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CO_2 Laser Surgical Management of Laryngeal Diplegia in Adduction: A Series of 46 Cases

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ABSTRACT

Introduction: Bilateral vocal fold paralysis in closure (BVFP) can lead to suffocating respiratory distress, and various techniques for glottic enlargement have been developed in recent years to replace tracheotomy. Endolaryngeal surgery with CO2 laser has a central place in this therapeutic arsenal.

Objective: The aim of this study was to evaluate the effectiveness of our CO_2 laser treatment techniques for bilateral vocal fold paralysis (BVFP), assess the durability of long-term outcomes, and compare the rates of failure, complications and revision procedures by analyzing postoperative respiratory, phonatory, and swallowing functions.

Method: This is both a retrospective and prospective study on a series of 46 patients treated with CO2 laser either by subtotal arytenoidectomy (SA), or Dennis and Kashima or Reker posterior cordectomy (PC).

Results: The mean age was 56 years with 98% female. 44 patients presented with dyspneic BVFP secondary to thyroidectomy, total in 38 patients, and whose indication was a benign goiter in 82% of cases. Respiratory distress led to tracheotomy in 21 cases with an average delay of 10 months. Of these, 18 (85.71%) were successfully decannulated at a mean delay of 5.42 months after the first intervention. Postoperatively, the tracheostomized patients were decannulated on average 5 months later; the non-tracheotomized patients were successful after extubation with the disappearance of their dyspnea. The phonatory outcome was deemed satisfactory based on patients' subjective evaluation of their voice.. There were no postoperative false airways. Recurrence occurred mainly in patients who had undergone PC and had insufficient glottic expansion or cord regrowth with a return to the clinical presentation of laryngeal stenosis. The overall recurrence time was a maximum of 14 months.

Conclusion: Endolaryngeal laser surgery is better than external surgery with a lower cost than a simple tracheostomy. SA and PC are equally effective in improving the breathing of the BVFP patient, although PC often requires revision surgery to achieve definitive success, but in the long term the success rates are equivalent. Occurred mainly in patients who had undergone PC and had insufficient glottic expansion or cord regrowth with a return to the clinical presentation of laryngeal stenosis. The overall recurrence time was a maximum of 14 months.

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Introduction

Laryngeal diplegia in adduction, or bilateral vocal cord paralysis (BVCP), by reducing the glottic lumen, obstructs the larynx and generates permanent laryngeal dyspnea (inspiratory bradypnea), often poorly tolerated, limiting both daily physical activity and work. It is therefore responsible for a disability and an important negative social impact.

It is manifested by a stridor with inspiratory dyspnea, the severity of which varies according to the position of the vocal cords (VC) s in relation to the glottic midline. The most frequent position is slightly lateral to the glottic midline (paramedian) [1]. It is a condition that, regardless of its cause, can be life-threatening and often requires surgical treatment to avoid acute asphyxia or chronic central airway obstruction [2].

Indeed, failure of recovery of mobility in at least one of the paralyzed vocal folds results in permanent bilateral vocal fold

paralysis and constitutes an indication for glottic enlargement surgery to improve respiration and prevent episodes of airway obstruction, which may be life-threatening and are often triggered by acute infectious events.

The goal of the treatment of BVCP is to obtain an adequate airway, while taking into account the complete laryngeal function, by preserving the sphincter function of the larynx and a satisfactory voice quality, which represents a challenge for the ENT surgeon. Therefore, the tendency towards less and less invasive surgery is obvious, and, at present, endoscopic surgery represents the great majority of the indications.

The evolution of endoscopic pharyngolaryngeal surgery has been closely linked to the introduction of laser technology. The CO_2 laser is currently the reference laser in laryngology.

Numerous surgical techniques have been recommended and consist of partial or total removal of the arytenoid or the vocal fold, the combination of both procedures is also possible. Some surgeons have also developed some techniques of latero-fixation of the vocal cord or the arytenoid [3].

Objective

In this work, we first review the various treatment options for bilateral vocal fold paralysis and their respective indications, before focusing on endoscopic CO_2 laser surgery. The physical principles of the CO_2 laser and its effects on living tissues are also discussed. We then examine the contribution of this technique through a review of the literature.

