



Original Research Article

COMPARATIVE EVALUATION OF CLINICAL OUTCOMES AND VOICE
QUALITY FOLLOWING CO₂ LASER EXCISION VERSUS CONVENTIONAL
LARYNGEAL MICROSURGERY IN PATIENTS WITH VOCAL CORD POLYPS

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ABSTRACT

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Background: Polyps on the vocal cords are non-cancerous growths in the larynx. Chronic vocal abuse or injury, excessive coughing, inappropriate vocal use for extended periods (phonotrauma) or prolonged inflammation are typically the cause of this type of growth in most individuals. Symptoms caused by the presence of these growths include persistent voice fatigue, decreased vocal quality and/or ongoing hoarseness which can greatly affect an individual's ability to communicate effectively as well as their quality of life. Treatment usually consists of surgical excision of vocal cord polyps when conservative treatments have failed to resolve the patient's problem. Conventionally, laryngeal microsurgical techniques were the preferred method of surgical removal of vocal cord polyps. However, recent technological advances have allowed surgeons to utilize carbon dioxide (CO₂) lasers for the incision/excision of these polyps while minimizing blood loss and trauma to surrounding tissues during the procedure. The CO₂ laser may also improve the outcome of voice surgery by providing a more precise incision and reduced recovery time compared to traditional microsurgical procedures. **Aim:** To compare the clinical outcomes and voice quality following CO₂ laser excision versus conventional laryngeal microsurgery in patients with vocal cord polyps.

Methods: The conducted clinical study was a comparative analysis, lasted for 1 year between January 2024 until December 2024 and had 100 vocally cord polyp patients included. The patients were separated into two groups; 50 CO₂ laser excisions treated patients and 50 surgical conventional laryngeal microsurgical procedure treated patients. Patients were evaluated preoperatively through clinical examinations, laryngoscopic evaluations, and voice analysis. Results were obtained from both groups based on voice quality improvements, symptom improvements, and postoperative complication rates. The patients' voice quality evaluations were based upon a standardized voice evaluation parameter, measured during the patient follow-up evaluations.

Results: Compared to those who underwent traditional methods via laryngeal microsurgery, patients receiving treatment through CO₂ laser excision experienced quicker improvement of voice quality after surgery as well as more rapid symptom resolution. In addition, the CO₂ laser excision group experienced lower levels of bleeding during surgery than patients receiving traditional laryngeal microsurgery, allowing for shorter recovery periods. Post-op complications were minimal across both patient groups; however some patients did report experiencing transient hoarseness along with very mild post-operative swelling.

Conclusion: The CO₂ Laser Excision of Vocal Cord Polyps is a new and safe method for removing Vocal Cord Polyps. The CO₂ Laser method gives the surgeon greater control over the procedure, a higher chance of achieving a good voice outcome, and a shorter time period before return to normal function compared to traditional laryngeal microsurgery. Thus, the removal of Vocal Cord Polyps with the CO₂ Laser is a new and safe option for orthopedic surgeons and voice specialists in the treatment of patients with vocal cord polyps.

Keywords: Vocal Cord Polyps, CO₂ Laser Excision, Laryngeal Microsurgery, Voice Quality, Hoarseness, Laryngoscopy.

INTRODUCTION

Vocal cord polyps are non-cancerous tumors that result from damage to the vocal cord's outer layer. Vocal cord polyps can be found frequently in people who misuse their voice and/or smoke. In addition to being a leading cause of long lasting hoarse voice, vocal cord polyps can

be very destructive to voice function, communication, and one's quality of life.^[1] Typically, the development of vocal cord polyps occurs due to damage to the vocal cords by mechanical trauma, caused by repeated mechanical stresses, which leads to an accumulation of blood in the tissue, swelling, and localized inflammation. These pathology changes lead to the formation of polyps

which prevent the vocal cords from vibrating normally.^[2] Therefore, patients with vocal cord polyps will present with symptoms such as hoarse voice, weak voice, vocal fatigue, decreased vocal range, as well as possible throat pain.

