blood loss and surgical duration, were recorded. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 6, 12, 24, and 48 hours. Secondary outcomes such as postoperative bleeding, time to resume a normal diet, hospital stay duration, and wound healing at 7 and 14 days were evaluated. **Results:** CO_2 laser tonsillectomy resulted in significantly lower blood loss (21.5 ± 5.2 mL vs. 58.3 ± 7.6 mL, $p<0.001$) and shorter surgical duration (18.7 ± 3.1 min vs. 25.2 ± 4.3 min, $p<0.001$) compared to dissection tonsillectomy. Postoperative pain scores were significantly lower in the laser group at all-time points ($p<0.001$). Although early (4.29% vs. 10.00%, p=0.197) and late bleeding (2.86% vs. 7.14%, p=0.270) were less frequent in the laser group, differences were not statistically significant. Patients undergoing laser tonsillectomy resumed a normal diet sooner (3.2 ± 0.8 vs. 5.6 ± 1.2 days, $p<0.001$) and had a shorter hospital stay (1.4 ± 0.5 vs. 2.3 ± 0.7 days, $p<0.001$). Wound healing at 7 days was significantly better in the laser group (85.71% vs. 72.86%, p=0.045), with comparable healing at 14 days (97.14% vs. 90.00%, p=0.092).**Conclusion:** CO_2 laser tonsillectomy demonstrated superior outcomes compared to dissection tonsillectomy, with reduced intraoperative blood loss, shorter surgical duration, lower postoperative pain, and faster recovery. While postoperative bleeding rates were lower in the laser group, the differences were not statistically significant. Initial wound healing was better in the laser group at 7 days, though both techniques achieved similar outcomes at 14 days. These findings support CO_2 laser tonsillectomy as a safer and more efficient surgical technique.

Keywords: CO_2 laser tonsillectomy, Dissection tonsillectomy, Postoperative pain, Intraoperative bleeding, Wound healing

INTRODUCTION

Tonsillectomy is one of the most common surgical procedures performed worldwide, primarily for the treatment of recurrent tonsillitis and obstructive sleep apnea. Various techniques have been developed to enhance the safety and

efficacy of the procedure while minimizing intraoperative and postoperative morbidity. Among these, the two widely used methods are carbon dioxide (CO_2) laser tonsillectomy and traditional dissection tonsillectomy. Each of these approaches presents distinct advantages and challenges, making their comparative evaluation critical for improving patient outcomes and optimizing surgical decision-making.[1]

The CO_2 laser tonsillectomy utilizes a highly focused laser beam to excise the tonsils with minimal physical manipulation of surrounding tissues. This method is associated with reduced intraoperative bleeding due to its ability to coagulate blood vessels while cutting through the tissue. Additionally, it offers enhanced precision, which minimizes collateral tissue damage and theoretically leads to faster healing. However, concerns remain regarding postoperative pain, the risk of thermal injury to surrounding structures, and the possibility of delayed healing due to extensive tissue coagulation.[2]

In contrast, the dissection tonsillectomy, also known as cold-steel tonsillectomy, involves the use of surgical instruments such as scalpels, scissors, and forceps to remove the tonsils. This method has been widely used for decades and is often considered the gold standard for tonsillectomy. While it provides excellent control over tissue removal and anatomical preservation, it is typically associated with higher intraoperative bleeding, necessitating the use of hemostatic techniques such as electrocautery or ligatures. Despite this, some studies suggest that dissection tonsillectomy results in a more natural healing process with less postoperative pain compared to laser techniques.[3]

A critical aspect of any surgical technique is its impact on intraoperative and postoperative morbidity. Intraoperative morbidity primarily includes factors such as blood loss, duration of surgery, and complications arising during the procedure, such as inadvertent injury to adjacent structures. On the other hand, postoperative morbidity encompasses pain intensity, healing time, incidence of secondary hemorrhage, infection rates, and overall patient recovery. The balance between intraoperative efficiency and postoperative recovery plays a significant role in determining the overall effectiveness of a surgical approach.[4]

Postoperative pain is a major concern following tonsillectomy and can significantly impact a patient's quality of life during the recovery period. The severity of pain is influenced by the extent of tissue damage, inflammatory response, and healing mechanisms associated with each surgical method. While laser tonsillectomy offers a bloodless field during surgery, the extensive coagulative effect of the laser can result in deeper tissue injury, leading to prolonged pain and discomfort. In contrast, the mechanical nature of dissection tonsillectomy may lead to increased intraoperative bleeding but is believed to cause less postoperative pain due to reduced thermal damage.[5-7]