The primary objective of this study is to report our experience with endoscopic CO_2 laser surgery in the management of bilateral vocal fold paralysis in adduction and to evaluate the functional outcomes of patients treated in the Department of Otorhinolaryngology at the 20 August Hospital, Ibn Rochd University Hospital, Casablanca.

Methods

1-Type of Study

We conducted a two-step study: An exhaustive retrospective descriptive study in which the collection of medical information was done through anamnesis, exploitation of the medical file, and the operating protocol, using our exploitation form. And then a prospective descriptive study of the postoperative evolution of these patients with follow-up examinations to detect morphological and functional problems. The work has been reported in line with the PROCESS criteria.

2-Study Population

Between January 2014 and June 2022, 46 patients presenting with laryngeal diplegia in adduction have received a CO_2 laser treatment in our department. We included all the permanent laryngeal diplegias in adduction, of adults, whatever their etiology, but excluded every laryngeal paralysis associated with other laryngeal lesions, laryngeal paralysis secondary to malignant tumors of the larynx, Unilateral laryngeal paralysis, and laryngeal paralysis in children.

3- Patient Follow-up

All patients included in the study had a consultation at the time of the 1st admission and after CO_2 laser treatment, where a nasofibroscopy and stroboscopy were performed to determine ventilatory results by Arno Olthoff scale and phonatory results by the GRBAS-I scale and VHI 30.

4- Analysis Plan

The criteria for success and failure are exclusively respiratory; the success of the procedure was defined: as decannulation for tracheotomized patients and disappearance of dyspnea or its improvement for non-tracheotomized patients.

The criteria of failure were an impossible decannulation or absence of improvement of dyspnea.

5-Operative Technique

The operation is done under general anesthesia, after premedication (hydrocortisone – lidocaine), induction(oxygenation - propofol-curare) and maintenance of anesthesia with propofol infusion, The anesthesiologist initially carries out a normal intubation while the surgeon sets the laser and microscope with a tube that must be moistened and the balloon filled with saline (to lengthen the resistance time of the balloon to perforation), the balloon is protected by moistened absorbent cotton placed under the vocal cords and pushed as far as possible into the subglottis while avoiding selective intubation.

Then the ENT extubates the patient and exposes the larynx with the laryngoscope and places the suspension (LINDHOLM LARYNGOSCOPE) (fig 1). The anesthesiologist is monitoring the patient and warning the ENT if saturation drops to intubate the patient; protective measures in the operating room are taken.

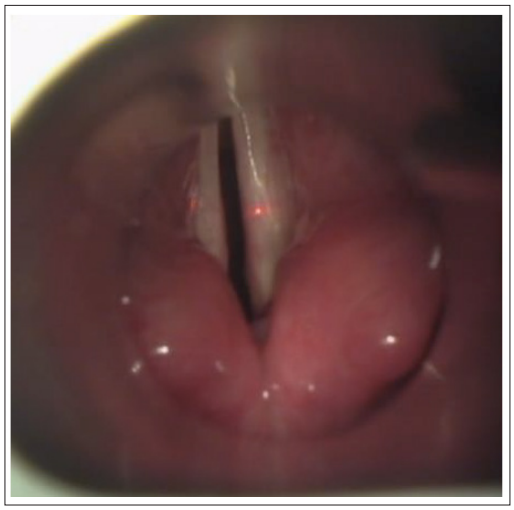

Figure 1: Surgically Exposed View of the Glottis and Vocal Cords

For the posterior cordectomy the laser is set to 5-10 W power, super pulse mode, very small spot size, then the incision is made at the front of the vocal process. The ENT proceeds to an excision of a triangle or a fragment of the membranous VC in a "U" shape just in front of the vocal process without stripping it (figure 2)