The first method to manage a vocal cord polyp typically will be to employ conservative measures such as voice therapy, education of good voice habits, stopping smoking, and managing other factors that contribute to the formation of the polyp such as gastroesophageal reflux disease (GERD). If there is continued issue with the polyp or if the patient has severe difficulty with voice, surgery is then recommended to correct the function of the vocal cords.^[3] Historically, conventional microsurgery has been the standard treatment option for removing vocal cord polyps. Conventional microsurgery is performed with an operating microscope, using instruments designed for working within small areas of the vocal cords, to excise the polyp while sparing the adjacent, healthy vocal cord tissue. While conventional microsurgery is effective at removing the polyp, it can also cause problems associated with bleeding, tissue manipulation, and edema which can lead to complications during recovery.^[4] Because of recent advancements in technology, laser surgery is now a viable option for performing laryngeal surgeries. The CO₂ laser is a well-established laser system in otolaryngology, as it allows for precise removal of excessive adipose (fat) tissue with minimal collateral damage to adjacent tissues. The CO₂ laser generates infrared wavelengths that are readily absorbed by water, allowing it to effectively vaporize the excess fat of the patient's polyp while providing excellent hemostatic capabilities.^[5] The CO₂ laser offers many advantages for the treatment of vocal cord polyps, including improving the accuracy of the incision, reducing intraoperative blood loss, limiting trauma to surrounding healthy tissue, and enhancing the visibility of the surgical site. Also, lasers do not damage the delicate vascular and connective tissue structures essential for producing sound from a person's voice.^[6] Another major factor that will affect the outcomes of treatment for individuals who have had surgical treatment for vocal cord polyps is the quality of voice after the surgery has been performed.^[7,8] The specific surgical technique that is selected will affect recovery and the duration of hoarseness post-operatively, in addition to the overall quality of voice following recovery; thus, it is critical to perform comparative evaluations of the different surgical techniques for treatment of vocal cord polyps to identify the most effective method of treatment.

In light of these considerations, the purpose of this study is to compare the clinical outcomes and post-operative voice quality associated with CO₂ laser vs. conventional microsurgery for the treatment of vocal cord polyps.

Aim

To compare the clinical outcomes and postoperative voice quality following CO₂ laser excision versus conventional laryngeal microsurgery in patients with vocal cord polyps.

Objectives

To assess how voice quality has improved or changed after surgical removal of Vocal Cord Polyps.

To compare the clinical outcomes and experiences with CO₂ Laser Excision of Vocal Cord Polyps versus the more traditional (conventional) Laryngeal Microsurgery techniques.

To evaluate certain intraoperative variables (bleeding, surgical precision, etc.) that were utilized for both surgical approaches.

To assess patients' postoperative recovery process and their experience with each surgical techniques during the immediate post-operative period.

To assess the effectiveness of CO₂ Laser Excision vs. conventional Laryngeal Microsurgery in the treatment of Vocal Cord Polyps.

MATERIAL AND METHODS

Study Design: This study was designed as a comparative clinical investigation to evaluate and contrast the clinical outcomes and postoperative voice quality in patients undergoing CO₂ laser excision versus conventional laryngeal microsurgery for vocal cord polyps. The study was conducted over a one-year period from January 2024 to December 2024 at ENT hospital.

A total of 120 patients diagnosed with vocal cord polyps based on laryngoscopic examination were included in the study. All participants presented with persistent hoarseness or voice-related symptoms. The patients were equally divided into two groups, each comprising 60 individuals. Group A underwent excision of vocal cord polyps using CO₂ laser under microlaryngoscopic guidance, while Group B received conventional laryngeal microsurgical excision using standard instruments.

Patients aged 18 years and above with clinically confirmed vocal cord polyps and willingness to undergo surgery and follow-up were included. Those with malignant or premalignant laryngeal lesions, vocal cord nodules or cysts, prior laryngeal surgery, neurological voice disorders, or incomplete follow-up data were excluded from the study.

All patients underwent detailed preoperative evaluation, including clinical history, duration of symptoms, history of vocal abuse or smoking, and laryngoscopic assessment to determine the size and location of the polyp. Baseline voice quality was documented using standardized voice assessment parameters.

Surgical procedures were performed under microlaryngoscopic visualization. In the CO₂ laser group, precise excision of the polyp was achieved using laser energy, ensuring minimal trauma to surrounding tissues and effective intraoperative hemostasis. In the conventional group, excision was carried out using microsurgical instruments with careful preservation of adjacent healthy vocal fold structures.