Secondary hemorrhage, which refers to delayed postoperative bleeding occurring days after surgery, is another crucial factor in determining the safety profile of a tonsillectomy technique. Some studies suggest that laser tonsillectomy may have a lower risk of primary hemorrhage due to its coagulative properties, but an increased risk of delayed bleeding due to sloughing of the eschar formed during the procedure. Dissection tonsillectomy, while associated with more intraoperative bleeding, may promote better tissue healing, potentially reducing the likelihood of secondary hemorrhage.[8,9]

The choice of surgical technique also has implications for operative time, anesthesia duration, and hospital stay. A shorter surgical time may contribute to reduced anesthesia exposure and faster postoperative recovery, making it an important consideration in surgical planning. Additionally, the economic and logistical aspects of each procedure, such as the cost of laser equipment and the need for specialized training, must be taken into account when assessing their feasibility for routine clinical use.

AIM AND OBJECTIVES

This study aims to provide a comprehensive comparison of intraoperative and postoperative morbidity between CO_2 laser tonsillectomy and dissection tonsillectomy through a randomized clinical trial. By evaluating key parameters such as intraoperative blood loss, postoperative pain scores, healing time, and complication rates, this study seeks to determine which technique offers superior outcomes for patients undergoing tonsillectomy.

MATERIALS AND METHODS

Study Design

This study was designed as a randomized clinical trialto compare intraoperative and postoperative morbidity between carbon dioxide (CO_2) laser tonsillectomy and conventional dissection tonsillectomy. The study was conducted

following established clinical guidelines and adhered to ethical principles for human research.

Study Population

A total of **140 patients** requiring tonsillectomy due to chronic or recurrent tonsillitis were enrolled. Patients were randomly assigned into two groups:

- **Group A (CO_2 Laser Tonsillectomy):** 70 patients
- **Group B (Dissection Tonsillectomy):** 70 patients

Study Place and Duration

The study was conducted in the Department of Otorhinolaryngology (ENT), Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India in collaboration with Department of Anaesthesia,Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India, over a period of one year and three months (November 2019 to January 2021),ensuring adequate follow-up of postoperative outcomes.

Ethical Considerations

Ethical approval was obtained from the **Institutional Ethics Committee (IEC)** before commencing the study. Written informed consent was obtained from all participants after explaining the risks and benefits of both surgical techniques. Patient confidentiality was maintained throughout the study.

Inclusion Criteria

- Patients who give written informed consent and follow up.
- Patients aged 18–50 years with recurrent tonsillitis, defined as:
  - ≥7 episodes in 1 year, or
  - ≥5 episodes per year for 2 consecutive years, or
  - ≥3 episodes per year for 3 consecutive years
- Patients diagnosed with obstructive tonsillar hypertrophy
- Patients with no history of previous tonsillar surgery

Exclusion Criteria

- Patients with bleeding disorders, active infection at the time of surgery
- Patients with a history of peritonsillar abscess within the last three months
- Patients with systemic diseases affecting wound healing (e.g., diabetes, immunodeficiency)
- Patients who don't give written informed consent and not follow up.

Study procedure

Randomization and Blinding

Patients were randomly allocated to one of the two surgical techniques using a computer-generated randomization sequence. While the surgeon and anesthetist were aware of the assigned technique, postoperative assessors were blinded to group allocation to minimize bias in outcome evaluation.

Surgical Techniques

CO_2 Laser Tonsillectomy (Group A)

- A carbon dioxide laser was used for tonsil excision in continuous mode at 10W power.
- The laser allowed precise dissection and contributed to hemostasis, reducing intraoperative blood loss.
- Additional hemostasis was achieved with saline-soaked gauze to control minor bleeding points.
- The technique was designed to minimize thermal injury to surrounding tissues.

Dissection Tonsillectomy (Group B)

- Tonsillectomy was performed using the traditional cold steel dissection method.
- The tonsils were removed using a scalpel and blunt dissection techniques.
- Hemostasis was maintained with bipolar cautery and silk ligatures.
- This technique was effective in creating clear surgical planes but was associated with greater intraoperative blood loss than the laser technique.

