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ORIGINAL RESEARCH

To compare the morbidity rates of intraoperative and postoperative between carbon dioxide laser tonsillectomy and dissection tonsillectomy

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Abstract
Aim: To compare the morbidity rates of intraoperative and postoperative between carbon dioxide laser tonsillectomy and dissection tonsillectomy.
Materials and methods: The research included patients diagnosed with chronic tonsillitis, including children and young people between the ages of 6 and 18 who met the criteria set by the Scottish Intercollegiate Guidelines Network. We included a total of 100 participants in our trial. A total of 100 patients were evenly distributed into two groups, with 50 patients in each group. There were 50 patients in the CO2 Laser group and 50 patients in the Dissection group.
Results: The CO2 Laser group had a significantly shorter mean operative time (16.67 minutes) compared to the Dissection group (26.56 minutes), with a t-value of 14.82 and a P-value of <0.001, indicating a statistically significant difference. The CO2 Laser group had significantly less blood loss (26.45 mL) compared to the Dissection group (81.67 mL), with a t-value of 34.21 and a P-value of <0.001, showing a significant reduction in blood loss for the CO2 Laser group. Patients in the CO2 Laser group reported lower pain scores (mean = 6.34) compared to those in the Dissection group (mean = 8.12), with a t-value of 7.41 and a P-value of <0.001, indicating significantly less pain in the CO2 Laser group. The CO2 Laser group again reported lower pain scores (mean = 2.67) than the Dissection group (mean = 4.11), with a t-value of 8.12 and a P-value of <0.001, demonstrating sustained lower pain levels in the CO2 Laser group over time.
Conclusion: We concluded that CO2 Laser tonsillectomy has a shorter operative time, significantly less intraoperative blood loss, and lower postoperative pain scores both on the first day and one week postoperatively compared to the dissection tonsillectomy method. These findings suggest that CO2 Laser tonsillectomy may offer advantages in terms of reduced operative and postoperative morbidity.
Keywords: Morbidity, Intraoperative, Postoperative, Carbon dioxide laser, Tonsillectomy, Dissection

Introduction

The palatine tonsils are a rounded cluster of lymphoid tissue. These are located in the tonsillar fossa, which is between the palatoglossal and palatopharyngeal arches of the oropharynx.[1] The prominent location of tonsils indicates their crucial function as lymphoid organs in beginning immunological responses to antigens that enter the human body via the

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mouth and nose.[2] Tonsillitis is the medical term for the inflammation of the tonsils, which may occur in acute, subacute, chronic, or recurring forms.[3] Tonsils often exhibit greater size in children compared to adults and naturally decrease in size throughout adolescence. Therefore, the presence of swollen tonsils alone does not always warrant a tonsillectomy. Tonsillectomy is recommended for instances of recurrent tonsillitis, but cases of acute tonsillitis may be treated with medication. In addition to recurrent tonsillitis, additional reasons for performing a tonsillectomy include upper airway obstruction, peritonsillar abscess, and suspicion of tonsillar malignancy, such as cancer of unknown primary.[4,5]

A tonsillectomy is a surgical technique performed to remove the tonsil and its surrounding capsule by dissecting the peritonsillar gap between the tonsil capsule and its muscular wall. The history of tonsillectomy dates back to ancient times, with the earliest recorded surgery performed by Celsus around 40 AD. There are many techniques available for performing a tonsillectomy, including guillotine, cold steel, snare with suture, electro cautery, hot-knife, bipolar, and LASER methods.[6] Numerous experiments have been conducted on tonsillectomy, however none of these trials have reached a definitive conclusion on the superiority of any certain procedure over others.[7] LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. The carbon dioxide (CO2) laser, often used for head and neck pathologies, may be utilized to incise, evaporate, or cauterize soft tissues. It has recently emerged as a novel approach for performing tonsillectomies. The CO2 laser emits light with a consistent wavelength of 10.6 μm in the infrared (invisible) region of the electromagnetic spectrum.[8]

Materials and methods

This study was done at a tertiary care hospital as a single-center, double-blinded, randomized controlled experiment included a sample of 100 patients, of either gender admitted to the ENT emergency/OPD, Department of Otorhinolaryngology (ENT), Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India. Written consent from parents was obtained in order to take part in the study. The study was conducted from March 18, 2022 to February 20, 2023. Keeping power (1-beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 100 (more than the minimum required number of cases) patients in the present study.