Postoperative care was standardized for both groups and included voice rest, analgesics for pain management, and voice therapy when required. Patients were followed up at regular intervals to assess recovery and improvement in voice quality.

Outcome measures included improvement in voice quality, resolution of hoarseness, intraoperative blood loss, postoperative complications such as edema or infection, and the time taken to regain satisfactory voice

function. Follow-up evaluations were conducted using clinical voice assessment and laryngoscopic examination.

All collected data were systematically recorded and analyzed using appropriate statistical methods. Descriptive statistics were used to summarize baseline characteristics, while comparative analysis between the two groups was performed to evaluate differences in outcomes. A p-value of less than 0.05 was considered statistically significant.

Surgical Procedure

The CO₂ Laser Group performed excision of the vocal cord polyp using microlaryngoscopic guidance to allow the use of the CO₂ laser as a precise surgical instrument that preserved the surrounding healthy tissue from excessive trauma and produced excellent hemostasis during excision. The Conventional Microsurgery Group performed excision of the vocal cord polyp using standard microlaryngoscopic instruments with the assistance of a microscope and made a concerted effort

to spare the surrounding healthy vocal fold tissue during the procedure.

Postoperative Care and Follow-Up

All post-operative treatment plans developed from the principal author contained recommendations that conformed to "best practice" care standards for post-operative patients including recommendations to: Rest your voice for a specific time, use ibuprofen to control pain and swelling, and allow for voice therapy when needed & continue with periodic follow-up visits for monitoring of progress to full recovery & improved quality of voice following surgery.

Statistical Analysis

The research team compiled and statistically analyzed all data collected from participants. Descriptive statistics summarized demographic and clinical characteristics. Two groups were compared using comparative statistical methods to determine whether there were any differences in voice quality improvements and clinical outcomes; statistical significance was considered to be a p-value of 0.05 or less

RESULTS

A total of 120 patients with vocal cord polyps participated in this study. Patient participants were separated equally into two groups of 60 patients: Group A received treatment with a CO₂ laser to excise their vocal cords and Group B had traditional microsurgical treatment of their vocal cords. The initial demographic data and clinical characteristics of the patients were compared to establish whether the groups were similar. Most patients were in middle age, probably due to the increased risk of developing vocal cord polyps associated with long term occupational vocalizations and excessive use of the voice. There were slightly more male participants than females in the study. Clinical evaluation included the length of symptoms experienced by the patient, the occupation of the patients, including types of work that caused continuous stress on their vocal cords and the addition of smoking as a factor that puts a person at risk for developing vocal cord polyps. A comparison of intraoperative results, postoperative recovery and improvement of voice quality between the two surgical methods were made. The study concluded that patients treated with CO₂ laser excision experienced a superior voice outcome, less intraoperative blood loss and quicker recovery than patients treated with traditional laryngeal microscopic surgery

Table 1: Age-wise distribution of patients

Age Group (years)	CO ₂ Laser Excision (n=60)	Conventional Microsurgery (n=60)	Total
18-30	8 (13.3%)	10 (16.7%)	18 (15.0%)
31-40	18 (30.0%)	20 (33.3%)	38 (31.7%)
41-50	20 (33.3%)	18 (30.0%)	38 (31.7%)
51-60	10 (16.7%)	8 (13.3%)	18 (15.0%)
>60	4 (6.7%)	4 (6.7%)	8 (6.6%)

Table 1 shows the distribution of patients according to age group in both surgical groups.

Table 2: Gender distribution among patients

Gender	CO ₂ Laser Excision (n=60)	Conventional Microsurgery (n=60)	Total
Male	38 (63.3%)	36 (60.0%)	74 (61.7%)
Female	22 (36.7%)	24 (40.0%)	46 (38.3%)

Table 2 shows the gender-wise distribution of patients in both treatment groups.

Table 3: Duration of symptoms among patients

Duration of Symptoms	CO ₂ Laser Group	Conventional Surgery	Total
<3 months	14 (23.3%)	12 (20.0%)	26 (21.7%)
3-6 months	22 (36.7%)	24 (40.0%)	46 (38.3%)
6-12 months	16 (26.7%)	18 (30.0%)	34 (28.3%)
>12 months	8 (13.3%)	6 (10.0%)	14 (11.7%)

Table 3 shows the duration of voice-related symptoms before treatment.