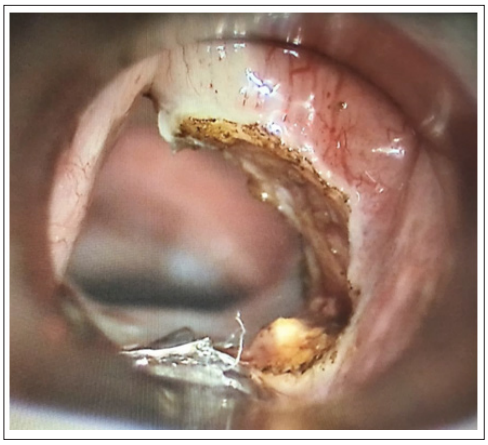

Figure 2: Final result of our Posterior Cordectomy

The arythenoidectomy Laser setting parameters are 5-6 W power, continuous mode, small spot. the incision is started at the front on the vocal process, then the surgeon proceeds to prolong the incision and resect half of the arytenoid except the posterior wall: The arytenoid is grasped with forceps, and the laser shot is focused on the cartilage. respecting the muscular apophysis. The cricoid is respected, and the arytenoid artery is coagulated if needed (fig3).

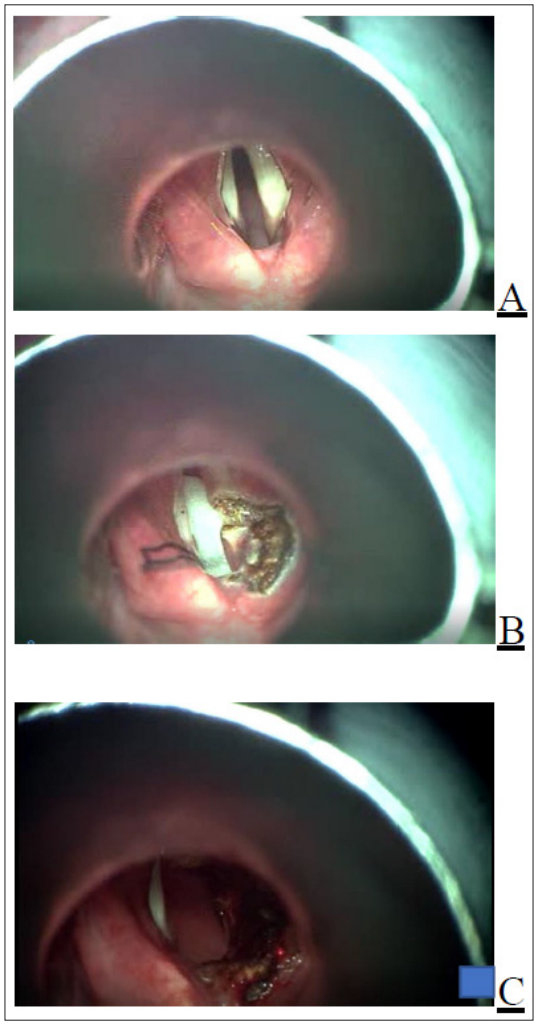

Figure 3: Intra-Operative Process pictures of our Arytenoidectomy. A- Pre-operative Exposed View of the Glottis. B-Per-Operative View of CO_2 Laser Incision. C- End Result Arytenoidectomy

At the end of the operation, a control with laryngoscopy is done to verify the glottic permeability, the absence of oedema, hemorrhage, blood clots, or foreign bodies.

6-Post-Operative

In the recovery room, the patient is maintained in a semi-recumbent position with close monitoring of respiratory status, including the detection of dyspnea and continuous pulse oximetry. Particular attention is paid to the early identification of subcutaneous emphysema. Humidified oxygen is administered via nasal cannula or face mask as needed, and appropriate analgesia is provided for pain control. All patients received postoperative adjuvant therapy comprising intravenous corticosteroids during the first 24 hours, two daily sessions of aerosolized methylprednisolone (20 mg diluted in isotonic saline) with upper airway humidification, followed by inhaled corticosteroids three times daily for 30 days. Amoxicillin–clavulanic acid (3 g/day) was started intraoperatively and continued for 10 days. Oral intake was resumed 6 hours after surgery with a soft, semi-liquid, non-hot diet.For tracheostomized patients, an attempt of decannulation is made during 1st post-operative appointment, which is 2 weeks post-op.

Postoperative rehabilitation focused on both respiratory and swallowing functions. It included locoregional relaxation exercises, respiratory training, pneumo-phonatory coordination, cervico-scapular relaxation, and techniques to facilitate effective expectoration.