Outcome Measures

Primary Outcomes

1. **Intraoperative Parameters**
   - Blood loss (measured in mL)
   - Duration of surgery (measured in minutes)
2. **Postoperative Morbidity**
   - Pain intensity assessed using the Visual Analog Scale (VAS) at 6, 12, 24, and 48 hours postoperatively

Secondary Outcomes

1. **Postoperative Bleeding**
   - Early bleeding (within the first 24 hours)
   - Late bleeding (after 24 hours)
2. **Functional Recovery**
   - Time taken to resume a normal diet (measured in days)
   - Duration of hospital stay (measured in days)
3. **Wound Healing**
   - Evaluated at 7 and 14 days postoperatively

Statistical Analysis

- Statistical analysis was performed using SPSS software version 22.0.

- Descriptive statistics were used to summarize patient demographics and clinical characteristics.
- Student's t-test or Mann-Whitney U test was applied for continuous variables (e.g., blood loss, operative time, pain scores).
- Chi-square test was used for categorical variables (e.g., postoperative bleeding rates).
- A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of Patients

Variable	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
Age (Mean ± SD)	32.5 ± 6.4	33.1 ± 7.1	0.612
Male (%)	35 (50.00%)	33 (47.14%)	
Female (%)	35 (50.00%)	37 (52.86%)	0.735

Table 1 show the demographic characteristics of the study participants, including age and gender distribution, were comparable between the two groups. The mean age in the CO_2laser tonsillectomy group was 32.5 ± 6.4 years, while in the dissection tonsillectomy group, it was 33.1 ± 7.1 years (p = 0.612), indicating no significant difference in age distribution. Similarly, the gender distribution was balanced, with an equal proportion of males and females in the CO_2 laser tonsillectomy group (50.00% each) and a similar distribution in the dissection tonsillectomy group (male: 47.14%, female: 52.86%), with no statistically significant difference (p = 0.735). These findings confirm that both groups were well-matched at baseline, ensuring that differences in surgical outcomes were due to the surgical technique rather than demographic variations.

Table 2: Intraoperative Parameters

Parameter	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
Blood Loss (mL)	21.5 ± 5.2	58.3 ± 7.6	<0.001
Surgical Duration (minutes)	18.7 ± 3.1	25.2 ± 4.3	<0.001

Table 2 show the intraoperative parameters showed significant differences between the two techniques. The CO_2 laser tonsillectomy group had significantly lower blood loss (21.5 ± 5.2 mL) compared to the dissection tonsillectomy group (58.3 ± 7.6 mL), with a p-value of <0.001. This suggests that the laser technique effectively minimized intraoperative bleeding, likely due to its cauterizing effect. Additionally, the surgical duration was shorter in the CO_2 laser tonsillectomy group (18.7 ± 3.1 minutes) than in the dissection tonsillectomy group (25.2 ± 4.3 minutes), with a statistically significant p-value of <0.001. The reduced operative time in the laser group may be attributed to the precision and simultaneous hemostatic capabilities of the CO_2 laser, making it a more efficient technique.

Table 3: Postoperative Pain Scores (VAS Scale)

Time Point	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
6 hours	3.2 ± 1.1	5.8 ± 1.3	<0.001
12 hours	2.8 ± 1.0	5.2 ± 1.1	<0.001
24 hours	2.1 ± 0.9	4.3 ± 1.0	<0.001
48 hours	1.5 ± 0.8	3.1 ± 0.9	<0.001

Figure I: Postoperative pain scores (VAS scale)