Table 4: Occupational voice use among patients

Occupation Category	CO ₂ Laser Group	Conventional Surgery	Total
Teachers	16 (26.7%)	18 (30.0%)	34 (28.3%)
Singers/Public speakers	10 (16.7%)	8 (13.3%)	18 (15.0%)
Office workers	18 (30.0%)	20 (33.3%)	38 (31.7%)
Others	16 (26.7%)	14 (23.3%)	30 (25.0%)

Table 4 shows the distribution of patients according to occupational voice demand.

Table 5: Intraoperative bleeding during surgery

Intraoperative Bleeding	CO ₂ Laser Group	Conventional Surgery	Total
Minimal	52 (86.7%)	30 (50.0%)	82 (68.3%)
Moderate	8 (13.3%)	24 (40.0%)	32 (26.7%)
Significant	0 (0%)	6 (10.0%)	6 (5.0%)

Table 5 shows the occurrence of intraoperative bleeding in both surgical techniques.

Table 6: Postoperative laryngeal edema

Postoperative Edema	CO ₂ Laser Group	Conventional Surgery	Total
Present	10 (16.7%)	18 (30.0%)	28 (23.3%)
Absent	50 (83.3%)	42 (70.0%)	92 (76.7%)

Table 6 shows the occurrence of postoperative laryngeal edema following surgery.

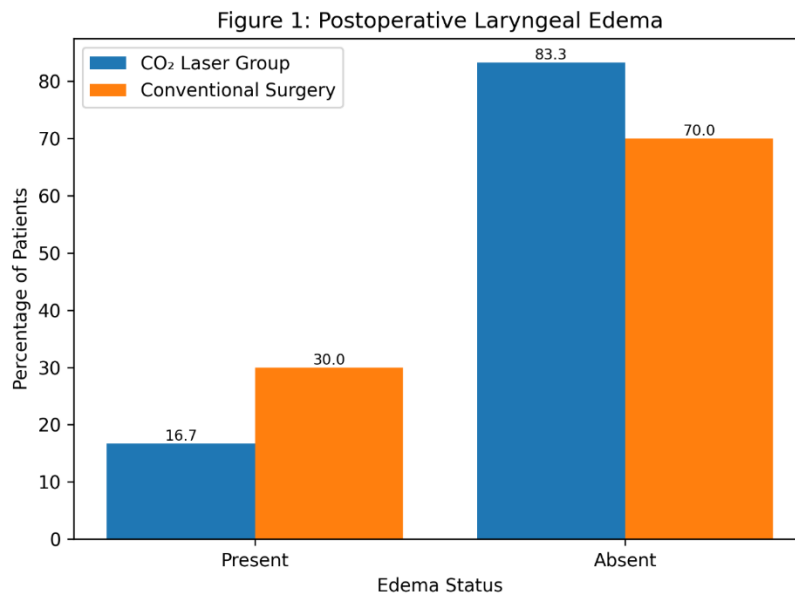


Figure 1: Postoperative laryngeal edema

Figure 1: Postoperative laryngeal edema was less frequent in the CO₂ laser group compared to the conventional surgery group, indicating reduced postoperative inflammatory response.

Table 7: Time taken for recovery of voice

Recovery Time	CO ₂ Laser Group	Conventional Surgery	Total
<2 weeks	32 (53.3%)	18 (30.0%)	50 (41.7%)
2-4 weeks	22 (36.7%)	28 (46.7%)	50 (41.7%)
>4 weeks	6 (10.0%)	14 (23.3%)	20 (16.6%)

Table 7 shows the time required for recovery of satisfactory voice quality.