7-Statistical Analysis

We used the Microsoft office-Excel 2021 version for the data entry and analysis of the files. All variables were numerically coded and could be analysed individually. All the files were included in the program and analysed.

Firstly, a descriptive analysis of the socio-demographic, clinical, etiological and therapeutic data was carried out. The quantitative variables were expressed in mean and standard deviation, and the qualitative variables in number and percentage. Then an analytical study was made to study the impact of the surgical treatment by CO_2 laser. We assessed the functional results subjectively and objectively. Prognosis was studied by the Kaplan Meier (survival curve). Statistical significance is defined as $p<0.05$.

Results

Forty-six patients were included in the study, of whom 97.8% were female. Age ranged from 27 to 92 years, with a mean age of 56.3 ± 13.2 years. Thyroidectomy was the predominant cause of bilateral vocal fold paralysis, accounting for 95.7% of cases. Histopathological examination revealed benign thyroid disease in 38 patients (82.6%) and malignant disease in 8 patients (17.4%). Twenty-one patients (45.7%) were not tracheostomized at the time of surgery (Table 1).

Table 1: Distribution of Surgical Technique According to Presence of Tracheotomy

	Posterior cordectomy= 37	Subtotal arytenoidectomy=9
Tracheotomized=21	15 - 32,61%	6 - 13,04%
Not trachotomized=25	22 - 47,83%	3 - 6,52%

Prior surgical treatment for bilateral vocal fold paralysis had been performed in five patients (10.9%) at another institution before presentation to our department. These procedures consisted of one cordopexy, one cordectomy, and three arytenoidectomies, including one combined arytenoidectomy and cordectomy.

Among the 46 patients treated using CO_2 laser surgery, 37 (80.4%) underwent posterior cordectomy and 9 (19.6%) underwent subtotal arytenoidectomy. The mean interval between the onset of paralysis and surgery was 28.3 months. Procedures were performed predominantly on the right side (23 cases) (Table 2).

Table 2: Distribution of Operated Side According to Surgical Technique

Operated side	Posterior cordectomy=37	Subtotal arytenoidectomy=9
Right=23	18 - 48,65%	5 - 55.56%
Left=12	9 - 24,32%	3 - 33.33%
Bilateral=11	10 - 27,03%	1 - 11.11%

Fourteen patients (30.4%) required a complementary glottic enlargement procedure. All had initially undergone posterior cordectomy. The mean time to revision was 5.4 months (SD = 4.37). Twelve patients (85.7%) underwent a complementary posterior cordectomy, whereas 2 patients (14.3%) underwent a complementary subtotal arytenoidectomy.

Among the 46 patients, long-term definitive success was achieved in 42 cases (91.3%). Four patients (8.7%) continued to experience respiratory difficulties; three remained tracheostomy-dependent, while one was successfully decannulated but still reported moderate exertional dyspnea. Of the 42 successful cases, 30 (71.4%) required only a single intervention without the need for revision surgery. Posterior cordectomy accounted for 35 of the successful cases (83.3%), whereas subtotal arytenoidectomy accounted for 7 (16.7%). Among the 35 successful posterior cordectomies, 12 (34.3%) required a revision procedure to achieve a satisfactory airway. In contrast, none of the patients treated with subtotal arytenoidectomy required revision surgery.

Among the 21 tracheotomized patients, 18 (85.7%) were successfully decannulated. Half of them required a revision procedure to achieve decannulation, and one of these patients continued to report moderate exertional dyspnea. The remaining 3 patients (14.3%) were still tracheostomy-dependent at follow-up.

Fifteen tracheotomized patients underwent posterior cordectomy. Of these, 12 (86.7%) were successfully decannulated, including 8 patients (53.3%) who required a revision procedure to achieve this outcome. Two patients remained tracheostomy-dependent despite revision surgery.

Six tracheotomized patients underwent subtotal arytenoidectomy. Five (83.3%) were successfully decannulated after the initial intervention, whereas one patient remained tracheostomy-dependent and had not yet undergone revision surgery at the time of follow-up.