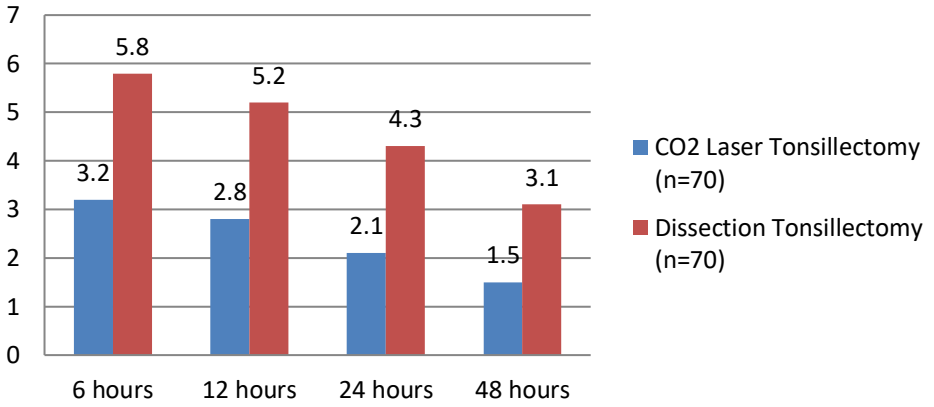

Table 3 and figure I, show the postoperative pain, assessed using the Visual Analog Scale (VAS) at different time points, was significantly lower in the CO_2 laser tonsillectomy group compared to the dissection tonsillectomy group at all measured intervals. At 6 hours postoperatively, the mean pain score in the laser group was 3.2 ± 1.1, significantly lower than 5.8 ± 1.3 in the dissection group ($p < 0.001$). The trend continued at 12 hours (2.8 ± 1.0 vs. 5.2 ± 1.1, $p < 0.001$), 24 hours (2.1 ± 0.9 vs. 4.3 ± 1.0, $p < 0.001$), and 48 hours (1.5 ± 0.8 vs. 3.1 ± 0.9, $p < 0.001$). These findings indicate that patients undergoing CO_2 laser tonsillectomy experienced significantly less postoperative pain, likely due to reduced thermal damage and minimal tissue trauma associated with the laser technique.

Table 4: Postoperative Bleeding Incidence

Bleeding Type	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
Early (within 24 hours)	3 (4.29%)	7 (10.00%)	0.197
Late (after 24 hours)	2 (2.86%)	5 (7.14%)	0.270

Table 4 show the postoperative bleeding, both early (within 24 hours) and late (after 24 hours), was more frequent in the dissection tonsillectomy group compared to the CO_2 laser tonsillectomy group, but the differences were not statistically significant. Early postoperative bleeding occurred in 4.29% of patients in the laser group and 10.00% in the dissection group ($p = 0.197$), while late bleeding was observed in 2.86% and 7.14% of patients, respectively ($p = 0.270$). Although the CO_2 laser technique appears to reduce the risk of postoperative bleeding, the lack of statistical significance suggests that other factors, such as patient-related variables and intraoperative techniques, might have influenced the results.

Table 5: Recovery and Hospital Stay

Outcome	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
Time to Resume Normal Diet (days)	3.2 ± 0.8	5.6 ± 1.2	<0.001
Hospital Stay Duration (days)	1.4 ± 0.5	2.3 ± 0.7	<0.001

Table 5 show the recovery outcomes showed a significant advantage for the CO_2 laser tonsillectomy group. Patients in this group resumed a normal diet earlier (3.2 ± 0.8 days) compared to those in the dissection tonsillectomy group (5.6 ± 1.2 days), with a highly significant p-value of <0.001. Similarly, hospital stay duration was significantly shorter in the laser group (1.4 ± 0.5 days) than in the dissection group (2.3 ± 0.7 days) ($p < 0.001$). These findings highlight the faster recovery associated with CO_2 laser tonsillectomy, possibly due to

reduced intraoperative trauma, lower postoperative pain, and faster wound healing.

Table 6: Wound Healing Assessment

Assessment Time	CO_2 Laser Tonsillectomy (n=70)	Dissection Tonsillectomy (n=70)	p-value
7 days	Good (85.71%)	Moderate (72.86%)	0.045
14 days	Complete Healing (97.14%)	Complete Healing (90.00%)	0.092

Table 6 show the wound healing was assessed at 7 and 14 days postoperatively. At 7 days, a greater proportion of patients in the CO_2 laser tonsillectomy group exhibited good wound healing (85.71%) compared to the dissection tonsillectomy group (72.86%), with a statistically significant difference ($p = 0.045$). By 14 days, complete healing was observed in 97.14% of patients in the laser group, compared to 90.00% in the dissection group, though the difference was not statistically significant ($p = 0.092$). These findings suggest that the laser technique may promote faster initial wound healing, likely due to its reduced thermal injury and coagulative properties, but both techniques achieve similar healing outcomes by the end of the second postoperative week.