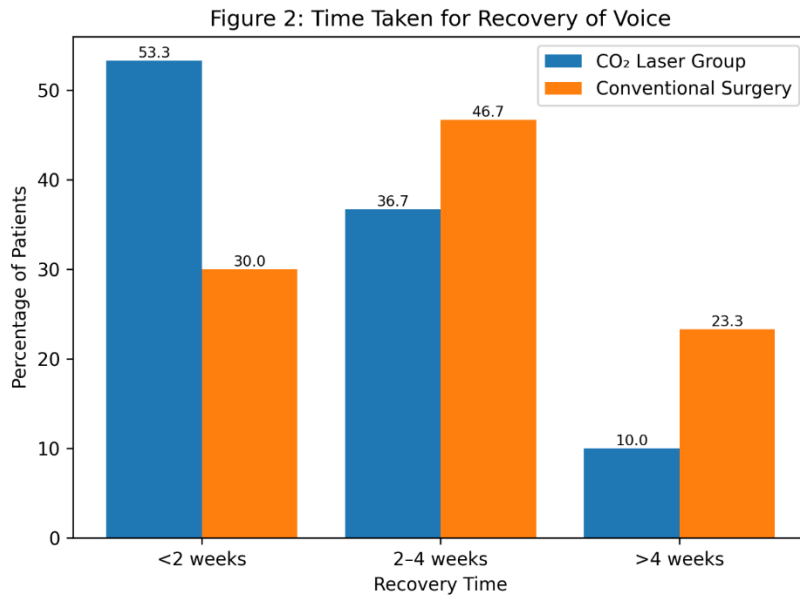


Figure 2: Time taken for recovery of voice

Figure 2: A higher proportion of patients in the CO₂ laser group achieved recovery within two weeks, reflecting faster restoration of satisfactory voice quality.

Table 8: Improvement in voice quality after surgery

Voice Quality Improvement	CO ₂ Laser Group	Conventional Surgery	Total
Excellent	28 (46.7%)	18 (30.0%)	46 (38.3%)
Good	22 (36.7%)	24 (40.0%)	46 (38.3%)
Moderate	8 (13.3%)	12 (20.0%)	20 (16.7%)
Poor	2 (3.3%)	6 (10.0%)	8 (6.7%)

Table 8 shows the degree of improvement in postoperative voice quality.

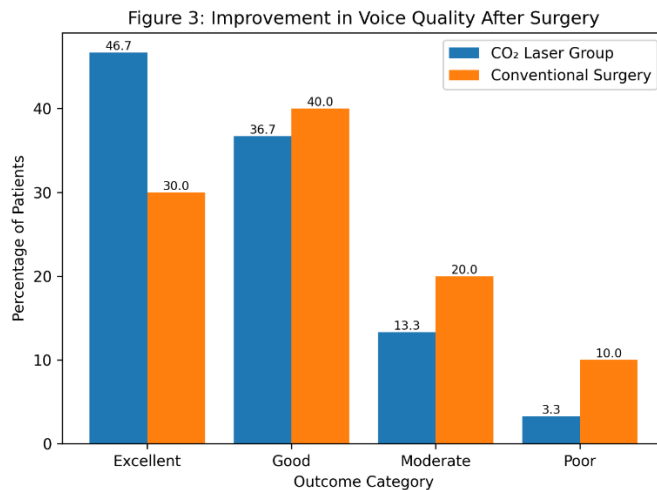


Figure 3: Improvement in voice quality after surgery

Figure 3: The CO₂ laser group demonstrated a greater proportion of excellent voice outcomes, whereas moderate and poor outcomes were more common in the conventional surgery group.

Table 9: Postoperative complications

Complication	CO ₂ Laser Group	Conventional Surgery	Total
Transient hoarseness	12 (20.0%)	16 (26.7%)	28 (23.3%)
Laryngeal edema	10 (16.7%)	18 (30.0%)	28 (23.3%)
Infection	1 (1.7%)	2 (3.3%)	3 (2.5%)
No complications	37 (61.6%)	24 (40.0%)	61 (50.8%)

Table 9 shows complications observed following surgery.