The mean time to decannulation after the initial intervention was 5.42 ± 4.76 months. For patients requiring revision surgery, the mean time to decannulation following the revision procedure was 3.5 weeks (0.8 months) ± 2.79 weeks.

Twenty-five patients were not tracheotomized at admission. All of them (100%) achieved long-term definitive success. Only 4 patients (15.4%) required a revision procedure to attain this outcome, and all had initially undergone posterior cordectomy. All patients treated with subtotal arytenoidectomy achieved successful outcomes without the need for revision surgery.

Global Analysis of Long-Term Results

Based on the predefined success criteria, the overall long-term success rate after a single intervention without revision was 66.6%, according to Kaplan–Meier analysis, irrespective of the surgical procedure performed. No failures or revision procedures occurred beyond 14 months of follow-up (Table 3).

Table 3: Patients Global Mean Survival Time

Mean survival time (TIME<106)	Standard deviation	Lower bound (95%)	Upper bound (95%)
69.428	6.916	55.871	82.984

Comparison of success rates according to tracheostomy status using the log-rank test ($\alpha = 0.05$) revealed a statistically significant difference between the two groups ($p = 0.006$). Tracheotomized patients experienced a higher rate of failure than non-tracheotomized patients. The success rate after a single intervention was 83.2% in non-tracheotomized patients, compared with 47.1% in tracheotomized patients.

Kaplan–Meier analysis and the log-rank test showed no statistically significant difference in long-term success rates after a single intervention between the two surgical procedures (subtotal arytenoidectomy and posterior cordectomy) ($p = 0.14$). This lack of significance may be related to the limited number of patients who underwent subtotal arytenoidectomy ($n = 9$). The long-term success rates after a single intervention were 61.8% for posterior cordectomy and 87.5% for subtotal arytenoidectomy (Table 4).

Table 4: Patients Mean Survival Time According to Type of Intervention

Mean survival time (posterior cordectomy):				
	Mean survival time (TIME<101)	Standard deviation	Lower bound (95%)	Upper bound (95%)
PC	62.83	7.69	47.75	77.90
SA	23,37			

Vocal fold position remained unchanged between the initial examination at admission and the latest follow-up assessment in the vast majority of patients (Table 5, Figure 4).

Table 5: Variation of Vocal Cord Position

Vocal cord position variation	Number of cases
Identical	45
Enlargement	1
Tightening	0
Total	46

