Bangabandhu Sheikh Mujib Medical University Journal 2024;17(4):e76147 bsmmuj.org
ISSN 2074-2908 | eISSN 2224-7750 | © CC-BY-NC-4.0 | Open access doi: 10.3329/bsmmuj.v17i4.76147

RESEARCH ARTICLE

Effectiveness of laser tonsillectomy compared to conventional cold steel tonsillectomy in children

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ABSTRACT

Background: The Effectiveness of CO_2 laser tonsillectomy is not conclusively known. The current study aimed to determine its effectiveness compared to the cold steel dissection for tonsillectomy in children.

Methods: This interventional study was done in the Department of Otolaryngology of AL-Yarmouk Teaching Hospital, Baghdad, Iraq. It was done in 80 children eligible for tonsillectomy, evenly divided into cold steel dissection tonsillectomy (group A) and CO_2 laser tonsillectomy (group B). The surgical outcomes of the two groups were analysed for operative time, intra-operative blood loss, post-operative pain, bleeding, tonsillar fossae sloughing, and the time taken to return to daily activity.

Results: The CO_2 tonsillectomy group showed better effectiveness in terms of operative time (37.6 versus 19.5 min), intra-operative blood loss (42.7 versus 15.8 mL), postoperative pain at days 1, 7 and 14), and tonsillar bed sloughing (25.0% versus 32.5%). However, primary and secondary postoperative haemorrhages were similar between the groups.

Conclusions: Although the results are not generalisable, the CO_2 laser tonsillectomy was more effective than the cold steel dissection tonsillectomy.

Keywords: *tonsillectomy, CO_2 laser tonsillectory, cold steel dissection*

INTRODUCTION

Tonsillectomy is the most common otolaryngological surgery performed in children, and various techniques have been used for many years.[1] Recent research has explored several procedures, including CO_2 laser, thermal welding, micro-debride, and radiofrequency tonsillectomy techniques, often comparing them with the traditional cold steel dissection procedure.[2]

Conventional tonsillectomy techniques are often linked with many notable morbidities, such as intraoperative blood loss, postoperative pain (linked with painful swallowing), and post-operative haemorrhage. These complications can significantly impact patient health, recovery quality, and the time needed to return to normal daily activities. Additionally, these issues increase the healthcare burden and hospital costs.[3]

Several studies have explored alternative operative techniques alongside the conventional cold steel method to reduce these complications.[3] The CO_2 laser tonsillectomy appeared as one of the potential candidate options. However, its superiority in mitigating complications and morbidities has yet to be proved.[4] Further investigation is needed to determine whether laser tonsillectomy is preferable to conventional techniques. The current study aimed to determine the effectiveness of CO_2 laser tonsillectomy regarding intra-operative blood loss and operative time, and post-operative pain, bleeding, tonsillar bed sloughing, and time required to resume daily activity.

Received: 12 Sep 2024 | **Revised version received:** 22 Oct 2024 | **Accepted:** 22 Oct 2024 | **Published online:** 10 Nov 2024
Responsible Editor: M Mostafa Zaman | **Reviewer E:** Helal Uddin Ahmed; **F:** Nasima Akhtar

HIGHLIGHTS

1. CO_2 laser and conventional tonsillectomy techniques are used for tonsillectomy now a days.
2. CO_2 laser tonsillectomy was associated with shorter operative time, lesser intra-operative bleeding, post operative pain and early return to daily activities than traditional tonsillectomy technique.
3. Therefore, the CO_2 laser tonsillectomy technique is more effective than the conventional cold steel tonsillectomy.

METHODS

Study setting and participants

An interventional study was conducted in the Department of Otolaryngology of AL-Yarmoul Teaching Hospital, Bagdad, Iraq. All potential participants underwent a thorough medical history review, a precise otolaryngological examination, and appropriate investigations to ensure an accurate diagnosis.

Eighty eligible children (aged 3-12 years) with chronic tonsillitis undergoing tonsillectomy were included based on the Paradise criteria,[5] a set of guidelines used to determine the appropriate indications for tonsillectomy in children. The exclusion criteria were a history of adenoidectomy, bleeding disorders, concurrent maxillofacial surgery, and the presence of a cleft lip or palate. Forty of them were assigned randomly to group A (who underwent the cold steel tonsillectomy) and forty to group B (who underwent the laser tonsillectomy) by the same surgical team.

After obtaining the necessary approval from the Institutional Ethics Committee, consent was obtained from each patient's guardian. The purpose of the study was explained to all guardians, along with counselling on the nature, benefits, and possible complications of the surgical techniques. They were assured of the confidentiality of the collected data, which would be used exclusively for this study.

Surgical procedures

The same surgical team performed both procedures under general anaesthesia. All safety and precautionary measures were strictly observed.

A. Cold steel dissection: In the rose position, a blunt dissector was used to dissect both tonsil tissues from the tonsil bed until homeostasis was secured by ligating the inferior pole.