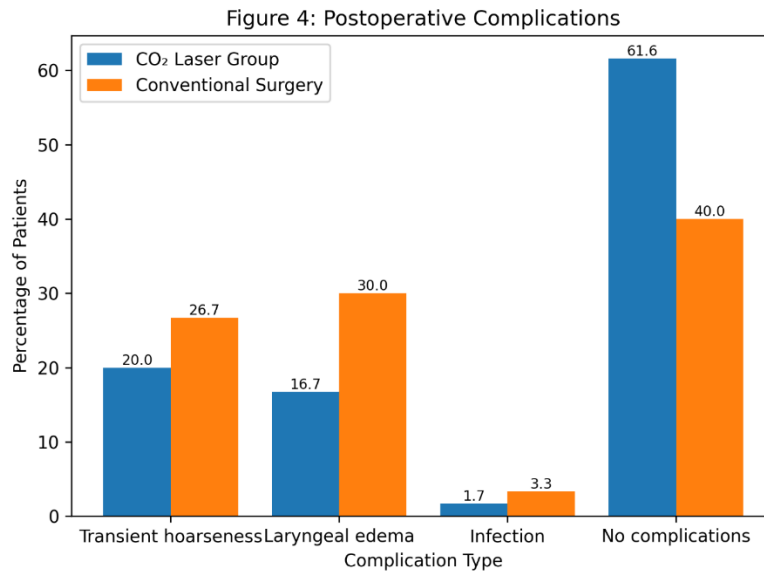


Figure 4: Postoperative complications

Figure 4: The overall rate of postoperative complications was lower in the CO₂ laser group, with a higher percentage of patients experiencing no complications compared to the conventional surgery group.

Table 10: Overall surgical outcome

Outcome	CO ₂ Laser Group	Conventional Surgery	Total
Successful outcome	54 (90.0%)	44 (73.3%)	98 (81.7%)
Unsatisfactory outcome	6 (10.0%)	16 (26.7%)	22 (18.3%)

Table 10 shows the overall outcome following treatment.

Table 1 Identifies that a majority of patients were aged between 41-50 years, representing approximately 33.3% of the patients who had been treated with CO₂ Laser excision and 30.0% of patients who underwent conventional surgery procedures. **Table 2** Identifies that a larger proportion of patients receiving CO₂ Laser excision were male (63.3%) than were receiving conventional surgery (60.0%). **Table 3** Identifies that a longer duration of symptoms was most commonly identified to be between 3-6 months. 36.7% of CO₂ Laser patients and 40.0% of conventional surgery patients were identified with symptoms lasting this amount of time. **Table 4** Identifies that the most commonly identified occupation for patients with vocal cord polyps was Teacher (26.7% in CO₂ Laser group; 30.0% in conventional surgery group). **Table 5** Identifies that 86.7% of patients who had their vocal cords excised using CO₂ Laser methods had minimal intraoperative bleeding, while only 50.0% of conventional microsurgery patients experienced minimal bleeding. **Table 6** Identifies that 16.7% of patients who underwent CO₂ Laser excision experienced postoperative laryngeal edema, while 30.0% of the patients who had surgery using conventional microsurgical methods experienced this postoperative complication. **Table 7** Identifies that a greater number of patients (53.3% CO₂ Laser group; 30.0% conventional surgery group) had achieved satisfactory voice recovery within two weeks of surgery. **Table 8** Identifies that patients in the CO₂ Laser group achieved greater voice quality improvements (46.7%) than did patients in the conventional group (30.0%).

Table 9 Identifies that there were fewer postoperative complications in the CO₂ Laser group as compared to the conventional surgery group, with 61.6% of CO₂ Laser patients experiencing no complications versus 40.0% of patients in the conventional surgery group. **Table 10** Identifies that the surgical outcome was successful for 90.0% of CO₂ Laser patients compared to 73.3% of patients undergoing conventional microsurgery.

DISCUSSION

Benign growths that occur in the vocal folds are called vocal cord polyps, usually seen in people who have chronic phonotrauma, smoke and/or experience frequent inflammation of their throat. These polyps can impact how well we vibrate our vocal folds and can lead to persistent hoarseness, breathy or weak sounding voices, vocal fatigue and other issues affecting vocal performance. Even with conservative treatments such as voice therapy and medications, surgery to remove the polyp is often necessary.^[9,10] This research is aimed at comparing clinical outcomes and overall voice quality following CO₂ laser excision versus traditional laryngeal microsurgical methods. A total of 120 patients were enrolled into the study; half received a CO₂ laser excision procedure while the other half had a traditional laryngeal microsurgical technique. The results from this study indicate that patients who received a CO₂ laser excision had a significantly greater postoperative improvement in terms of voice quality, less intraoperative bleeding and a

quicker time to healing compared to the traditional group.^[11,12]