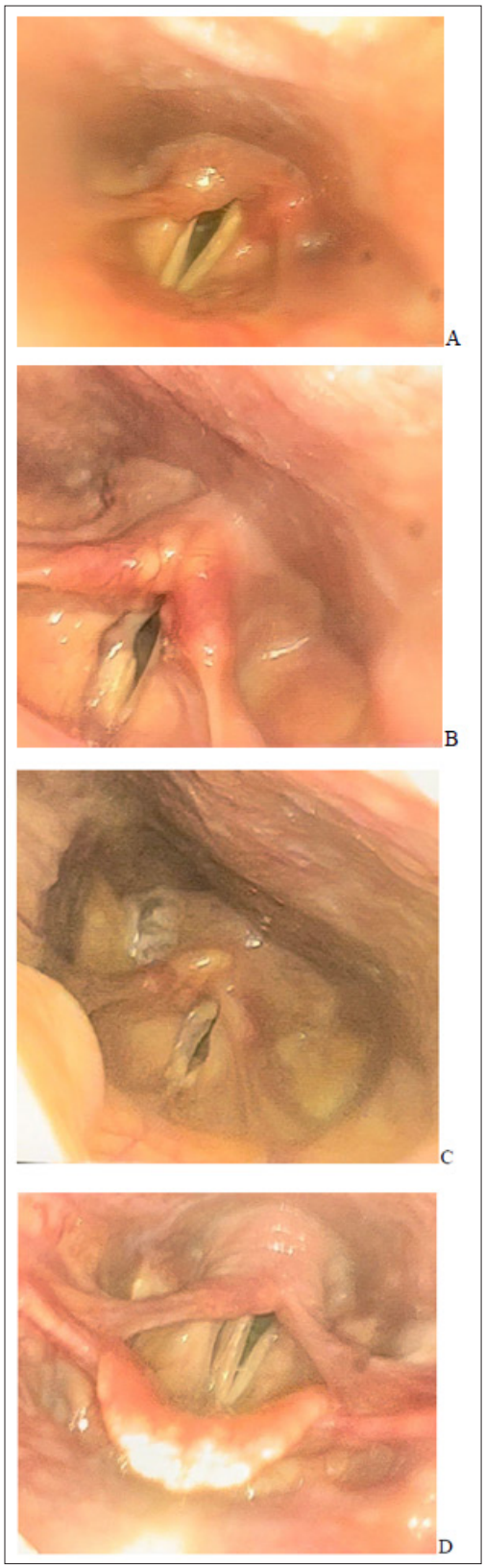

Figure 4: Long-term Stroboscopic Appearance of the Glottis in our Patients, Showing the Surgical notch. A & B- Right Posterior Cordectomy. C- Left Cordectomy. D- Left Arytenoidectomy

Respiratory assessment showed that 42 patients experienced either no dyspnea or only mild dyspnea during the walking test, while persistent dyspnea was reported by a single patient. During stair climbing, dyspnea occurred only after two or more flights of stairs in 69.8% of patients.

Regarding phonatory outcomes, the most affected parameter of the GRBASI scale was Grade (G), reflecting the overall degree of hoarseness, with a mean score of 1.98 ± 0.73. This was followed by Asthenia (A), corresponding to the perceived weakness of the voice, with a mean score of 1.74 ± 0.81. The least affected parameter was Instability (I), reflecting variations in voice quality over time, with a mean score of 0.23 ± 0.42.

The mean total Voice Handicap Index (VHI) score was 40.12 ± 30.76, corresponding overall to a moderate degree of voice handicap. Scores ranged from 2 to 94. Half of the patients had VHI scores corresponding to a mild degree of voice handicap, indicating minimal perceived impairment. Severe voice handicap was observed in approximately one-third of the patients, whereas 16.3% demonstrated a moderate degree of handicap.

Overall, patients who underwent subtotal arytenoidectomy had a mean VHI score of 17.78 ± 26.87, corresponding to a mild degree of voice handicap. In contrast, patients treated with posterior cordectomy had a mean VHI score of 43.66 ± 30.92, corresponding to a moderate degree of voice handicap.

No clinically significant swallowing disorders were observed in the series, and no patient experienced severe aspiration or potentially dangerous swallowing impairment.

Discussion

The main problem in patients with bilateral vocal cord paralysis is shortness of breath, the degree of which depends on the width of the glottis. The surgical technique used should combine adequate breathing and maintaining good voice quality, with vocalization considered secondary. Therefore, achieving normal respiratory function without tracheostomy is the main goal of treatment [4].

CO_2 Laser

CO_2 laser, invented by Patel in 1964 in the Bell Laboratories, it became a surgical instrument in 1972 thanks to the work of Uzi Sharon, an engineer, and Isaac Kaplan, a specialist in plastic surgery (founders of the Sharplan Laser Ltd. company) who were able to couple the invisible beam of the CO_2 laser with a "visible" (red) beam emitting at 630nm from a helium-neon laser (HeNe) in such a way as to form a single beam passing through the articulated arm and the handpiece [5].

CO_2 laser is considered as the most preferred laser for transoral laser microsurgery because of its precise cut and better absorption by water [6]. Its advantages have brought great relief in facilitating endolaryngeal surgery, it is a very useful equipment. Its advantages are: very precise incisions, less oedema (less inflammation), good hemostasis, faster and easier surgery, fewer complications (scarring, granulation, stenosis) and little damage to the tissue adjacent to the laser incision [6]. The management of laryngeal diplegia in adduction or bilateral vocal cord paralysis (BVCP) by CO_2 laser began in our department in the year 2014 with the acquisition of the equipment and continues to this day.

The Main Cause of FC Paralysis

Our series consists of 46 cases of BVCP treated with CO_2 laser. It is composed of adults with an average age of 56 years with a majority of the female sex (97.83%) and it is in line with the profile of the surgical thyroid pathology in our country, the main cause of laryngeal diplegia 44 cases (more than 95%), all due to thyroid surgery, which corresponds to what is reported in the majority of publications [7].