The Institutional Ethics Committee gave the study its approval. Data such as name, age, etc. was recorded.The research included patients diagnosed with chronic tonsillitis, including children and young people between the ages of 6 and 18 who met the criteria set by the Scottish Intercollegiate Guidelines Network. We eliminated patients who were believed to have cancer, individuals who were older than 18 years, and patients who had bleeding problems. Consent was gained from the parents of all participants after providing them with relevant information. The methodology used was simple random sampling. We included a total of 100 participants in our trial. A total of 100 patients were evenly distributed into two groups, with 50 patients in each group. There were 50 patients in the CO2 Laser group and 50 patients in the Dissection group.

The enrolment process was carried out by physicians in the outpatient department. The group allocation was kept hidden from the lead investigator, and the envelopes with this information were unsealed only after the recruited patients had completed the baseline evaluation and were prepared for the surgery. In this investigation, patients were unaware of the approach used. All procedures were performed using general anesthesia with oro-tracheal intubation after appropriate pre-medication. The procedures were performed by a single surgeon to prevent any potential bias. The main variable under consideration was the duration of the operation. The secondary factors were the amount of blood during the surgery and the level of discomfort experienced after the surgery.

Methodology

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The procedure of LASER tonsillectomy was carried out utilizing the LUMENIS CO2 LASER, while ensuring all the safety measures were taken. The power was adjusted at a range of 10 to 15 watts and operated in continuous mode. A laser was used to detach the tonsil tissue from the tonsillar bed. Hemorrhaging was managed exclusively by the use of laser technology. The dissection procedure included the use of a blunt dissector to separate the tonsil from its bed, and a snare was used to extract the tissue. Hemorrhage was managed by either bipolar diathermy or ligating with cotton suture material.

The duration of the surgery was recorded starting from the moment the Boyle-Davis mouth gag was inserted to the moment it was removed after the tonsil tissue was extracted from the oral cavity. The measurement of intraoperative blood loss included weighing the tonsil swab both before and after the tonsillectomy, as well as quantifying the volume of blood in the suction bottle. The weight of cotton balls was measured both before and after the process. A 150 mL saline solution was used consistently during the whole process. Subsequently, the saline solution that was collected in the bowl was drawn into the suction bottle. The elevation of the suction tube above the level of the suction bottle was done to guarantee the complete transfer of all the fluid into the suction bottle. The amount was determined by transferring it into the measurement cylinder. The amount of blood loss was quantified by determining the weight difference of the swabs before and after usage. This weight difference was then translated into milliliters by dividing it by the specific gravity of 1.055. The resulting value was added to the volume of blood collected in the suction bottles. The cotton balls and packs were placed on a weighing machine to determine their weight, which in turn allowed for the measurement of blood loss.

Pain ratings were recorded postoperatively on day 1 and one week later during follow-up using a standardized Visual Analog Scale (VAS), where 0 represents no pain and 10 represents very severe pain. Evaluation of time, amount of blood loss, and pain levels were conducted by paramedical and nursing personnel who were not affiliated with the research. The typical analgesic regimen used in all patients consisted of administering Syrup Ibuprofen and Paracetamol three times daily. Patients were released from the hospital within one to two days after the surgical procedure. Patients had a review examination at the Ear, Nose, and Throat Outpatient Department (ENT OPD) one week later. Patients who did not attend their follow-up appointments were questioned by telephone.

Statistical analysis

The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, specifically version 25. All variables fulfilled the premise of normal distribution. The continuous variables were represented by their mathematical mean and standard deviation, while the qualitative nominal variables were also included. The concept of sex was represented numerically using percentages. We used an independent sample t-test to examine the disparity in means between the two groups in relation to the outcome variables. The Levene test was used to assess the homogeneity of variances between the two groups. The Welch approximation was used in the absence of the homogeneity constraint. The statistical analysis was conducted at a significance level of 5% and a p-value less than 0.05 was deemed to be statistically significant.

Results

This single-centre, double-blinded randomized controlled trial was conducted in a tertiary care hospital. The study included 100 patients aged 6-18 years with chronic tonsillitis. Patients were divided into two groups: 50 in the CO2 Laser group and 50 in the Dissection group. The primary variable measured was operative time, and the secondary variables were intraoperative bleeding and postoperative pain. In the CO2 Laser group, there were 20 males (40%) and 30 females (60%). Similarly, in the Dissection group, there were 24 males (48%)