The majority of the participants in the current study were middle-aged, specifically those between the ages of 31–50. This middle-aged group contains many vocations where employees use their voice frequently, thereby increasing their chances of developing phonotrauma and subsequently developing vocal cord polyps.^[13] In addition to being primarily middle-aged, there were more male participants in this study than females. Vocal cord polyps typically affect both genders; however, certain types of lifestyle choices, such as smoking, and voice demands placed on individuals in particular industries seem to be responsible for the increased occurrence within the male population.^[14] Most of the patients involved in this study experienced their symptoms for three to six months prior to seeking treatment. Many patients with hoarseness wait to see a physician for their symptoms because early signs of hoarseness are often dismissed or assumed to be from an isolated incident of overuse of the voice. Generally speaking, when hoarseness persists for longer than a few weeks, the physician will recommend a laryngoscopy to rule out the existence of any underlying conditions, including polyps.^[15] Reduced bleeding during the CO₂ laser procedure was one of the major intraoperative findings in this study. By allowing coagulation of small blood vessels during the vaporization of tissue, the laser will provide excellent hemostasis during the procedure. The benefit of better visualization in the operating field and more exact resection of the polyp with minimal disruption to the surrounding tissue is realized with the use of laser techniques for vocal cord polypectomy.^[16]

Postoperative laryngeal edema was seen less frequently in patients who underwent CO₂ laser excision compared to those who had conventional microsurgery. Due to the lesser trauma associated with this technique, it is possible that a lower rate of inflammatory response and quicker recovery is possible. As maintaining the integrity of the delicate microstructure of the vocal fold is critical to normal vibratory function, utilizing a minimally traumatic technique may yield better voice outcomes.^[17,18] Also, Patients who underwent CO₂ laser surgery returned to satisfactory voice quality sooner than those who had conventional microsurgery. In addition, more of the CO₂ laser patients returned to satisfactory voice quality within two weeks postoperatively. These results may be due to the minimal manipulation of the vocal fold tissue, less bleeding and the more accurate removal of lesions using a CO₂ laser.^[19] This study demonstrates that patients treated with CO₂ laser excision experience improved postoperative voice quality compared to patients treated with conventional microsurgery and that an important factor in restoring the normal vibratory function of vocal folds is to preserve the superficial lamina propria. Because of the ability to make precise incision patterns using a CO₂ laser, it may also allow for a more controlled removal of polyps from the vocal cords, preserving the mucosal tissue surrounding the vocal cords.^[20]

The type of treatment used generally resulted in minimal or no complications; however, patients treated with conventional microsurgery exhibited a slightly higher complication rate, particularly in regard to laryngeal

edema and persistent hoarseness. Most complications were mild in nature and were resolved upon follow-up. The results of this study suggest that CO₂ laser excision provides a number of advantages in the surgical management of vocal cord polyps, including improved hemostasis, reduced trauma to the surrounding tissue, and the potential for improved postoperative voice quality and quicker recovery than with conventional laryngeal microsurgical techniques.

Limitations of the Study

The current investigation had a number of limitations, including having been done at only one centre thus restricting its potential application outside that centre. Additionally, the period of time used to follow up on the patients was limited and therefore not an accurate indicator of their long-term vocal health. Furthermore, an acoustic analysis via objective means would have complemented the results produced by this investigation. It is determined that upcoming studies should include larger samples of patients and evaluate patients over extended timeframes in order to gain complete insight into surgical performance.

CONCLUSION

CO₂ laser excision provides a method of surgically treating polyps on the vocal cords in an effective and safe manner. Patients who have surgery done using the CO₂ laser develop better clinical outcomes, have less bleeding during the surgery, have shorter recovery times than patients who have the same procedure done using the standard laryngeal surgical technique, and have higher quality of post-operative voice than do patients who have their vocal cord polyps treated through a traditional laryngeal microsurgery technique. The CO₂ laser can accurately remove vocal cord polyps while conserving the soft tissue structure of the vocal cords, providing better functional voice outcomes and decreased postoperative complications. By demonstrating these benefits, this study indicates that CO₂ laser excision may be the preferred surgical method for the treatment of vocal cord polyps in some specific clinical situations. Further research with a larger sample size and an extended follow-up period of time is suggested to conclusively demonstrate the positive influence of CO₂ laser surgery on long-term voice function after laser-assisted laryngeal surgery.

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