B. CO_2 laser tonsillectomy: This procedure was performed using a CO_2 laser beam in continuous mode at 18 watts with a circular dot of size 2.0 mm. The laser beam was applied to separate the tissue of each tonsil from its bed, producing energy at a wavelength of 10.6 nm.

Ascertainment of variables

1. Operative time (mins): This was measured from the beginning of the mucosal incision to securing complete hemostasis.

2. Intra-operative blood loss: Blood loss was calculated by measuring the blood collected in the suction bottle and the blood absorbed by soiled cotton balls and gauze. The process was as follows: all soiled and unsoiled cotton balls and gauze were weighed together on a physical balance. The difference in weight was recorded as the amount of blood lost in the cotton/gauze, which was then converted into millilitres by dividing the weight by the specific gravity of blood (1.055).

   The weight of blood absorbed in cotton/gauze is calculated as follows: Let y represent the weight of unused cotton balls and x represent the weight of blood-soaked cotton swabs. The weight of the blood loss in the cotton is calculated as x-y. To find the volume of the blood lost, this weight difference is divided by the specific gravity of blood (1.055), giving the quantity of blood absorbed in the cotton/gauze as (x-y) /1.055 mL. For blood in the suction bottle, let z represent the total amount of fluid (blood + known quantity of saline) collected in the suction bottle, with a known amount of saline used being 150 mL. The quantity of blood in the suction bottle is, therefore, z-150mL. The total intra-operative blood loss is then calculated by summing the blood in the suction bottle and the blood absorbed in the cotton and gauze, resulting in the

formula: (x–y)/1.055+(z–150)(x - y) mL. This formula provides a comprehensive measure of blood loss by including both sources—the soaked cotton/gauze and the fluid collected in the suction bottle.[6]

After surgery, patients were followed for 21 days to assess the following:

3. Post-operative haemorrhage: Primary haemorrhage is defined as bleeding from the tonsillar fossa occurring within 24 hours after surgery. Secondary haemorrhage is defined as bleeding from the tonsillar fossa occurring within 24 hours and 14 days post-surgery.[7]
4. Postoperative pain was measured using the Wong-Baker FACES pain scale for children under 7 years old[8] and the Visual Analogue Score (VAS) for children over 7 years old.[9] Pain assessment was done on postoperative days 1, 3, 7, 14, and 21.
5. Tonsillar bed sloughing as final evaluation done on the 14th day.
6. Return to daily activity was assessed in days.

Statistical analysis

Data analysis was conducted using Statistical Package for Social Science (SPSS) version 25. Descriptive statistics included the mean and standard deviation (SD) for continuous variables and frequency and percentages for categorical variables. The Mann-Whitney U or *t* test was used, as appropriate, to compare the means between the two groups. A chi-square test was used to compare the categorical variables between groups A and B. $P<0.05$ was considered statistically significant.

RESULTS

The children were on average, 7 years old; half were boys, and most were from urban areas. The two groups had no significant differences regarding age, sex, and residence locations **(TABLE 1)**.

Group A had a longer operative time (37.6 min vs 19.5 min, $P<0.001$) and greater intraoperative blood loss (42 mL vs 15.5 mL, $P<0.001$) than group B **(TABLE 2)**.

TABLE 1 Demographic characteristics of 80 children who underwent tonsillectomy, n (%)

Characteristics	Group A (Cold steel technique) (n=40)	Group B (CO_2 laser technique) (n=40)	*P*
Preschool age (<6 years)	12 (30.0)	14 (35.0)	
School-age (≥6 years)	28 (70.0)	26 (65.0)	0.603
Boys	20 (50.0)	17 (42.5)	0.654
Urban residence	34 (85.0)	35 (87.5)	0.99

Primary post-operative haemorrhage (5% versus 0%, $P=0.49$) and secondary postoperative haemorrhage (2.5% versus 5%, $P=0.99$) were statistically similar between the groups. Post-operative pain, however, was not conclusive. The pain on days was higher in group A on days 1, 7 and 14 ($P<0.05$) but similar on other days. The tonsillar bed sloughing was similar (25% versus 32.5%) between groups ($P=0.62$). However, the resumption of daily activities was shorter (7.1 days versus 3.2 days) in group B ($P=0.001$).