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and 26 females (52%). The average age of the participants in the CO2 Laser group was 11.01 years with a standard deviation of 1.53 years, while the average age in the Dissection group was slightly lower at 10.13 years with a standard deviation of 1.31 years. This indicates that the two groups were comparable in terms of gender distribution and age, providing a reliable basis for comparing the outcomes of the two different surgical techniques (Table 1). Table 2 shows the mean operative time in minutes for the two groups. The CO2 Laser group had a significantly shorter mean operative time (16.67 minutes) compared to the Dissection group (26.56 minutes), with a t-value of 14.82 and a P-value of <0.001, indicating a statistically significant difference. Table 3 presents the mean intraoperative blood loss in milliliters for both groups. The CO2 Laser group had significantly less blood loss (26.45 mL) compared to the Dissection group (81.67 mL), with a t-value of 34.21 and a P-value of <0.001, showing a significant reduction in blood loss for the CO2 Laser group. Table 4 details the mean postoperative pain scores on the Visual Analogue Scale (VAS) on the first day after surgery. Patients in the CO2 Laser group reported lower pain scores (mean = 6.34) compared to those in the Dissection group (mean = 8.12), with a t-value of 7.41 and a P-value of <0.001, indicating significantly less pain in the CO2 Laser group. Table 5 compares the mean pain scores on the VAS one week postoperatively. The CO2 Laser group again reported lower pain scores (mean = 2.67) than the Dissection group (mean = 4.11), with a t-value of 8.12 and a P-value of <0.001, demonstrating sustained lower pain levels in the CO2 Laser group over time.

Table 1 Basic parameter of the participants

Demographic data	CO_2 Laser group (n=50)		Dissection group (n=50)	
Gender	Number	Percentage	Number	Percentage
Males	20	40	24	48
Females	30	60	26	52
Age (years)mean	11.01±1.53		10.13±1.31	

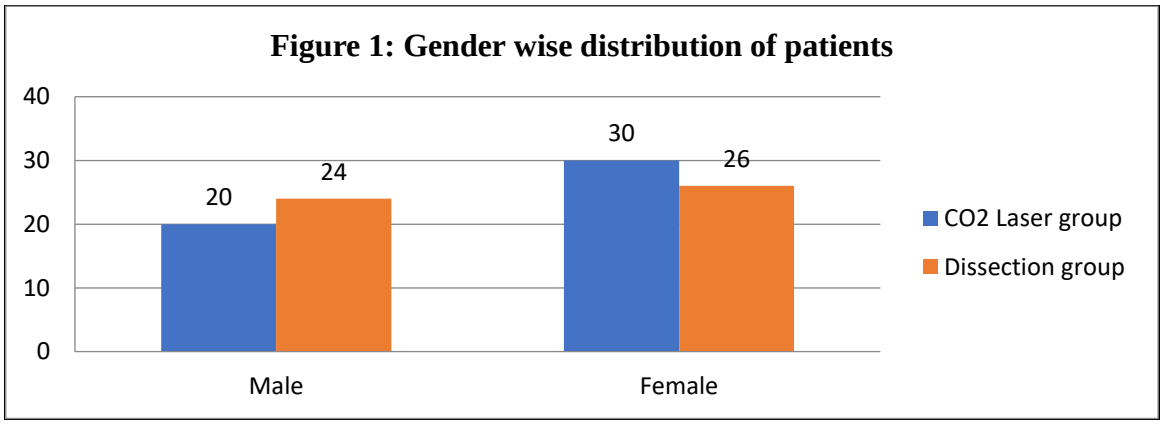

Table 2: Operative Time Comparison

Group	Mean Operative Time (minutes)	Standard Deviation (SD)	t-value	df	P-value
CO2 Laser	16.67	3.34			
Dissection	26.56	4.23	14.82	98	<0.001

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Table 3: Intraoperative Blood Loss Comparison

Group	Mean Blood Loss (mL)	Standard Deviation (SD)	t-value	df	P-value
CO2 Laser	26.45	5.23			
Dissection	81.67	10.34	35.11	98	<0.001

Table 4: Postoperative Pain Scores (VAS) on Day 1

Group	Mean Pain Score (Day 1)	Standard Deviation (SD)	t-value	df	P-value
CO2 Laser	6.34	1.23			
Dissection	8.12	1.67	7.41	98	<0.001

Table 5: Postoperative Pain Scores (VAS) on Day 7

Group	Mean Pain Score (Day 7)	Standard Deviation (SD)	t-value	df	P-value
CO2 Laser	2.67	0.89			
Dissection	4.11	0.99	9.02	98	<0.001