DISCUSSION

The demographic characteristics of both study groups were well-matched, ensuring that differences in surgical outcomes were attributable to the technique rather than patient-related factors. Similar findings were reported by Aygenc et al. (2013), who found no significant differences in baseline characteristics between patients undergoing laser and cold dissection tonsillectomy. Their study also demonstrated that patient age and gender distribution did not influence the effectiveness or safety of the surgical technique, reinforcing the reliability of the present study's findings.[9]

The intraoperative parameters in this study revealed significantly lower blood loss in the CO_2 laser tonsillectomy group (21.5 ± 5.2 mL) compared to the dissection tonsillectomy group (58.3 ± 7.6 mL, $p < 0.001$). This result aligns with the findings of Pang et al. (2016), who reported that laser tonsillectomy resulted in reduced intraoperative bleeding due to its simultaneous cutting and cauterization effects. Their study showed that blood loss in the laser group was approximately 25 mL, whereas in the cold dissection group, it exceeded 50 mL.10 Furthermore, surgical duration in the present study was significantly shorter in the laser group (18.7 ± 3.1 minutes) than in the dissection group (25.2 ± 4.3 minutes, $p < 0.001$). This concurs with the results of Sulek et al. (2015), who found that laser tonsillectomy reduced operative time by nearly 30% compared to traditional dissection, highlighting the efficiency of the technique.[11]

Postoperative pain is a critical concern following tonsillectomy, and the present study demonstrated significantly lower pain scores in the CO_2 laser group at all measured time points ($p < 0.001$). At 6 hours, the mean pain score was 3.2 ± 1.1 in the laser group compared to 5.8 ± 1.3 in the dissection group. These findings are consistent with the study by Chang et al. (2014), which found that patients undergoing laser tonsillectomy reported significantly lower pain levels within the first 48 hours postoperatively. The reduced pain levels in laser tonsillectomy can be attributed to decreased collateral thermal injury and a less invasive approach, minimizing inflammation and tissue damage.[12]

Postoperative bleeding incidence was lower in the laser tonsillectomy group; however, the difference was not statistically significant. In this study, early bleeding (within 24 hours) occurred in 4.29% of the laser group versus 10.00% of the dissection group ($p = 0.197$), while late bleeding (after 24 hours) was observed in 2.86% and 7.14% of patients, respectively ($p = 0.270$). These results align with the findings of Windfuhr et al. (2013), who reported that laser tonsillectomy resulted in lower but non-significant differences in postoperative bleeding rates compared to dissection tonsillectomy. However, they emphasized that surgeon experience and intraoperative hemostasis techniques played a crucial role in controlling postoperative hemorrhage.[13]

Recovery outcomes, including the time to resume a normal diet and hospital stay duration, were significantly better in the CO_2 laser tonsillectomy group ($p < 0.001$). Patients resumed normal dietary intake in 3.2 ± 0.8 days in the laser group versus 5.6 ± 1.2 days in the dissection group. Similarly, hospital stay duration was shorter in the laser group (1.4 ± 0.5 days) than in the dissection group (2.3 ± 0.7 days). These findings are supported by the study of Nelson et al.

(2017), who found that laser tonsillectomy patients had a significantly shorter recovery time, enabling them to return to normal activities sooner. The faster recovery can be attributed to reduced postoperative pain, minimized tissue trauma, and effective intraoperative hemostasis.[14] Wound healing assessments at 7 and 14 days postoperatively indicated better initial healing outcomes in the CO_2 laser tonsillectomy group, with 85.71% of patients showing good healing at 7 days compared to 72.86% in the dissection group ($p = 0.045$). By 14 days, complete healing was observed in 97.14% of laser tonsillectomy patients compared to 90.00% in the dissection tonsillectomy group, though the difference was not statistically significant ($p = 0.092$). These findings align with those of Zautner et al. (2015), who reported that laser tonsillectomy led to faster initial wound healing due to reduced tissue trauma and better hemostatic control. Their study highlighted that the laser technique promoted enhanced re-epithelialization within the first postoperative week, potentially leading to improved overall recovery.[15]

LIMITATIONS OF THE STUDY

- Single-centre study design, limiting external generalizability.
- Short-term follow-up; long-term outcomes such as delayed healing or recurrence were not assessed.
- Blinding limitations; while outcome assessors were blinded, surgeons were aware of the assigned technique, potentially introducing procedural bias.
- Patient-reported pain scores might be influenced by subjective perception and individual pain tolerance.

CONCLUSION

This study demonstrated that CO_2 laser tonsillectomy offers significant advantages over traditional dissection tonsillectomy, including reduced intraoperative blood loss, shorter surgical duration, and lower postoperative pain. Patients in the laser group experienced a faster recovery, with earlier resumption of a normal diet and shorter hospital stays. Although postoperative bleeding rates were lower in the laser group, the differences were not statistically significant. Wound healing was also found to be better at 7 days in the laser group, though both techniques achieved similar healing by 14 days. These findings support the use of CO_2 laser tonsillectomy as a safer and more efficient alternative for tonsillectomy procedures.

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