TABLE 2 Comparison of cold steel and CO_2 laser tonsillectomy surgeries in 80 children with chronic tonsillitis[a]

Clinical data	Group A (Cold steel technique) (n=40)	Group B (CO_2 laser technique) (n=40)	*P*
Operative time, min	37.6 (9.0)	19 .5 (6.3)	<0.001
Intra-operative blood loss, mL	42.7 (17.6)	15.8 (10.4)	<0.001
Primary postoperative haemorrhage, n (%)	2 (5.0)	0 (-)	0.49
Secondary postoperative haemorrhage, n (%)	1 (2.5)	2 (5.0)	0.99
Post-operative pain			
Day 1	8.8 (0.8)	6.2 (0.7)	0.02
Day 3	7.3 (0.8)	7.4 (0.7)	0.83
Day 7	3.4 (0.5)	1.8 (0.8)	<0.001
Day 14	2.6 (0.5)	0.3 (0.6)	<0.001
Day 21	0.3 (0.3)	0.6 (1.4)	0.44
Tonsillar bed sloughing, n (%)	10 (25.0)	13 (32.5)	0.62
Resume daily activity, days	7.1 (0.9)	3.2 (1.1)	<0.001

[a]Results are mean (standard deviation) unless indicated otherwise.

DISCUSSION

We report here that the CO_2 laser tonsillectomy procedure for children is superior to the conventional cold steel dissection. This finding is in concordance with another study.[4]

The operation time period

This study found a significant reduction in intraoperative time in the laser tonsillectomy group, aligning with the results from other studies.[4, 10, 11] The shortened duration of surgery in laser tonsillectomy may be due to the laser's ability to simultaneously dissect tonsillar tissue and coagulate small blood vessels, thereby decreasing the time needed for hemostasis. This surgical method is linked to improved blood clotting, resulting in a shorter operation time. In contrast, conventional tonsillectomy involves blunt dissection, which can cause more extensive injury to tonsillar tissue and blood vessels in the tonsillar bed. This increases tissue damage and bleeding within the tonsillar fossa, making hemostasis more time-consuming.[12] The decreased operative time observed in the laser group potentially reduces complications associated with anaesthesia and surgical site infections. This is especially important for pediatric patients, who face a higher risk of intraoperative complications due to their lower blood volume[13] and increased soft tissue trauma. Additionally, a short surgery duration can help alleviate parental anxiety.

Pain

The pain in the conventional tonsillectomy technique is primarily due to the extensive manipulation and stretching of tonsillar tissue. Yet, the sense of pain caused by thermal injury is more in the laser group. The temporary desensitisation effect of the laser beam on nerve endings lowers pain sensation in initial post-operative days, resulting in relatively equal pain scores between the groups in the early postoperative days.[14]

The differential use of analgesics might have impacted the pain data. Kumar A *et al.*[4] reported that laser tonsillectomy was associated with a significant reduction at day 7. A study by Ghiyali VS *et al.*[14] reported that pain scores on postoperative days 1, 3, and 5 were significantly reduced in the laser group. However, a study by Atiyah JR[15] found that pain was more significantly associated with laser tonsillectomy at two weeks, affecting 82% of the laser group compared to 11% of the dissection group, attributing this to thermal injury. Aldamluji N[16] found that a lowered sense of pain assists oral intake initiation earlier in the laser group. Similarly, a study by Martine MA and Chowdhury MA[17] found that the laser technique was less painful than cold steel tonsillectomy. The advantage of lowering the sense of pain associated with laser tonsillectomy is that it not only provides patient relief but also improves oral intake, which can minimise the danger of dehydration, infection, and secondary haemorrhage.

Tonsillar bed sloughing

In the current study, laser-induced thermal injury may have contributed to sloughing in the tonsillar bed; however, this was not statistically significant. Similar results were reported by Martin MA and Chowdhury MA[17] study. Kumar *et al.* also reported similar results.[4]

Bleeding

Tsikopoulos A. *et al.*[18] reported that CO_2 laser tonsillectomy is more likely to result in a clinical lowering in operative time and blood loss than the conventional dissection technique. Additionally, they found that a shorter duration of post-operative discomfort and a quicker return to daily activities after laser tonsillectomy could provide a socioeconomic advantage.

Conclusion

We acknowledge that the generalisability is limited because of its small sample size and representativeness. Moreover, the two procedures were not done on either side of the same patient. Acknowledging these limitations, we conclude that the CO_2 laser tonsillectomy technique is more effective in terms of intra-operative blood loss, operative time, post-operative pain, and time to return to daily activity than the conventional cold steel tonsillectomy technique.

Acknowledgments

We acknowledge with thanks the support provided by the colleagues of the Department of Otolaryngology of our hospital.

Author contributions

Conception and design: MRD, MQMR. *Acquisition, analysis, and interpretation of data:* MRD, MQMR. *Manuscript drafting and revising it critically:* MRD, MQMR. *Approval of the final version of the manuscript:* MRD, MQMR. *Guarantor of accuracy and integrity of the work:* MRD, MQMR.

Funding

We did not receive any funds for this study.

Conflict of interest

We do not have any conflict of interest.

Ethical approval

The institutional ethics committee of AL-Yarmouk Teaching Hospital, Baghdad, Iraq, approved the study protocol, vide its Memo number 275 dated 2 January 2024.

Data availability statement

We confirm that the data supporting the findings of the study will be shared upon reasonable request.

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