Two studies made at Tokyo University Hospital and the other at Henry Ford Hospital in Michigan, USA both confirm that surgery was the frequent cause of paralysis which was thyroid surgery: in USA longitudinal study combining two series between 1985-1995 and 1996 - 2005 by Rosenthal and Benninger, thus gathers 184 cases of laryngeal diplegias over 20 years and places surgery as the most frequent cause (37%), followed by malignancy (14.3%). In 80% of cases, the surgery was thyroid surgery, at Tokyo University Hospital: 2 successive periods: that between 1961 and 1989, studied by Hirose and concerning 1000 patients with recurrent paralysis, and that of Takano for a period spanning 1990 to 2005. For Hirose, as for Takano, the iatrogenic surgical cause was up to 58,5%, though the thyroid rate decreased to 24,1% [8-12].

Interval Between Laryngeal Diplegia and Treatment

The indication for surgery for any chronic VC immobility is the same regardless of etiology, namely deterioration in respiratory function and/or tolerance with inspiratory stridor at rest, making the performance of daily tasks difficult, i.e., when physiological compensatory mechanisms fail to provide adequate oxygenation at the level of physical activity required for each individual (Table 6)

Table 6: Interval Between Laryngeal Diplegia and Treatment According to Literature

Author	Year of publication	Delay post thyroidectomy
Nawka [13]	2015	> 12 months
Dionigi [14]	2016	> 12 months
Jackowska [15]	2018	6 months
Our study	2023	> 9 months

Operative Phase

A decision on a glottic expansion procedure should never be taken before the state of the subglottis has been checked, and the distance between the apex of the vocal process and the cricoid laterally than the cricoid configuration should be studied , the gender the profession of the patient and Previous laryngeal surgery on the paralysis, Khalifa reports a low success rate (50%) in cases where a trans-cervical arytenoidectomy had been performed previously. Cabanes found in his failures (4 out of 45 cases, 10 of which had a history of laryngeal surgery), 3 with a history of previous laryngeal surgery.

Choice of side to operate on: For Bizakis the left side is preferred as it is easier for a right-handed surgeon. For Nawka, there is no dominance of one side over the other (53% left). Cabanes prefers the left side because he is right-handed, but if the BVCP is less

than 12 months old, he advises operating on the less mobile side [13-18].

Unilateral or Bilateral Surgery: Gorphe recommended performing the procedure bilaterally from the outset to avoid a high failure rate, as per their experience, and having to resort to contralateral revision. Quantity and site of glottic resection: The study by Abd al-Fattah in Egyp, published in 2006, provided several answers [13,19].

In our study two techniques are practiced in our department: Posterior cordectomy (PC) and Subtotal arytenoidectomy (SA). PC was the first procedure performed in our department from the beginning of the use of the CO2 laser. It was exclusive until 2017 before giving way to SA.

From 2017 to date, SA has gradually taken on more importance and has become the basic or even the only procedure to be performed in our department from 2020 onwards, thus dethroning PC. This choice was dictated by the various advantages offered by SA in terms of completeness of technique, safety of result, reduction of morbidity and need for revision.

PC concerned more than 3/4 of our patients. In 76% of cases, the procedure was unilateral with a clear predominance on the right side. The choice of the side to be operated on was mainly based on the principle of operating on the side that was more affected or more immobile on laryngoscopy at the beginning of the procedure. Another criterion for choosing the side to be operated on was the side that was best exposed during DSL under GA to perform the laser on.

Success Analysis

In our study, the specific success rate is 91.3% (n=46). There was a need for revision in 28.57%, i.e., less than a third of patients to achieve respiratory success.the success rate in literature is shown in (table 7)

Table 7: Success Rate in Literature

Author	Year of publication	N. of BVFP	Respiratory success
Gorphe [21]	2013	20	100%
Testa and Motta [26]	2014	93	100% (90/93 good, 3/93 moderate)
Jackowska [15]	2018	132	53%
Nawka [13]	2015	–	75% post unilat
Ozdemir [32]	2013	66	88%
Our study	2023	46	91,3%

Respiratory results for tracheotomized patients in Our series notes belated decannulations although successful and this is often due to the patients' insuffisant notch inconsistencies with appointments and misunderstanding of the need for routine re-assessment but in the literature it from immediate postoperative decannulation to 2 months postoperatively in the majority of cases (table 8) [13,16,20,21].