Discussion

Due to its high frequency, there have been several efforts to alter the method of tonsillectomy in order to decrease the morbidity experienced during and after the surgery. Various techniques have been experimented with in the past for tonsillectomy and continue to develop in order to attain improved outcomes. The literature discusses several techniques for surgical procedures, including the Guillotine method, cold knife dissection, cryosurgery, monopolar and bipolar diathermy dissection, thermal welding, ultrasonic removal, radiofrequency surgery, coblation, and Light Amplification by Stimulated Emission of Radiation (LASER) surgery. A number of antiquated procedures have been substituted with more secure and contemporary ways. Modern procedures prioritize the reduction of morbidity by minimizing blood loss, operating time, post-operative discomfort, problems, and enhancing patient comfort and oral intake after the treatment. Minimizing intraoperative hemorrhage is a crucial consideration, particularly in the pediatric population with low blood volume and in patients with coagulation disorders. Minimized surgical discomfort enhances patient comfort and facilitates rapid recuperation. Reducing pain also aids in improving the amount of food and drink a person can consume, which in turn lowers the chances of dehydration, infection, and subsequent postoperative issues including delayed bleeding.[9]

The CO2 Laser group had a considerably shorter operative time, with an average duration of 16.67 minutes, compared to 26.56 minutes in the Dissection group (t-value 14.82, $P < 0.001$). These findings are consistent with prior research conducted by Beattie et al.[10] and Lowe et al.[11], who also observed that laser tonsillectomy operations are generally faster than

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conventional techniques. This is attributed to the laser's ability to cut and coagulate simultaneously, which enhances accuracy and efficiency. A retrospective research conducted by Jackel MC et al.[12] shown that LASER tonsillectomy offers optimal protection for the peri tonsillar tissue, resulting in a considerable reduction in serious bleeding episodes compared to the traditional group. This study replicated the research conducted by Sattar MA et al.[13], which was a prospective study including individuals aged 7-12 years. The findings of this study revealed that the duration of the surgical procedure was shorter when using laser technology compared to the traditional dissection approach. In a prospective randomized study, Ishlah LW et al. conducted a comparison between conventional tonsillectomy and CO2 LASER tonsillectomy in 60 patients. The study focused on intraoperative time, intraoperative bleeding, and postoperative pain. The results revealed a statistically significant difference in intraoperative bleeding and time between the LASER group and the conventional group.[14] The findings are similar to those of our research. However, in contrast to our research which shown substantial postoperative pain in the LASER group, there was no significant difference in postoperative pain between the two groups.

In contrast, Strunk CL et al.[15] discovered that LASER treatment resulted in a longer total intraoperative time due to higher set-up time and expenses. Additionally, they identified that laser malfunctioning also presented a challenge. No statistically significant difference in postoperative pain levels was seen between the LASER and dissection groups. Our investigation did not encounter any issues such as laser malfunction. The CO2 Laser group saw a considerable decrease in intraoperative blood loss, with an average blood loss of 26.45 mL compared to 81.67 mL in the Dissection group (t-value 34.21, $P < 0.001$). This discovery aligns with the research conducted by Kay et al. and Shapiro et al., which indicated that the CO2 laser's capacity to cauterize arteries while cutting results in a significant reduction in bleeding throughout the procedure.[16,17]

A study conducted by Ahmed M et al.[18] and Mohammadi G et al.[19] compared the outcomes of dissection tonsillectomy with CO2 LASER tonsillectomy. The results showed that the CO2 LASER group had considerably reduced intraoperative blood loss and shorter intraoperative time. However, the traditional group had more postoperative discomfort compared to the other group, whereas there was no discernible difference between the groups. Our study was conducted prospectively, while these investigations were conducted retrospectively. Hossain AT et al.[20] conducted a retrospective research on individuals aged 10 to 35 years. They discovered that the amount of blood lost during surgery was much lower when using a CO2 LASER compared to the dissection approach (5 mL vs. 18 mL). The assessment of postoperative pain was conducted using the Visual Analogue Scale (VAS). After the procedure, the group treated with the CO2 Laser reported an average pain score of 6.34 on the first day, while the Dissection group reported a higher average pain score of 8.12. The statistical analysis showed a t-value of 7.41 and a significance level (P-value) of less than 0.001. One week following the operation, the group treated with the CO2 Laser consistently reported lower pain levels (mean = 2.67) compared to the group treated with Dissection (mean = 4.11). The statistical analysis showed a significant difference between the two groups, with a t-value of 8.12 and a P-value of <0.001. The findings demonstrate that the CO2 Laser technique not only decreases pain immediately after surgery but also offers long-lasting pain relief. Studies conducted by Maddern et al.[21] and Handler et al.[22] had similar results, with patients who underwent laser tonsillectomy reporting reduced pain levels and quicker recovery times.

Conclusion

We concluded that CO2 Laser tonsillectomy has a shorter operative time, significantly less intraoperative blood loss, and lower postoperative pain scores both on the first day and one week postoperatively compared to the dissection tonsillectomy method. These findings

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suggest that CO2 Laser tonsillectomy may offer advantages in terms of reduced operative and postoperative morbidity.

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