Table 8: Rate and Time of Decannulation in Literature

Author	Year	Technique	N. of tracheotomies	Rate of decannulation	Time of decannulation
Jackowska [15]	2018	Dennis' PC	41	63% (26) – 34% (14) after 1st intervention	5-150 days
Testa and Motta [26]	2014	TA+PC (1/2) +VF (vestibular fold) (1/2)	37	100%	7-15 days
Brake [31]	2015	TA+PC	19	11/19	–
Our study	2023	PC: 15, SA: 6	21	18/21=85,71% – 9/21 (1st) – 9/12 (revision)	5,42 months (+/-4,76) – 3,5 weeks (+/-2,79)

Rate of surgical revisions: varies from 0 to 50% according to different authors. And they are almost exclusive to PC. In our study, the percentage of revision for tracheotomised patients was 50%, while the rate was 15.38% for non-tracheotomised patients. The revision technique in our study was PC in 85,71% while in the literature Al Fattah revised a SA by a contralateral sa , Khalifa revised Bilat PC by the Same and Bosley revised TC by the Same[13,14,22].

Stability and Durability of Respiratory Results Over Time

Subjective respiratory improvement (daily activities,stair climbing and 6 min walk) in our series was 91,3%, 92% in Drancyand 100% in Misiolek [23,24].

Voice Assessment

For the 43 cases evaluated, the overall alteration of phonation was moderate or even slight, 3/4 of the cases (74.41%) had a score of 1 to 2 for the Grade parameter (G) and more than 2/3 (69.76%) had a score between 0 and 1 for the Roughness (R) on GRBAS scale , Dennis and Kashima find an acceptable voice for all their patients and insist that vocal quality continues to improve 6 months to 1 year post-op. We compared VHI following Subtotal arytenoidectomy with that of the posterior cordectomy patients, and found that the SA scored a much lower voice handicap (17,78) than PC (43,66), Bentebbiche also found a global VHI score that was not significantly altered post-surgery[25,26].

Comparison Between PC and SA

Our study found no statistical difference. A meta-analysis by Sapundzhiev revealed that to date no technique has proven to be superior to others in terms of efficacy and states that no technique achieves normal results (table 9) [7].

Table 9: Comparison of Surgical Techniques in Different Studies

Study	Compared techniques	Result
Lawson and Remacle [3]	Subtotal arytenoidectomy vs posterior cordectomy	Equivalent on both respiratory and phonatory levels
Eckel [2]	Total arytenoidectomy vs cordectomy	Statistical equivalence
Yilmaz [23]	Total vs partial arytenoidectomy	Equally successful
Bosley [25]	Medial arytenoidectomy vs cordotomy	Equal respiratory success and no statistical difference in phonation
Our study	Subtotal arytenoidectomy vs posterior cordectomy	No statistical difference

Strengths of this study include the combined nature and evaluation of an effective tool, CO_2 laser, for the treatment of bilateral vocal cord paralysis with good results. Furthermore, the assessment of airway improvement is only subjective. However, we believe that avoiding tracheostomy in non-tracheostomized patients or extubation in tracheostomized patients is a well-established measure to improve patient outcomes.

Conclusion

CO_2 Laser endo-laryngeal glottic airway enlargement is currently the gold standard treatment for dyspnea secondary to laryngeal diplegia in adduction.It is performed on the posterior glottis at the expense of the arytenoid and/or the posterior part of the vocal cord. SA and PC are equally effective in improving the breathing of the laryngeal diplegia patient, although PC often requires revision surgery to achieve definitive success, but in the long term the success rates are equivalent [27-33].

Declarations

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethics Approval and Consent to Participate: This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of 20 August 1953 Hospital. Written informed consent was obtained from all participants prior to inclusion.

Consent for Publication: Written informed consent for publication was obtained from all participants.

Competing Interests: The authors declare no competing interests.

Authorship: All authors attest that they meet the current ICCRR criteria for Authorship.

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